DOCUMENT RESUME

ED 447 782 IR 020 403

AUTHOR	Bourdeau, Jacqueline, Ed.; Heller, Rachelle, Ed.
TITLE	ED-MEDIA 2000 World Conference on Educational Multimedia, Hypermedia & Telecommunications. Proceedings (12th, Montreal, Quebec, Canada, June 26-July 1, 2000).
INSTITUTION	Association for the Advancement of Computing in Education, Charlottesville, VA.
ISBN	ISBN-1-880094-40-7
PUB DATE	2000-00-00
NOTE	1839p.; The ED-MEDIA 2000 CD contains the last five proceedings (1996-2000) books published by the Association for the Advancement of Commputing in Education (AACE).
AVAILABLE FROM	Association for the Advancement of Computing in Education (AACE), P.O. Box 2966, Charlottesville, VA 22902; Web site: http:www.aace.org; Tel: 804-973-3987; Fax: 804-978-7449 ($40 AACE members; $50 non-members).
PUB TYPE	Collected Works - Proceedings (021)
EDRS PRICE	MF16/PC74 Plus Postage.
DESCRIPTORS	Authoring Aids (Programming); Computer Assisted Instruction; Computer Uses in Education; Distance Education; *Educational Media; Educational Practices; Educational Research; *Educational Technology; Elementary Secondary Education; Foreign Countries; Higher Education; *Hypermedia; *Multimedia Instruction; *Multimedia Materials; Teaching Methods; *Telecommunications

ABSTRACT

This 12th annual ED-MEDIA conference serves as a multidisciplinary forum for the discussion and exchange of information on the research, development, and application of all topics related to multimedia, hypermedia, and telecommunications/distance education. This document contains the 705 papers from attendees representing more than 50 countries from 6 of the 7 continents of the world. The papers cover a range of topics, including: computer-assisted instructional design; distance education; authoring; information seeking; technology integration; media in education; interactive learning environments; cognitive and pedagogical issues; computer-mediated communication; professional development; evaluating instructional effectiveness; teaching and learning strategies; learner centered instruction; hypermedia systems and design; and computer supported cooperative work. (AEF)

ED-MEDIA 2000

World Conference on Educational Multimedia, Hypermedia & Telecommunications

Edited by
Jacqueline Bourdeau
Rachelle Heller

Proceedings of ED-MEDIA 2000

WORLD CONFERENCE ON EDUCATIONAL MULTIMEDIA, HYPERMEDIA & TELECOMMUNICATIONS

Montreal Canada; June 26-July 1, 2000

AACE Association for the Advancement of Computing in Education

Published by

Association for the Advancement of Computing in Education (AACE)
P.O. Box 2966
Charlottesville, VA 22902 USA
www.aace.org

Printed in the USA

ISBN: 1-88-00-94-40-1

Special thanks to—AACE Technical Coordinator: Jerry Price, Univ. of Houston.

ED-MEDIA 2000

World Conference on Educational Multimedia, Hypermedia & Telecommunications

ED-MEDIA 2000-World Conference on Educational Multimedia, Hypermedia & Telecommunications is an international conference, sponsored by the Association for the Advancement of Computing in Education (AACE). This annual conference serves as a multi-disciplinary forum for the discussion and exchange of information on the research, development, and applications on all topics related to multimedia, hypermedia and telecommunications/distance education. ED-MEDIA, the premiere international conference in the field, spans all disciplines and levels of education and attracts more than 1,000 attendees from over 50 countries.

The ED-MEDIA 2000 CD contains the last 5 proceedings books published by the Association for the Advancement of Computing in Education. The files are in the following formats:

- **PDF:** 2000, 1999, 1998, 1997 & 1996

VIEW PROCEEDINGS BOOKS

- **2000** - Montreal, Quebec, Canada
- **1999** - Seattle, Washington, USA
- **1998** - Freiburg, Germany
- **1997** - Calgary, Alberta, Canada
- **1996** - Boston, Massachusetts, USA

We have included recent versions of Adobe Acrobat Reader 4.0 so that you may view the files on this disk. To install Adobe Acrobat Reader 4.0, open the file on the CD labeled rs405eng.exe.

ABOUT AACE

AACE (founded in 1981) is an international, educational, and professional organization dedicated to the advancement of the knowledge, theory, and quality of learning and teaching at all levels with information technology.

This purpose is accomplished through the encouragement of scholarly inquiry related to information technology in education and the dissemination of research results and their applications through:

- Publications

- Conferences
- Divisions/Societies/Chapters
- Inter-Organizational Projects

Join with fellow professionals from around the world to receive AACE benefits of membership and to share knowledge and ideas on research and applications in information technology and education.

AACE's membership includes researchers, developers, and practitioners in schools, colleges, and universities; administrators, policy decision-makers, trainers, adult educators, and other specialists in education, industry, and the government with an interest in advancing knowledge and learning with information technology in education.

International Headquarters:

AACE
P.O. Box 2966
Charlottesville, VA 22902 USA
Phone: 804-973-3987
Fax: 804-978-7449
E-mail: info@aace.org
WWW: http://www.aace.org/

Steering Committee

Chair: **Erik Duval**, *Katholieke Univ. Leuven (Belgium)*
Betty Collis, *Univ. of Twente (The Netherlands)*
Gary Marks, *AACE (USA)*
Thomas Reeves, *The Univ. of Georgia (USA)*
Ivan Tomek, *Acadia Univ. (Canada)*

2000 Program Committee

Program Co-Chair: **Jacqueline Bourdeau**, *Univ. of Quebec at Montreal (Canada)*
Program Co-Chair: **Rachelle Heller**, *George Washington Univ., (USA)*

Alan Amory, *Univ. of Natal, South Africa*
Philip Barker, *Univ. of Teesside, UK*
Ann Barron, *Univ. of S. Florida, USA*
Alfred Benney, *Fairfield Univ., USA*
Jacqueline Bourdeau, *Univ., du Quebec, Canada*
Christine Brown, *Univ. of Wollongong, Australia*
Mark Brown, *Massey Univ., New Zealand*
Peter Brusilovsky, *Carnegie Technology Education, USA*
John Buford, *GTE Laboratories, USA*
Patricia Carlson, *Rose-Hulman Institute of Technology, USA*
Steve Chen, *City College of New York, USA*
Betty Collis, *Univ. of Twente, The Netherlands*
Darina Dicheva, *Winston-Salem State Univ., USA*
Gordon Davies, *Open Univ., UK*
Christian Depover, *Universit, de Mons-Hainaut, Belgium*
Mike Dobson, *Univ. of Calgary, Canada*
Philip Duchastel, *Nova Southeastern Univ., USA*
Erik Duval, *Katholieke Univ. Leuven (Belgium)*
Allan Ellis, *Southern Cross Univ., Australia*
Jorma Enkenberg, *Univ. of Joensuu, Finland*
Yoram Eshet, *Tel Hai Academic College, Israel*
Kurt Fendt, *Massachusetts Institute of Technology, USA*
Tony Fetherston, *Edith Cowan Univ., Australia*
Brian Fisher, *Univ. of British Columbia, Canada*
Gail Fitzgerald, *Univ. of Missouri-Columbia, USA*
Annette Fuchs, *Univ. of Alberta, Canada*
Yoshimi Fukuhara, *NTT-ME Information Xing, Inc., Japan*
Chetan Gopal, *GTE Laboratories, USA*
Kent Gustafson, *Univ. of Georgia, USA*
Barry Harper, *Univ. of Wollongong, Australia*
Rachelle Heller, *George Washington Univ., (USA)*
Lyn Henderson, *James Cook Univ., Australia*
William Hunter, *The Univ. of Calgary, Canada*
Tricia Jones, *Univ. of Michigan, USA*
Akihiro Kashihara, *I.S.I.R., Osaka Univ., Japan*
Kinshuk, *Massey Univ., New Zealand*
Joel Klemes, *The Open Univ. of Israel, Israel*
Piet Kommers, *Univ. of Twente, The Netherlands*
Min Liu, *Univ. of Texas-Austin, USA*
Carol B. MacKnight, *Univ. of Massachusetts, USA*
Hermann Maurer, *Graz Univ. of Technology, Austria*
Janet McCracken, *Univ. of Calgary, Canada*
Scott McElfresh, *Muhlenberg College, USA*
Catherine McLoughlin, *Univ. of New England, Australia*
Christina Metaxaki-Kossionides, *Professor,Univ. of Thrace, Greece*
Panagiotis Metaxas, *Wellesley College, USA*
Kelly Mills, *Texas Tech Univ., USA*
T. Craig Montgomerie, *Univ. of Alberta, Canada*
Maria Teresa Molfino, *Consiglio Nazionale delle Ricerche, Italy*
Tomasz Muldner, *Acadia Univ., Canada*
David Murphy, *Monash Univ., Australia*
Graham Oberem, *California State Univ., San Marcos, USA*
Toshio Okamoto, *The Univ. of Electro-Com., Japan*
Ron Oliver, *Edith Cowan Univ., Australia*
Setsuko Otsuki, *Hiroshima City Univ., Japan*
Ron Owston, *York Univ., Toronto, Canada*
Roy Rada, *Pace Univ., USA*
Samuel Rebelsky, *Grinnell College, USA*
Thomas Reeves, *The Univ. of Georgia (USA)*
Geoff Ring, *Edith Cowan Univ., Australia*
Robby Robson, *Oregon State Univ., USA*
John Rogers, *DePaul Univ., USA*
Takashi Sakamoto, *National Inst. of Multimedia Education, Japan*
Nick Scherbakov, *IICM TU Graz, Austria*
Hideyuki Suzuki, *NEC corporation, Japan*
Karen Swan, *Univ. at Albany, USA*
Michael Szabo, *Univ. of Alberta, Canada*
Jaime Sanchez, *Univ. of Chile, Chile*
Akira Takeuchi, *Kyushu Institute of Technology, Japan*
Ivan Tomek, *School of Computer Science, Canada*
Wayne Twitchell, *Grinnell College, USA*
Yoneo Yano, *Tokushima Univ., Japan*
Alison Young, *UNITEC Institute of Technology, New Zealand*

Preface

Bienvenue à Montréal et à ED-MEDIA 2000!

Whether your counting system indicates that we have begun the 21st century, or we are ending the 20th, we have the opportunity at this historic moment to look backward as well as forward. This 12th ED-MEDIA conference enables us to view the growth of new technologies education from the perspective of a novel idea to a major element in our educational process. This ED-MEDIA conference is poised to join the ranks of the successful previous 11 conferences.

The Conference is organized by the Association for the Advancement of Computing in Education (AACE) and over the years has developed a strong international following. The Conference has grown hand in hand with the emergence of new learning technologies and now represents the premier event for this field in the world. This year s attendees come from 6 of the 7 the continents of the globe and represent more than 50 countries. And we probably would have participation from Antarctica had there not been prime research weather there.

The interest in educational media around the globe is evidenced by the number of submissions, the extent of the topics covered by these papers both long and short as well as proposals for demos and panels. We received over 600 proposals of full and short papers, workshops, tutorials and posters from nearly 50 different countries. Our review process, which itself is well automated with web-based submissions, reviews and responses, usually includes 3 referees from our international panel of expert reviewers on the Program Committee. Those submissions selected for presentation represent work of the highest quality. In addition, we are extremely proud of the presentations scheduled for keynote and invited talks as they truly represent the best and the brightest in the history, depth and breadth of our discipline as well as the international aspect of our conference. We are extremely proud to have a keynote presenter, for the first time, from the African continent.

You may wonder what Program Chairs do during those dark months between the last conference and the present one. We have had the opportunity to review the proposed presentations, work with authors to hone their presentations, help develop interesting panels, invite provocative keynoters and of course, worry about details so that your experience at this conference and with these proceedings will provide you with a worthwhile overview of your field.

One of our opportunities is to review the entire conference as it emerges and to do a bit of research ourselves into the nature of the field as represented by your submissions. In this era of everything, we expected the WWW and Internet to be the most popular terms. A simple keyword search indicated they came close and were the hands down winner if you include distance education. But other trends also emerge. The concept of collaborative learning in setting, teamwork, and teaching style is a topic of interest. While prototype and application development endure as does programming, new areas of support for cognition and learning styles as well as integration of technological support across the curriculum are emerging themes.

Where is the ED in EDMEDIA now? It has moved from being the target for ready-to-use media to becoming a foundation and an inspiration in designing new ones: numbers of papers base their work on learning and instruction theories as well as on good teaching practices, or refer to them for evaluation. We see that interacting has replaced using technologies, in two ways: interacting with other people over computer networks, and interacting with smart software. In both cases, these smart interactions represent meaningful and subtle conversations that make them more interesting. People are no longer users, but are choosers defined by the roles they play in action: learners, teachers, managers, etc. Beyond tools and infrastructures, ED-MEDIA 2000 presents all that is at stake with technologies in education: collaboration or commercialization, equal access or disparities, cultural differences.

The best papers for ED-MEDIA 2000 could be considered those that received a 4.5 (out of 5.0) or above on our reviewer rating scheme. From among those, the award winning papers are selected. If we look to them as a indication of where our field is situated at the cusp of the 21st century, we can note that educational technology researchers can be found around the world and well represented by both men and women. The studies documented by these papers are well founded research methodologies into a variety of areas including an adaptive navigation support system for the world wide web, techniques for annotation of learner created hyperlinks or trails, the use of agents in teaching and learning, and an investigation into the learning sequences students select and their relationship to learning styles.

It is incumbent upon researchers in educational multimedia to know where we have been and to know where the discipline is currently focused, but it is also necessary to plan for the future. One challenge for the future does emerge. Evaluations of systems are often done on a small scale, relying on local review and evaluation. We acknowledge that research into large scale and long term evaluations is difficult as populations move and times change, but we would like to encourage the attendees to ED-MEDIA 2000 and the readers of this proceedings to consider techniques and strategies and programs to extend the breadth and depth of their evaluation techniques and processes.

As Conference Program Co-chairs, we have been aided considerably by a number of volunteers and helpers who have given tirelessly of their time. In particular we must thank the Conference Steering Committee of Gary Marks, Ivan Tomek, Tom Reeves, Betty Collis and Erik Duval who led and coordinated the conference this year. We would like to thank the Chairs of the various Program Committees: Niki Davis, Panels Chair; Sam Rebelsky, Workshops/Tutorials Chair; and Martyn Wild, Posters/Demos Chair. We would also like to thank the crew behind the scenes from AACE for their tireless efforts in coordinating and managing the huge number of administrative functions that a conference like this necessarily involves.

We look forward to meeting with you during the conference and trust that you will take the time to renew old acquaintances, meet new friends, be inspired by peers and take home some new ideas and activities to report back at ED-MEDIA 2001 in Finland, June 25-30.

Program Chairs:
Jacqueline Bourdeau
Université du Québec à Chicoutimi, Québec, Canada
(jbourdea@uqac.uquebec.ca)

Rachelle Heller
The George Washington University, Washington DC, USA
(sheller@seas.gwu.edu)

ED-MEDIA 2000

World Conference on Educational Multimedia, Hypermedia & Telecommunications

ED-MEDIA 2000-World Conference on Educational Multimedia, Hypermedia & Telecommunications is an international conference, sponsored by the Association for the Advancement of Computing in Education (AACE). This annual conference serves as a multi-disciplinary forum for the discussion and exchange of information on the research, development, and applications on all topics related to multimedia, hypermedia and telecommunications/distance education. ED-MEDIA, the premiere international conference in the field, spans all disciplines and levels of education and attracts more than 1,000 attendees from over 50 countries.

The ED-MEDIA 2000 CD contains the last 5 proceedings books published by the Association for the Advancement of Computing in Education. The files are in the following formats:

- **PDF:** 2000, 1999, 1998, 1997 & 1996

VIEW PROCEEDINGS BOOKS

- **2000** - Montreal, Quebec, Canada
- **1999** - Seattle, Washington, USA
- **1998** - Freiburg, Germany
- **1997** - Calgary, Alberta, Canada
- **1996** - Boston, Massachusetts, USA

We have included recent versions of Adobe Acrobat Reader 4.0 so that you may view the files on this disk. To install Adobe Acrobat Reader 4.0, open the file on the CD labeled rs405eng.exe.

ABOUT AACE

AACE (founded in 1981) is an international, educational, and professional organization dedicated to the advancement of the knowledge, theory, and quality of learning and teaching at all levels with information technology.

This purpose is accomplished through the encouragement of scholarly inquiry related to information technology in education and the dissemination of research results and their applications through:

- Publications

- Conferences
- Divisions/Societies/Chapters
- Inter-Organizational Projects

Join with fellow professionals from around the world to receive AACE benefits of membership and to share knowledge and ideas on research and applications in information technology and education.

AACE's membership includes researchers, developers, and practitioners in schools, colleges, and universities; administrators, policy decision-makers, trainers, adult educators, and other specialists in education, industry, and the government with an interest in advancing knowledge and learning with information technology in education.

International Headquarters:

AACE
P.O. Box 2966
Charlottesville, VA 22902 USA
Phone: 804-973-3987
Fax: 804-978-7449
E-mail: info@aace.org
WWW: http://www.aace.org/

KEYNOTE SPEAKERS

TABLE OF CONTENTS

The hypermedia conversation: reflecting upon, building and communicating ill-defined arguments
Milton Campos, Universite de Montreal, Canada

Tips and Tricks for the Development , Delivery and Management of Online Courses
Jonathan Kadis, Utah State University, USA

The State of the Art in Interactive Multimedia Journals for Academia

Jennifer Burg, Department of Computer Science
Yue-Ling Wong, Department of Chemistry
Ching-Wan Yip, Department of Physics
Anne Boyle, Department of English
Wake Forest University
Winston-Salem, NC 27109 USA
imej@wfu.edu

Abstract: Scholars have been predicting a revolution in the academic publishing world since the early 1990's, including university centered distribution, extensive online peer review, and innovative multimedia enhancements. Online journals have indeed proliferated, yet interactive multimedia electronic journals (*imej* journals) have not yet become widespread, nor have they approached their potential for scholarly communication. In this article, we discuss the obstacles in the way of *imej* journals for academic publication, predict some technological changes that should hasten their adoption, and argue for their promotion as an excellent forum for disseminating, verifying, and refining scholarly research.

1. The Predicted Revolution in Scholarly Publication

For over a decade, academics have been predicting a revolution in scholarly publication. In 1991 Ann Okerson, then Director of the Office of Scientific and Academic Publishing of the Association of Research Libraries, concurred with the growing opinion that paper journals were becoming obsolete, advocating a "university-based system into which scholars from all disciplines would place their findings" (Okerson 1991). Andrew Odlyzko of AT&T Research Labs predicted the "impending demise of traditional scholarly journals" (Odlyzko 1995) while Princeton's Stevan Harnad advocated a system of "scholarly skywriting in the post-Gutenberg galaxy," where academics would share, critique, and add to each other's findings in an electronically-accelerated process of research and publication (Harnad 1990, 1997). A number of models for network-based electronic publishing were proposed, generally envisioning university-centered distribution, lower publication costs, 24-hour computer access to documents, faster review processes, a hierarchy of publication stages according to the level of peer review, extensive online discussion and updates, powerful search techniques, and multimedia enhancements (Bailey 1994). Though no single publication model has dominated the scene, many of these changes have been evolving. Certainly, the number of online journals has exploded in the past ten years, with initiatives like Project Muse, JSTOR, Project Gutenberg, ACM's Digital Library, OCLC, Springer Link, Ginsparg's preprint library, and on and on.

Nevertheless, a closer look at existing online journals shows that they fall short of the predictions. Online academic journals (that is, those that have no traditional print counterparts) do not enjoy the acceptance and respect that would make them competitive with hard copy publications. Nor have electronic journals taken advantage of the added value and marketable difference that multimedia enhancements could offer. Were the predictions overblown, or must we simply be patient for changes that will inevitably come? What is the state of the art in interactive multimedia journals for academia, and what can we hope for in the next ten years?

2. Today's Multimedia Journals

Let us first put our interest in online multimedia publication in context. In 1998, *The IMEJ of Computer-Enhanced Learning* -- an interactive multimedia electronic journal -- was founded at Wake Forest University, spurred by the university's campus-wide distribution of laptop computers and a growing interest in educational technology. Our belief was that *imej* journals (pronounced "image") have much to offer to education and scholarship, and we wanted to see by our own experience if this publication model was viable. We envisioned a journal that seemed ideal for the subject of computer-enhanced learning, where readers with practical questions about the value of technology in education could see and experiment with what others have done -- trying out simulations, taking sample quizzes, manipulating 3-D images, and hearing teachers explain their pedagogical innovations in their own words. In the two years since the journal's inception, we have been monitoring the growth of interactive multimedia publications in academia and evaluating our own attempts to produce a journal that lives up to our vision for online scholarly publication.

Our most recent informal search of existing electronic journals shows that, although the word *multimedia* is used generously to describe online publications, there is still relatively little real multimedia development, particularly of the interactive sort. Nearly all journals that describe themselves as "multimedia" have only tables, graphs, and pictures, and the term *interactive* generally implies the ability to post comments to authors on a bulletin board, the availability of email popup windows, the use of hyperlinks to related subjects, and occasionally the linking of footnote numbers to the footnotes at the end of the paper.

We expected to find a good amount of multimedia material in scientific and medical publications, where the usefulness of 3-D images and simulations is easy to imagine (Eason et al. 1997) (Wilkinson 1998), but our findings were disappointing. The Springer Link electronic library (www.link.springer.de) has an extensive collection of scientific journals and marks each with a symbol indicating where supplementary electronic material is included. However, a sampling of these revealed mostly *.pdf* and image files, a number of videos, and only one rotating molecule as an example of interactivity. The Royal Chemical Society's Web site (www.rsc.org/is/journals/j1.htm) similarly marks its journals containing supplementary electronic material, but once again we found only image and document files. McGill University has a site for *The Online Journal of Cardiology* (www.mmip.mcgill.ca) with links to teaching videos, a Virtual Stethoscope, online quizzes, and moving Xray images, but all this material appears to be their own production rather than submitted research publications. Among the journals we found, two with a significant multimedia interactivity were the Internet Journal of Chemistry (IJC, www.ijc.com) and the Radiology Society of North America Electronic Journal (RSNA EJ, http://ej.rsna.org). IJC lists its multimedia element under a separate link, categorizing them as images, interactive chemical structures, interactive graphs, movies, etc. From this list of categories there are links to the articles containing the multimedia enhancements. RSNA EJ contains a number of animated radiology images using video, VRML, or Java-based simulations.

Multimedia has possibilities in the humanities as well. A few music journals such as EOL (*Ethnomusicology Online*, http://research.umbc.edu/efhm/eol.html) take advantage of sound files. In the creative vein, some journals exploring interactive narrative and art have sprung up, such as *Cultronix* (http://english-www.hss.cmu.edu/cultronix/) at Carnegie Mellon or *Labyrinth* at the University of Southern California (www.annenberg.edu/labyrinth). But overall, it is difficult to find examples of the type of journal predicted since the early 1990's. Even *The Journal of Interactive Media in Education* (http://www-jime.open.ac.uk), an early and well-produced entry into the field of multimedia publication, appears to be backing away from multimedia interactivity in recent issues. Its 1999 volume has only one article marked as containing an interactive element, as opposed to seven in 1998. Admittedly, our survey was informal and necessarily incomplete. We invite our readers to let us know of examples of interactive multimedia that we may have missed. Our intent is not to indict the quality of the journals mentioned here, but instead to raise our central questions: Have we expected too much too soon in *imej* journals? What are the obstacles to their development, and will they eventually be overcome?

3. Obstacles in the Way of *imej* Journals

The obstacles in the way of the success of *imej* journals are both technical and human. On the technical side, the problems include bandwidth limitations, the speed of technological change, and compatibility issues. To be widely accepted, *imej* journals must be more user-friendly than they currently are. Videos are still too small (in display size), too jerky, and too long to download, especially for readers accessing electronic journals through modems. The adoption of cable modems, DSL, and faster network connections in our homes, along with improved compression, streaming media delivery, dedicated media servers, and bandwidth load balancing will eventually bring the technology up to user expectations.

Standardization issues may take longer to resolve, and the phenomenom of rapidly-evolving technology will leave vestiges of obsolete platforms in archived online journals. In our first issue of *IMEJ*, for example, we used VRML requiring Cosmo Player for viewing, an already obsolete medium. The Java language continues to evolve month-by-month, requiring constant upgrades to the plug-in. Despite the best efforts of an electronic journal's producers to choose the longest-lived development tools, it is inevitable that they will use applications that will become outdated.

Some of the most attractive and fastest-evolving multimedia features are the very ones where standardization has not settled in, including audio/visual media delivery and dynamic *html*. In the media player world, we have RealPlayer G2, Microsoft Windows MediaPlayer, and Quicktime battling it out. In the browser wars, Internet Explorer and Netscape have still not reconciled to a common way of handling Java security and *dhtml*. The adoption of the W3C standard and the next version of both browsers will bring them closer to this goal (www.webstandards.org/dhtml.html). In the meantime, it is feasible, though time consuming, to offer multimedia supplements in multiple platforms to accommodate as many readers as possible.

Clearly, the technical obstacles are challenging, but we believe that they can and will be overcome. The human problems, as one might expect, may be more difficult to solve. The user-compatibility issue is complicated by the fact that production of an article in an *imej* journal, in the final stages, is a collaborative work between the authors and the journal's multimedia developers. Even if a journal adopts multimedia and browser standards to serve the greatest number of readers -- or better yet, if multimedia elements are offered in a choice of all commonly-used platforms -- the journal's multimedia developers must get the raw material from the authors. From our experience at *The IMEJ of Computer-Enhanced Learning*, we have seen that authors generally work on their accustomed platforms with their favorite tools, and they prefer to give us multimedia material they have already prepared or that they can prepare easily in their usual manner. One author gives us a Lotus Screencam file, a second provides a video, and a third author sends a PowerPoint presentation. In this setting, it is all the more difficult to set production standards or offer multiple versions. Authors are also understandably particular about how their work is transformed by multimedia additions. The author and editor/multimedia developer may have a different view of the article, and what one might consider a multimedia enhancement, the other might consider superfluous.

The last obstacle is the Catch 22. Generally, the scholars who have the best material to offer to *imej* journals are reluctant to publish in them because they fear electronic publications will be considered minor league by their colleagues. But at the same time, *imej* journals cannot enter the major leagues until they attract better quality publications. How do we find our way out of this dilemma? We see some possible remedies, but they can only work over time.

As computer use becomes the norm in the academic world, and as programs for media production become more user friendly and better standardized, some of the production problems of *imej* journals will be alleviated. Just as scholars now typically do their own word processing and document production, it is likely that they will also do a large part of their own multimedia production in the future. Templates for journal publications will make it possible for authors to submit their material in prescribed formats. Work has already been done in this direction. We at *IMEJ* have templates for article production, though they are used in-house rather than as a submission mechanism for authors.

New Web authoring tools, markup languages, and network protocols are now under development, and their standardization will be important for the viability of *imej* journals. The W3C consortium has been working on its recommendation for the next version of HTML, to integrate XML -- a language facilitating collaborative Web page development -- and cascading style sheets. A companion network protocol called WebDAV is being worked on as a collaboration of researchers at IBM, Merant (formerly Intersolv), INSO, Microsoft, Novell, Rational, and the University of California at Irvine (http://msdn.microsoft.com/workshop/standards/webdav.asp). WebDAV, which stands for Web Distributed Authoring and Versioning, will allow multiple developers to work on Web documents, including multimedia components, from distributed locations with the necessary mechanisms for locking and advanced features for searching based on XML metadata properties. A standard for WebDAV is being developed by an Internet Engineering Task Force, promising a tool well-suited for the collaborative production inherent in *imej* journals.

To gain scholarly and professional acceptance of *imej* journals, we must be careful about being identified with commercial or non-academic sites. Technically, we can learn from these sites and the polish of their presentation. Microsoft's MSDN Show, for example, blends entertainment and education by means of online source code, videos, and synchronized video transcripts. The Discovery Channel Web site offers excerpts from and supplements to its TV programs. CSPAN's Booknotes presents interviews of the latest authors. These sites are useful and educational, but combine information with entertainment and advertising, which contributes to the notion that Web publications are meant to sell us something or amuse us.

Scholarly publications must establish a different presence among the electronic media, using the power of multimedia to elucidate rather than entertain. *imej* editors can earn their credibility by careful peer review, substantive content, purposeful use of multimedia, and polished technical production. Peer review is in a sense the easy part, facilitated by ease and speed of communication in the electronic environment. But first, there must be something to review. *imej* journals must attract high quality submissions in spite of their unestablished reputations, and this we believe they can do by exciting the interest of those who enjoy taking a chance on innovation and creativity. By gradually attracting the work of energetic, risk-taking scholars and accumulating a body of credible work, the first *imej* journals can slowly but steadily show the potential that multimedia interactivity holds to promote scholarship and learning, and fulfill the promise of this new forum for academic publication.

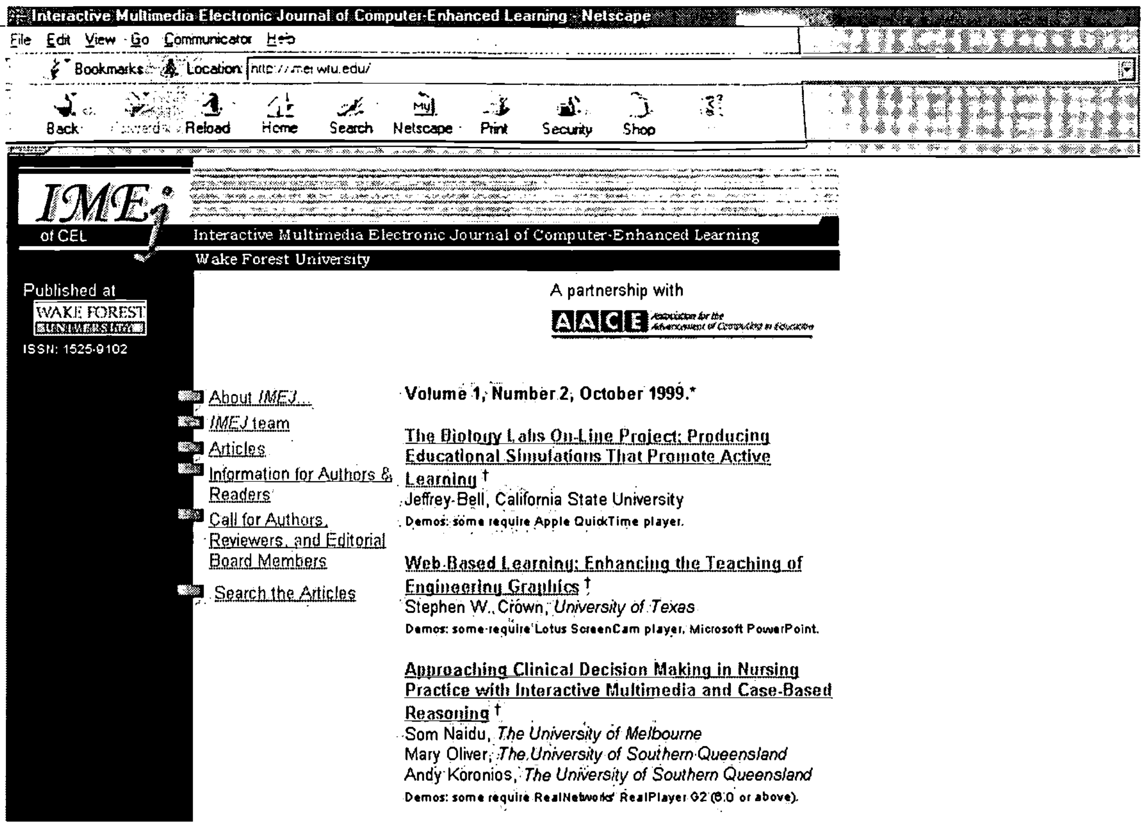


Figure 1: Home page of *The IMEJ of Computer-Enhanced Learning*

4. How Are We Doing So Far?

A biannual publication, *The IMEJ of Computer-Enhanced Learning* released its third issue in April of 2000. The first issue had eleven articles, the second had nine, and the third had seven. The smaller number of articles over time has resulted from our realization of the amount of time required for multimedia development. Aside from the peer review of articles, all the editing and production for the journal is done by Wake Forest professors, Academic Computing Specialists, and student assistants as a sideline from their regular work, motivated by an interest in multimedia development and computer-enhanced learning. No subscription fee is charged for journal access. Wake Forest University supports the journal's costs as an investment in educational technology.

We regularly receive email from readers interested in joining our project in an editorial capacity, and so far sixteen volunteers have been added to our pool of reviewers, twelve from the United States and the remainder from Greece, New Zealand, Germany, and Canada. Our readership is steadily growing, as evidenced by a trace of accesses to our server. Hits have grown by about 50% since the launch of the journal, with a steady increase in unique visitors.

The number of yearly submissions to *IMEJ* is small, and our experience in this regard is not unique among electronic journals. In a May 1999 issue of *The Chronicle of Higher Education*, Vincent Kiernan reports that electronic publications, such as *The Chicago Journal of Theoretical Computer Science, Earth Interactions* (both from MIT Press) and Open University's *Journal of Interactive Media in Education*, receive only about a dozen submissions per year. Kiernan suggests that a perception of impermanence and a fear that such publications will not count toward tenure and promotion are the main drawbacks. Electronic journals that are also published in hard copy versions seem to have the greatest success. Connections with online archives, where preprints of articles can be posted directly by authors, are a boost to an emerging electronic journal as well. *The Journal of High Energy Physics* (http://jhep.sissa.it/), for example, selects papers from the physics electronic archive at Los Alamos National Laboratory, where authors can post their preprints by filling out a form. By this means they receive a large number of articles.

The majority of the articles for *IMEJ* thus far have been gleaned from presentations at EDMEDIA conferences where, with the endorsement of AACE, we have selected representative "best works" to be updated and augmented for publication in interactive multimedia form. This has helped us to overcome the startup problems any new journal faces, particularly one in a relatively new and academically non-traditional medium. We hope that we have begun to show proof of the production quality and editorial standards possible in an *imej* journal, and we are approaching the critical mass of articles needed to convince contributors that our journal is a credible -- even a desirable -- place to submit their best work.

5. What Lies Ahead?

Where do we hope to go with *imej* journals in the next ten years? What is the best that *imej* journals might have to offer?

Initially, prognosticators were most excited about the increased level of scholarly discourse that online discussions and peer review offered in electronic publication. Computers have undoubtedly increased the ease and amount of communication among researchers. But in our opinion, bulletin board discussions and electronic peer review are not where the greatest potential lies in *imej* journals within academia.

It is in the presentation of research results themselves where we stand to gain the most in interactive multimedia publications. We imagine scholarly journals that offer more direct access to and verification of our colleagues' research. Experiments can be replicated with the reader's own data. Computer programs can be run and their reported efficiency checked on a variety of input. Graphs can be redisplayed with new data. Simulations can be tested. Medical procedures can be demonstrated. Molecules can be rotated. Architectural spaces can be explored. Art work can be studied. Atomic and subatomic particles can be visualized. Sounds can be played and examined graphically. Eventually, even surfaces can be explored tactilely. This mutual testing, replication, experimentation, and verification of research results among scholars inspires further research and creative collaborations across disciplines and across the globe. We believe that such advances in scholarship and learning are truly worth our efforts to overcome the obstacles that lie in the way.

6. References

Bailey, Jr., Charles W. (1994). Scholarly electronic publishing on the Internet, the NREN, and the NII: Charting possible futures. *Serials Review* 20 (3), 7-16.

Eason, Ken, et al. (1997). "A comparative analysis of the role of multi-media electronic journals." Final Report of Support Project in the JISC Electronics Libraries (eLib) Programme. HUSAT Research Institute and Department of Human Sciences, November 1997.

Ginsparg, Paul. (1994). First steps towards electronic research communication. *Computers in Physics* 8 (4), 390.

Ginsparg, Paul. (1996). "Winners and Losers in the Global Research Village." Invited contribution for the Conference held at UNESCO HQ, Paris, Feb. 21, 1996.

Harnad, Stevan. (1997). All-or-none: No stable hybrid or half-way solutions for launching the learned periodical literature into the post-Gutenberg galaxy. In *The Impact of Electronic Publishing on the Academic Community*. Ed. I. Butterworth. London: Portland Press, pp. 18-27.

Harnad, Stevan. (1991). Scholarly skywriting and the prepublication continuum of scientific inquiry. *Psychological Science* 1, 342-343.

Kiernan, Vincent. (1999). Why do some electronic-only journals struggle, while others flourish? *The Chronicle of Higher Education*, May 21, 1999.

Odlyzko, Andrew M. (1995). Tragic loss or good riddance? The impending demise of traditional scholarly journals. In *Scholarly Publication: The Electronic Frontier*. Eds. Robin P. Peek and Gregory B. Newby. Cambridge, MA: The MIT Press, 1997. (Originally published in 1995.)

Okerson, Ann. (1991). Back to academia? The case for American universities to publish their own research. *Logos* 2, (2), 106-112.

Wilkinson, Sophie L. (1998). Electronic publishing takes journals into a new realm. *Chemical & Engineering News*, May 18, 1998.

Acknowledgements

We would like to thank Wake Forest student Chris Marts for the ideas and discussions he contributed to the preparation of this paper.

INVITED PAPERS

Collaborative Learning: an Effective and Enjoyable Experience! A Successful Computer-Facilitated Environment for Tertiary Students

Dr. Robert E. Kemm,
Department of Physiology,
The University of Melbourne,
Victoria, Australia, 3010,
r.kemm@physiology.unimelb.edu.au;

Dr. Helen Kavnoudias,
Department of Physiology,
The University of Melbourne,
Victoria, Australia, 3010,
h.kavnoudias@physiology.unimelb.edu.au;

Debbi Weaver,
Department of Physiology,
The University of Melbourne,
Victoria, Australia, 3010,
d.weaver@physiology.unimelb.edu.au;

Paul Fritze,
Multimedia Education Unit,
The University of Melbourne,
Victoria, Australia, 3010,
p.fritze@meu.unimelb.edu.au;

Nicholas Stone,
Centre for the Study of Higher Education,
The University of Melbourne,
Victoria, Australia, 3010,
n.stone@cshe.unimelb.edu.au;

Dr. Neil Williams,
Department of Physiology,
The University of Melbourne,
Victoria, Australia, 3010,
n.williams@physiology.unimelb.edu.au.

Abstract: We have developed a collaborative learning environment (CLE) as a student-centred approach to lecture replacement, with a special focus on assisting students' learning of difficult concepts. The majority of the program is structured around cost-efficient web-delivered tutorials incorporating re-usable interactive components. These are supported by several stand-alone computer-based learning tutorials including ones that we developed to allow students to construct their own models of physiological mechanisms, together with computer-facilitated semester-long investigative projects to enhance their communication and critical reasoning skills. Each week for two hours during two semesters, students work in groups of three with an iMac computer. The computer-facilitated tasks are designed to support and extend their three weekly lectures by encouraging peer-learning and peer-teaching. In this article, the successful attributes of this collaborative learning environment are described and evaluated. In addition, relationships between the use of CLE and the students' approaches to learning are being investigated.

Introduction

Tertiary institutions are moving increasingly towards the delivery of courses using computers to provide students with the opportunities to learn at their own pace, together with a reduction in traditional lectures. There is also a trend to provide asynchronous access to courses via the Internet. There is broad recognition that traditional forms of university course delivery are inappropriate in preparing students for a dynamic workforce in a post-industrialist, knowledge society (Drucker 1995, Lohrey 1995). Where it has been successfully implemented, collaborative learning is recognised as a potent transition factor in supporting the development of higher order cognitive abilities (Johnson & Johnson 1992). Despite this recognition, evidence of direct positive effects on student learning remains largely anecdotal (Meloth 1999). Face-to-face collaborative learning, with academics as facilitators, is an area where campus-based universities have a major advantage in tertiary education. We contend that to provide such collaborative learning opportunities has advantages over relying only on electronic communication in virtual study groups. However, amidst contracting resources and increasingly crowded curricula, there is an understandable reluctance to establish the substantially different and potentially risky conditions of learning necessary for successful collaborative learning (Cooper & Sweet 1999).

We have now evolved a collaborative learning environment (CLE) in which we develop and present computer-facilitated learning as a means of effectively broadening the learning opportunities of science students studying physiology. Since 1993 our efforts in computer-assisted learning have aimed to extend, enhance and replace some of the students' lecture experiences with multimedia-based tutorials in an environment that encourages peer-learning and peer-teaching. A global aim in our science teaching in physiology is to use the curriculum to develop in our graduates some understanding of the abilities required of them as practicing scientists. Emphasis is given to understanding the experimental, research, theoretical, communication and critical reasoning base of the discipline.

An attribute of key importance to development of our CLE was to bring different experiences to students learning. This diversity was essential to address the wide range of backgrounds of the students entering our courses, such as their achievement levels, approaches to learning and cultural backgrounds. Our approaches included introducing scientific principles and methods for investigating physiology (eg simulated experiments), and using a diverse range of computer-aided interactive teaching formats. Importantly these approaches were not designed to stand alone, rather to integrate with other learning resources such as lectures and printed texts. Students were also encouraged to engage in continuous reflection and evaluation.

Our concept of a collaborative learning environment consists of: a friendly and informal physical workspace that is conducive for group interactions, with an optimum group size of three students per computer; an economical production model that provides a coherent set of weekly web-based problems; supplementary standalone highly-interactive multimedia tutorials dealing with essential concepts; a tutor to guide and assist (not teach); and extension after hours into the virtual classroom of the internet using electronic communications.

Results so far suggest that the introduction of our collaboratively based approaches to course delivery has had a significant positive effect on student learning outcomes. These outcomes include not only traditional examination results, but also more 'authentic' (Wiggins 1992) methods of assessment such as observation of group role fulfillment and student audit trails of problem solving processes.

Background

The Department of Physiology at the University of Melbourne has played a leading role in computer-assisted learning over many years. In 1985 we first tried to improve our practical class teaching of physiology with pilot studies using the Apple II and a computer-oscilloscope for recording from human nerves, accompanied by a computer-aided tutorial relating the theory and practical experience (Delbridge & Kemm, 1985). However, it was not until 1992 when we purchased 64 Mac IIci computers, each with a MacLab physiological recording system, that we really had the computer performance to significantly improve our students' practical classes and then consider multimedia tutorials as an additional option.

Since 1993 we have been continually successful with our applications for competitive government and University funds to produce standalone multimedia tutorials that aim to help students understand difficult physiological concepts. The Physiology Department has always been a leader in multimedia development at the University of Melbourne and produced the first site-licensed multimedia tutorial sold internationally in 1993. Since then we have been producing and evaluating a series of tutorials that require students to build and test their own models of physiological processes, and the first of these is now being distributed internationally (Weaver et al, 1999). However, although these initiatives have proven to be very effective, production of these highly interactive tutorials was slow and expensive, so they could not be used to provide two semesters of coursework for our science students within the time frame and budget available.

In 1997, the Department introduced fortnightly scheduled 3-hour sessions of computer assisted learning. Initially these CAL sessions were used to revise lecture material. Tutorials were based on HyperCard programs, produced in-house by one of the authors (using Chemistry's 'Tutorial Tools' by Paul Fritze), and a variety of other standalone tutorials obtained nationally and internationally. However, although the in-house tutorials were well received, the standard of external tutorials received a very mixed response

In 1998, we produced a coherent set of in-house tutorials specifically designed for our students, supplemented by a select few of the best available standalone tutorials. Content was delivered economically on an Intranet for a Web browser, using templates and tools developed in association with Paul Fritze of the University's Multimedia Education Unit. The model for tutorials was that students work on a problem in groups of three with the computer providing questions, feedback and hints as they proceeded with calculations and exploring issues. These 1.5 hr/week CAL sessions were not compulsory and were held in a Science Faculty multimedia computer laboratory remote from the Department. There was no formal assessment of this course component. Attendance fell over each semester, largely because of the many technical problems experienced with the unsatisfactory maintenance of the software and hardware and the remoteness of the laboratory from the support systems within the Department. There was no significant change in student performance.

For the 1999 teaching year the Department of Physiology equipped a refurbished laboratory with 15 iMac computers and a G3 server. Additionally, we introduced group learning of a topic covered in the curriculum, and assessed student participation in the collaborative learning process to encourage attendance. The duration of these computer assisted learning sessions was increased to 2 hours. All this helped staff to provide better support and to emphasise that the CLE was as important as lectures for learning physiology.

In 2000, we are reflecting on all aspects of the Web delivered course and upgrading it where appropriate with new interactive Web components that will allow us to provide more directed feedback to students with different backgrounds and achievement levels (Fritze & Kemm, 2000). We are continuing to develop a few highly interactive multimedia modules dealing with difficult concepts for which students develop their own mechanistic models.

The Current Status of the Evolved Collaborative Learning Environment

The evolution of our collaborative learning environment is the result of adjustments made in response to many surveys and educational experts' observations of how students go about their learning when facilitated by computer programs. The CLE sessions can be regarded as a medium between students who actively construct meaning and skills, using resources of the environment that include discipline content, methods and experiences, such as laboratory work, demonstrations, real-life experience and particularly social interactions.

CLE Sessions and the Physical Environment:

Students attended sessions of 2 hours weekly, with 12 sessions in each of two semesters. This part of the course was first assessed in 1999 and counted for 5% of the course marks (see section on Assessment). Most of the 360 students enrolled for CLE. Attendance was remained high throughout semester in the Department's own facility.

Each collaborative learning environment (CLE) session accommodated 42 students normally working in groups of three on a computer assisted learning (CAL) package presented on an iMac computer. Groups of three were chosen as is claimed to be the optimum group size for interactive computer programs. A G3 Server used AppleShare 6.1 IP to network the 14 students' iMacs and the tutor's iMac. The tables and benches were arranged to encourage groups to talk and argue in a relatively noisy working environment. The tutor's approach further emphasised the friendly and relatively informal learning environment. A wide range of textbooks was provided as student resources. The head CAL tutor and developers were located next door to the laboratory.

Computer Assisted Learning (CAL) Components:

Our overall approach to our CAL development used a *constructivist* approach and addressed both pedagogical and instructional design issues from the outset, such as using guidelines from the work of Reeves and Harmon (1994) that was designed for the evaluation of completed multimedia. We used a group development model with assistance from education experts, instructional designers, as well as academics and multimedia authors who developed and delivered the material on the Web. We used an iterative process, to adjust tutorials in line with results of formative assessment with students throughout the development.

A true multi-media approach was adopted where students used a combination of paper based work textbook referencing and interactive computer delivered tasks, side by side. The idea was to develop activities that would allow students to build on their own knowledge within their own learning framework, with the computer available as a virtual tutor to help them check their answers, provide a level of tutorial feedback and to pose further questions to stimulate their interpretations. The problems were initially based on the areas of difficulties in physiology that staff had previously identified in conventional tutorials.

Students were presented with problems to investigate that required them to examine experimental data, perform calculations, answer questions and keep written records of their work. A wide variety of tasks were presented on the Web, occupying about 1.5 hours of each CLE session. Production of sufficient material for 24 weeks required an efficient production method that could be easily modified on reflection after evaluation.

These weekly problems were supplemented by a variety of highly interactive standalone tutorials that could occupy up to one hour of CAL activities. These included two of our set of highly interactive cell-model building multimedia tutorials (Weaver et al, 1996; Kemm et al, 1997; Weaver et al, 1999a & 1999b) as well as externally produced modules. Students were given the opportunity at the end of the session and during the last session of each semester to test their knowledge with a variety of multiple choice and open-ended questions.

Semester-long Tasks:

In Semester 1: Students formed extended groups (of six) to investigate one of four problems, such as the consequences of blood doping on physiological systems. This semester long project was introduced with the aim of students learning to be perceptive in their reading of short excerpts of scientific writing. They were required to determine the key phrases in the passage, their relative importance and then to write a concise clear report on their interpretation of that piece. This project was designed to assist students to develop generic skills in determining the level of knowledge required and writing abilities to communicate their knowledge more effectively.

Each group was given a weekly series of tasks, researching the material and progressively developing their interpretation. 30-minute periods at the end of each CLE session were designated for these assignments. Students submitted work on the various stages to their own private computer-based discussion forum. They were provided with weekly feedback on their progressive submissions as a computer checklist, and at the end of six weeks submitted their report to another group for peer review. The reviewing group was within the same class and had worked on the same question, therefore were 'expert reviewers'.

We used the learning framework 'TopClass' to allow students to communicate within their group, and to keep track of their progressive work submissions on a semester long project. Science students study such a wide range of subjects that it is difficult for them to form cohesive groups to assist their learning (contrasted with professional courses, eg. dentistry), so that electronic communication is encouraged to reinforce the exchanges that occur in the weekly CLE sessions.

The key learning issues were to work cohesively as a group and make consensus decisions about identifying and ranking key concepts, being able to express themselves concisely, unambiguously, accurately and be able to read another text with some insight as to what is expected... In essence, we aimed to improve their collective skills in negotiation, communication, reading, and writing and reviewing their science.

In Semester 2: We chose to build on the collective skills of collation and consensus writing undertaken in the 1st semester with a course aimed at providing students with some insight into critically reading their Physiology. We formally applied reasoning skills to a graded series of reading tasks using the interactive program 'Reason!'. Although we have reported on this process applied to third year students (van Gelder et al, 1999), the introduction at this time was only done as a trial. The second year students were not as successful in applying 'Reason!', and some modifications will be needed to allow this less sophisticated group to gain more benefit from the process.

Course Assessment:

CLE Assessment: The CLE assessment (5% of total) was aimed at rewarding students who effectively participated in these sessions. The mark was based on attendance and tutors' records of student participation (by observation of a group's activities and their submissions, together with individual student's roles in discussion and record keeping). A student must have attended the majority of sessions be deemed to have participated effectively in group learning (tutor's observations and computer submissions) to have gained a score of greater than 3/5 (rated as good in Table 1).
Examinations: These are described in a following Section, which discusses attempts to relate the participation in CLE with examination performance.

Evaluation Strategies

We have a number of evaluation strategies in place and collected data in 1998 and 1999, as part of our overall action research strategy dealing with global learning outcomes from the CLE as well as in students' extension of cell model building skills to new or hypothetical situations. We used a comprehensive set of methods to collate and assess information, in order to gain a broad understanding of student reactions and to obtain a more detailed examination of student learning processes and actions. We obtained human ethics approval for our surveys and to log important student activities in the computer tutorials

The tutor-facilitators play a key role in the implementation of the program so their impressions of the course are most relevant to understanding student reactions. They made observations and kept records of students' work and participation in the CLE sessions. Formative evaluation continued throughout with regular formal meetings between the main developer and tutors, as well as many informal interactions amongst the students, tutors and the academic developers whose nearby location enabled and encouraged this latter process.

We have found that students cooperate well with questionnaires and interviews if they are fully informed and can see that they are developmental and that timely feedback will assist their own learning. This is unlike their less enthusiastic response to repeated general University circulated questionnaires on teaching quality in each course.

Student Questionnaires

Questionnaires specific to the CLE were used to survey students' attitudes to various aspects of the CAL tutorials and the CLE sessions, in consultation with our educational advisors. These were supplemented by focus group interviews with students.

In addition we investigated students' self-assessment of their approaches to learning. We used a modified study process questionnaire to extend the investigation of deep, achieving and surface learning-approaches (Biggs, 1987) so it included additional learner characteristics. This is discussed in application to one of standalone interactive tutorials (Kemm et al, 1997). Such additional information will be used to further analyse the results reported in this article at a later time.

The student questionnaires were modified each semester from initially determining general reactions to the style and depth of coverage of the tutorials, to focus on particular issues that were relevant to the efficacy of the collaborative learning environment. The study process questionnaire was administered once each year. The last questionnaires had approximately 70 questions designed to reveal students' attitudes and use of the CLE, covering aspects such their pattern of work with the CLE, development of independent learning skills, relevance of the CLE to their learning compared with lectures, and their attitudes to group work. Additionally we had some specific questions about their use of the feedback screens in their learning and about the nature of some tutorials, as part of our interest in learning which tutorial styles worked best and for which students. Most questions required students to rank their responses on a 5-point scale, supplemented by several open-ended questions.

Results

Influences on Assessment:

The aim was to determine whether any part of the CLE assisted students to have a better examination outcome. In all courses, examinations consist of multiple choice questions (MCQ), short answers questions (about 10 min) and essays (about 30 minutes). The written examination questions were set so that one question related to material only covered in lectures, one specifically designed around material obtained in CLE sessions and one question specifically aligned to the semester long CLE project (choice of the four projects undertaken). Multiple choice questions (MCQ), covering the whole syllabus, were no different in their coverage from previous years. Faculty Scores for student's 1st year performance (average of best 75% of subjects) were used to give an idea of the students' previous achievement levels.

Table 1 shows the influence of effective participation in the CLE sessions on the student performance. Student groups were divided into "levels of achievement" based on their previous 1st year academic performance. Subgroups based on CLE participation ratings used scores of 3.5 and 3, a score that should distinguish combined attendance and participation from non-attendance or attendance alone (see course assessment). The data in Table 1 shows a marked polarisation in the mean scores between these subgroups. Thus we are confident that the subgroups did reflect those students who were involved in the material and the learning process, and those who were not. The data suggests that there is an improvement in exam outcome for all groups with good CLE participation, with a greater proportional change for the "lower achieving" students. The examination marks have the CLE component removed and are normalised, so a perfect score is 100%.

Prior Faculty Score Grouping	CLE Participation Rating (Subgrouping)	Number in CLE	Mean Prior Faculty Score %	Total Exam Mark %	CLE Score (/5)
75	good	27	79 ± 0.5	71 ± 2	4.7 ± 0.1 *
	poor/none	11	78 ± 1.0	67 ± 3	1.9 ± 0.4 *
61-74	good	76	68 ± 0.3	63 ± 1 *	4.5 ± 0.1 *
	poor/none	39	67 ± 0.5	54 ± 2 *	1.3 ± 0.2 *
60	good	63	57 ± 0.5	51 ± 2 *	4.3 ± 0.1 *
	poor/none	39	56 ± 0.8	45 ± 2 *	1.4 ± 0.2 *
* probability < 0.05 for the good and poor/none pairing for each subgroup					

Table 1: Influence of collaborative group interactive CLE sessions on the results with each subgroup

Table 2 shows the distribution of examination marks for science students dependent on their participation in the CLE sessions. The data shows a shift to higher grades for those students participating in CLE, again most significantly for the lower achieving students. Of interest is that 55% of the students in this group who attended and participated in CLE passed. By contrast only 35% passed of the group who chose not to participate/attend.

First Year Faculty Score Grouping	CLE Participation Subgrouping	Range of Physiology Examination Marks				
		>80	70-79	60-69	50-59	<50
75	good	30	22	41	7	0
	poor/none	18	27	27	18	9
61-74	good	7	24	33	24	11
	poor/none	0	6	34	34	26
60	good	0	7	32	22	39
	poor/none	0	0	12	23	65
Analyses are expressed as percentages of subgroups						

Table 2: Effects of CLE participation on distribution of examination results of science students taking 2nd year Physiology.

Table 3 shows the influence of the CLE participation on the major components of the examination, and the improvement is apparent across both the written and multiple choice components. We had hoped that the semester long written assignment in particular may have enhanced the Science students' performance in the written part of the examination. If this were true then the written part of the exam should have been done better by the group taking CLE, but the MCQ mark might be expected to be independent of CLE participation. The data however show improvement in both the written and multiple choice exam components for those in the high participation group. Accordingly, from the performance data alone, there is no such clear-cut distinction that might indicate the influence of the different components in the CLE. It is suggested that the apparent improvement in learning skills was influenced by the different components of the CLE (e.g. the CAL tutorials).

Prior Faculty Score Grouping	CLE Participation Subgrouping	n	Total Exam Mark (%)	Written Exam Component (/50)	Multiple Choice Exam Component (/50)	CLE Participation Mark (/5)
75	good	27	71 ± 2	33 ± 1	38 ± 1	4.7 ± 0.1 *
	poor/none	11	67 ± 3	30 ± 2	37 ± 2	1.9 ± 0.4 *
61-74	good	76	63 ± 1 *	30 ± 1 *	33 ± 1 *	4.5 ± 0.1 *
	poor/none	39	54 ± 2 *	25 ± 1 *	30 ± 1 *	1.3 ± 0.2 *
60	good	63	51 ± 2 *	23 ± 1	28 ± 1	4.3 ± 0.1 *
	poor/none	39	45 ± 2 *	20 ± 1	25 ± 1	1.4 ± 0.2 *
* probability < 0.05 for the good and poor/none pairing for each subgroup						

Table 3: influence of CLE Participation on Components of the Examination

The final observation from the assessment was a marked reduction in the failure-rate to <15% compared with 25% over many previous years. It should be noted that we have not been able to reduce this failure rate in previous modifications of our teaching to assist the students most at risk who, as might be expected, were those students with a poor 1st year performance.

Successful Attributes of the CLE

As will be seen from the data analysis above, it was not possible to attribute changes in learning outcomes to any particular aspect of our CLE. We know from previous experience that many factors can be detrimental, such as the students not realising that concepts and material covered in the CLE are as important as lectures, and that students are intolerant of poor quality material or unreliable hardware or software.
We believe that the successful learning outcomes are due to a combination of successful attributes of the CLE, identified by the student surveys and observations, and these are presented in the following sections.

The Physical Environment for the CLE:

The ease of installation and reliability of the iMac computers and the G3 Server has been crucial to the success of the project. They required minimal maintenance since the beginning of 1999. Also, attention to software protection and automatic overnight reinstatement of any student modifications of the desktop eliminated significant problems that we had in teaching in an open-access laboratory in previous years.

Our surveys showed that 74% of students preferred to work in groups, showing a minority of students still liked to work alone. At the beginning of the 1st semester, more high achieving students preferred to work alone but many changed their minds, having experienced the benefits of group work. There may also be cultural differences in these preferences. Focus group interviews confirmed these results and the major advantage seen from group work were the interactions and discussions, which were confirmed by the noise levels in the classes.

The scheduling of sessions for group-work was crucial for collaboration, since our experience of other courses with open-access computer laboratory sessions shows that most students tend to work alone, a few in pairs and rarely in larger groups. We believe this is a critical issue to encourage collaborative learning, especially in Science where the diversity of courses that students undertake make it difficult for them to find collaborators with similar timetables.

The CLE sessions induced a 'sense of belonging' to a community within a course where the students come from quite disparate backgrounds, generating more of the interactions that exist in our more selective professional courses. There was identification within each session of 40, rather than just being an anonymous student amongst the class of 350. The open discussions and studying together also reinforced a common approach to scientific investigation and enhanced their appreciation of the philosophical approaches to learning.

The modern, pleasant and comfortable surroundings were found to encourage lively interaction, the main features being the open layout, lighting, carpets and comfortable seating. Furthermore, its location within the Department and easy access to support staff and academics next door showed the commitment of the Department to assisting the students. This sense of personalised support was reinforced by having a tutor look after each class and by providing easy email access by students to staff specialists. Lastly reference should be given to hugely successful paisley 60s style couch in the adjoining corridor, where many successful physiology and non-physiology related communication skills were reinforced.

Web Delivered CAL Components:

It is not possible to relate the learning outcomes to any specific CAL components. There is insufficient space to describe all the characteristics of the computer-assisted web components that worked well with our students in the CLE sessions, but the highlights are as follows, including some representative screen shots:

Weekly tasks not only had a Web-delivered component, but also were accompanied by a paper task sheet indicating the scope of the task for the session. This gave the students some take-away material that could be used in later study/reflection. In addition students were required to keep a record book and make notes, and do calculations as they progressed, so further reinforcing their learning and providing their own records.

The developed Web-authoring tools were essential for producing the core of the material for the 24-weeks of CLE sessions in a cost-effective manner. A single important feature over stand-alone programs is that both material and tasks could be updated relatively easily to incorporate new knowledge, or change emphasis in tasks with changes in the staff presenting lectures. The Interactive Web Objects were controlled by scripts that were readily modified by standard text editors and we used Dreamweaver to manage the website. This meant that 'authoring' of the web pages did not require a programmer, but an academic with some skills in word processing and HTML could be employed instead. This allowed the focus to be on appropriate pedagogy and relevant physiological content. The collaboration between the Multimedia Education Unit and the Physiology Department was essential to both bodies, providing Physiology with a suite of Web based tools while allowing the authors the feedback to develop and test them using pedagogical requirements firmly grounded in the context of the real course.

- Students indicated that the diversity of tasks and web-presentations were stimulating and very helpful for their learning. These included calculations with relevant human data, interactive graphing of relationships, open-ended answers to questions, sorting sequences of processes, building models of cellular functions. Fig. 1 shows a screen showing one of a sequence of tasks requiring investigation about cell communication. This requires association of modes of cell communication with a diagram as a simple revision task.

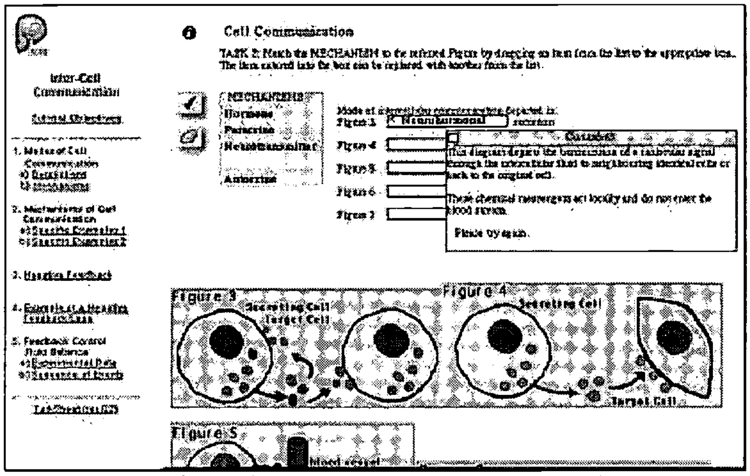
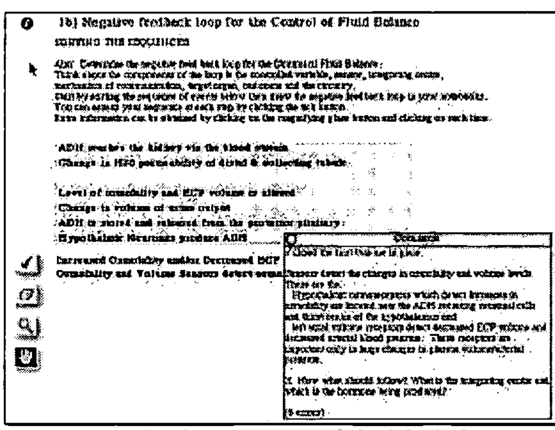


Figure 1: Set of Tasks listed, one of which is shown requiring matching of mechanisms to diagrams.

- A popular format (Fig. 2) was the sorting of sequences of events in a physiological process, which students found challenging and rewarding and generated much discussion as they explored many of the possible solutions. As developers, we did not predict this preference. This emphasised that continuous evaluation of what is working is essential, since academics often misjudge what students will find useful and challenging.
- Our students have a poor understanding of the significance of the shape of graphs, so we use a free form drawing tool (Fig. 3) to allow them to represent changes that they might expect in important relationships. Here they have drawn the straight line as the change they expect in the supplied curve.



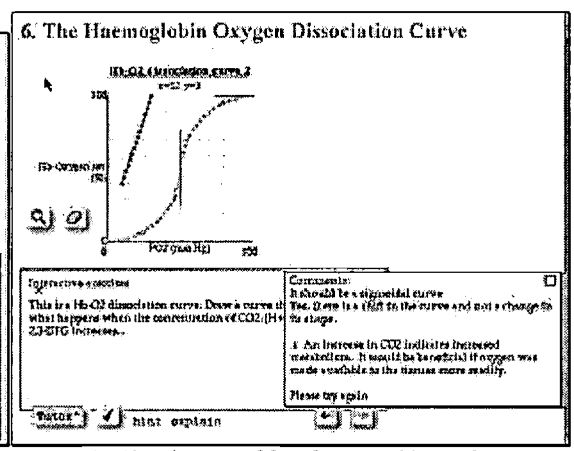


Figure 2: Sorting a sequence of physiological events. **Figure 3:** Showing use of free-form graphics tool.

- Students used the textual feedback on what was appropriate or inappropriate about their responses and found this to be very helpful in their learning. The feedback was designed to progressively reinforce students' development of an appropriate framework for their solutions to problems - such as their own summaries with the key features of negative feedback control by hormones (see insets in all Figures).
- While the students found the content challenging, the computer-aided tutorials gave them a better idea than lectures of the level of understanding required to understand physiological mechanisms.
- Students developed appropriate learning strategies: such as exploring mechanisms using interactive programs, reinforcing lecture material by more study, and by reflection of the material and by redoing components of the CAL.

Standalone Interactive Multimedia Components:

Students found the interactive model-building standalone tutorials to be challenging and very helpful for understanding some difficult concepts. However, their approaches to using these tutorials is being researched separately and is too extensive to fully report here. Previous investigations, (Kemm et al, 1997), showed that students were unable to construct hypothetical cells from their experience of constructing a cell to secrete stomach acid. A revision tutorial that shows the principles in the operation of membrane transporters was then developed to allow students to think out their solutions (Fig. 4) and apply this knowledge to new cell models, such as for the operation of cells in the proximal tubule of kidney (Fig. 5). We are currently investigating this transfer of model building skills in a controlled study to see if we can increase the number of students who think out solutions rather than simply use trial and error. We use audit trails to investigate the actual steps students take in arriving at their model solutions. In later modules, more emphasis has been given to placing the cell modelling tasks in context with overall requirements of the tissues in which they are found.

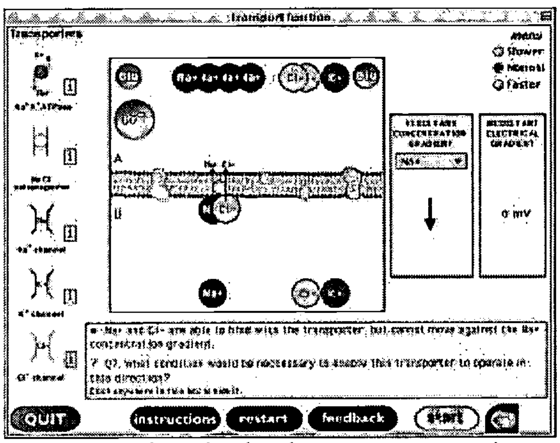


Figure 4: Animated tool to show transporter operations.

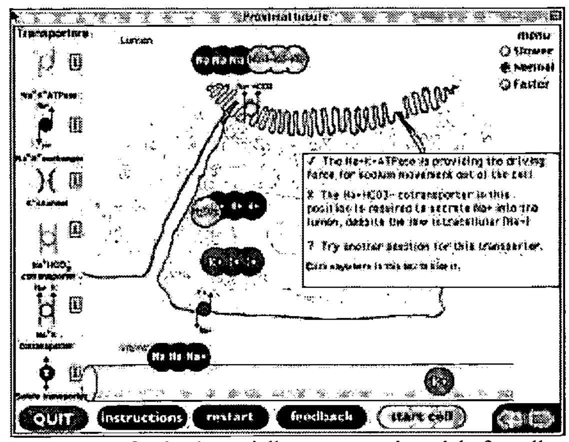


Figure 5: Student's partially constructed model of a cell.

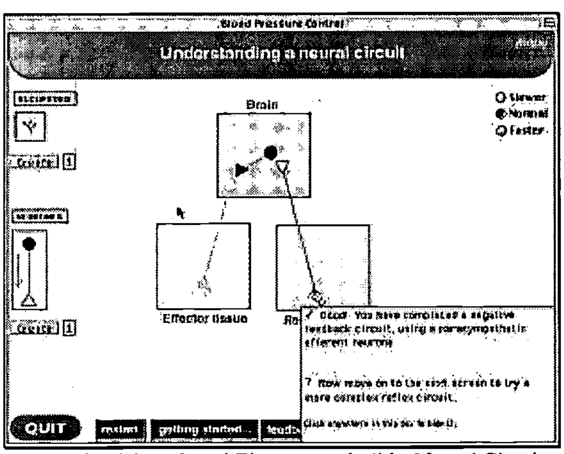


Figure 6: Using Neural Elements to build a Neural Circuit

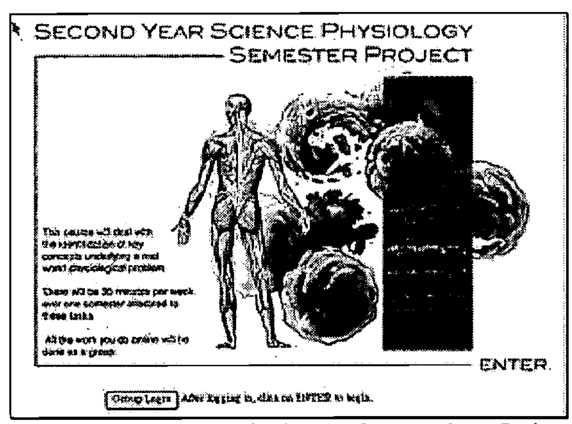


Figure 7: Introduction to a Semester Long Project

Another approach to model building is to develop neural circuits underlying the operation of physiological control systems. Students found our first version of a tutorial on the control of blood pressure very difficult. Our analysis of audit trails and questionnaires showed that we needed to separate their learning of how the elements of the model worked, using a simple 'playground' (Fig. 6) that also allowed them to develop a negative feedback neural circuit. They were then better able to deal with the complex neural feedback pathway involved in the regulation of blood pressure when moving from a lying to standing position.

Semester-long Tasks:

Students undertook the semester long task of writing about a topical issue with enthusiasm. There was lively discussion, although they were quite frustrated by some features of the TopClass Framework which meant it proved less than optimal for their purposes. There was considerable variation in the standards of both the final submissions and the quality of peer reviews, but students generally produced good work. Not many were able to identify all of the requirements, such as: the key issues in their problem, the relative importance of various factors, and to produce concise and unambiguous writing about the problem. In 2000 we have introduced a new means of for students to develop their submissions, receive feedback and to track their efforts using more effective interactive Web tools (OCCA described in Fritze & Kemm, 2000).

Discussion:

Learning Outcomes:

It is extraordinarily difficult to use traditional quantitative methods to show differences in learning outcomes attributable to a particular curriculum intervention by using traditional statistical methods (Reeves, 1993). Even if there are reasonable control groups, large numbers are often necessary to overcome the many confounding factors influencing the students in studying in a course, although there have been occasional successes such as (Reeves et al, 1997).

In our study, we were fortunate to have a self-selected control group who did not participate effectively in the CLE. Although less than ideal, we were not permitted to design an experiment in which some students are not offered this learning opportunity. Nevertheless, the self-selected group did represent a broad coverage of student achievement and there was no difference in sub-groupings based on prior achievements (first year Faculty Score). The significant results show that effective CLE participation was associated with an improvement in learning outcomes of some groups of students when compared with performance in another subject in the same year.

These improvements were observed in students across the achievement scale with students always doing better if they attended and took CLE. A significant outcome was a marked reduction in the failure-rate to <15% compared with an average of 25% over many previous years. It is of consequence that while CLE enhanced the outcome of the Physiology students most likely to fail (45% ± 2 to 52% ± 2) the same improvement was not evident in their Biochemistry mark, a closely related subject (51% ± 2 and 51% ± 2). This preliminary information gives further support to the notion that the CLE has enhanced learning in Physiology in this low achieving group. It is of note that we have not been able to reduce this failure rate in previous modifications of our teaching to assist the students most at risk. Perhaps the more diverse learning strategies provided these students with new and additional ways to understand and communicate physiology.

It was not possible to identify the improved learning with any particular aspect of the CLE. We believe that it is the combination of computer and human facilitated learning environment within which students work together and discuss the subject on a regular basis that has contributed to a general improvement in learning skills and attitudes

Important Characteristics of our Collaborative Learning Environment:

The important characteristics that we believed supported our successful implementation were:

- The choice of an appropriate and flexible set of delivery tools that allowed development of an appropriate pedagogy for students to learn effectively from their tasks. It was important not to allow development to be held up by awaiting the 'latest' version of any delivery tool, but to work our way around it to ensure that one could deliver an appropriate task on time, even if resorting to a greater dependence on written tasks. Our productivity exceeded that in our prior multimedia developments.
- Using the computer's interactivity to focus on concepts not easily covered in lectures, with the CAL not designed to replace all lectures or students' use of textbooks and other resources.
- A generation of a pleasant and friendly learning space was crucial to encouraging students to openly discuss issues and to discover the power of peer-learning and peer-teaching, with supportive staff.
- Choice of reliable software and hardware (eg our experience with iMacs, compared with previous years, meant staff could concentrate on learning issues and not solving technical problems).
- Students needed to recognise that learning in CLE sessions was as important as attending and learning from lectures. Assessment was an important signal that encouraged students to attend, but it must be make it so competitive that students no longer wish to collaborate. We found that allocating 5% for participation in CLE sessions did encourage the CAL to be taken more seriously than previous years, but increasing this will bring on more issues of equity and accuracy of assessment methods.
- The proximity of the developers to the CLE laboratory provided opportunities for them to obtain a deeper understanding to the cultural and individual characteristics of the learning experiences.
- Students openly showed their enjoyment of the learning environment and there was always lively discussion of physiology (and not extraneous social matters). This also encouraged both the tutors' and the developers' interest in further improving the collaborative learning experience in line with the students' survey results and informal feedback. The use of scheduled classes was imperative to allow students to establish and maintain working relationships with their group.

Conclusions and Future Directions

We have found that there is significant value in using *scheduled face-to-face on-campus* collaborative learning, to complement student's individual self-paced asynchronous learning, that is facilitated by computer tutorials and resources. Continuing investigation of our collaborative learning environment has the potential to build on existing initial successes and to provide some credible evidence and advice to support the management of such positive educational change. Additional evaluation of what works and why with each of our computer tutorials, and with which students, will allow us to make more use of adaptive feedback with new embedded Web objects (Fritze & Kemm, 2000). Thus we could provide more appropriate learning challenges to students who have different approaches to learning and have different achievement levels.

While our results appear promising, in order to maximise the benefit of this innovation there is a need to investigate empirically which factors provide the most positive influences. This could allow the development of a transferable framework for establishing even more successful collaborative learning environments. In particular, we need to learn more about where to allocate human and other resources in order to have optimal effect on student achievement (Thomas, Sammons & Mortimore 1995). In addition to existing teaching processes, this would entail a carefully planned action research project that will provide some more precise and actionable indicators of key factors. More specifically, it would help to create more educative links between instruction, learning and assessment essential for the development of 'deeper' and more durable learning abilities by students (Boud 1994, Loacker, Cromwell. & O'Brien 1986). Such data would be a valuable contribution to other academic staff taking up the challenge of introducing more progressive teaching approaches that foster greater levels of self-directed and higher order learning such as collaborative problem solving and active reflection and metacognitive analysis (Slavin 1990, Mezirow 1994). It would also provide a local infrastructure and an adaptable generic model for generating useful ongoing measures to inform quality assurance and continuous improvement processes.

Overall, we will continue to use an iterative approach to the development of collaborative learning tasks that address effective pedagogy in a campus-based computer-facilitated learning environment. We will use a pragmatic mix of available tools (such as commercial products that support emerging standards for delivery of interactive multimedia) and locally developed solutions that address our own needs. In particular, our aim is to provide a more inclusive curriculum with learning opportunities for the wide range of abilities and learning styles of our students.

References

Biggs, J. B. (1987). *The Study Process Questionnaire* (SPQ): Manual. Hawthorn: Australian Council for Educational Research.

Boud, D. (1994). *Assessment and learning: contradictory or complementary?* Keynote Address to 'Assessment for Learning in Higher Education: Responding to and Initiating Change'. Conference of the Staff and Educational Development Association, Telford, 16- 18 May.

Cooper, G, and Sweet, M. (1999). *Why Teachers Do Not Use Collaborative/Cooperative Learning.* [WWW document] URL http://darkwing.uoregon.edu/~tep/library/articles/notuse.html

Delbridge, L. and Kemm, R.E. (1985). Computer managed learning in and undergraduate laboratory. In *Student Control of Learning: Computers in Tertiary Education*, eds. Bowden, J. A. & Lichtenstein, S. , pp. 85-97. Melbourne: CSHE University of Melbourne and IBM.

Drucker, P. (1995). *Managing in a Time of Great Change.* Butterworth-Heinemann, Oxford.

Fritze, P. and Kemm, R.E. (2000) OCCA: Development of an Institutional Strategy for 'Mass Customization' of Online Learning, Proceedings EdMedia 2000 (in press)

Johnson, D. W., & Johnson, R. (1992). *Contemporary Education*, 63 (3), 173-180.

Loacker, G., Cromwell, L. & O'Brien, K. (1986). Assessment in Higher Education: To Serve the Learner. Adelman, C. (ed.) *Assessment in American Higher Education.* Office of Research and Improvement, U.S. Dept. of Education, Washington, D.C.

Lohrey, A. (1995). *Transferability in Relation to the Key Competencies.* Centre for Workplace Communication and Culture, University of Technology Sydney (Report for DEET).

Kemm, R.E., Weaver, D.A., Dodds, A., Evans, G., Gartland, D., Petrovic, T., Delbridge, L. & Harris, P. J. (1997a) Designing and Evaluating an interactive hypothesis testing tool to aid student understanding - Gastric acid secretion and its regulation. In *ASCILITE '97 What Works and Why*, ed. Rod Kevill, Ron Oliver, & Rob Phillips, p 324-330. Perth: Curtin Univ. of Technology.

Meloth, M. (1999). The Role of the Teacher in Promoting Cognitive Processing During Collaborative Learning, in O'Donnell, A. & King (Eds.), *Peer Group Learning*. Hillsdale, NJ: Erlbaum.

Mezirow, J. (1994). Understanding Transformation Theory. *Adult Education Quarterly*. 44, 4, Summer.

Reeves, T.C., Laffey, J.M. and Marlino, M.R. (1997) Using technology as cognitive tools: Research and Praxis In *ASCILITE '97 What Works and Why*, ed. Rod Kevill, Ron Oliver, & Rob Phillips, pp. 324-330. Perth: Curtin University of Technology 481-485

Reeves, T. C., & Harmon, S. W. (1994). Systematic evaluation procedures for interactive multimedia for education and training. pp. 472-505 in S. Reisman (Ed.). *Multimedia computing: Preparing for the 21st century*.

Reeves, T. (1993). Pseudoscience in computer based instruction: The case of learner control research. *Journal of Computer Based Instruction* 20, 39-46, Harrisburg, PA: Idea Group Publishing.

Slavin, R. E. (1990). *Cooperative Learning: Theory, Research and Practice. Prentice Hall, Englewood Cliffs, NJ.*

Thomas, S., Sammons, P. & Mortimore, P. (1995). Determining what adds value to student achievement. *Educational Leadership International*, March, 19-22.

Van Gelder, T., Williams, N.T., Di Nicolantonio, R., and Kemm, R.E. (1999) *Critical Thinking in Physiology: A Reason!-able approach* ASCILITE '99 Responding to Diversity, Queensland University of Technology, Brisbane 351-358

Weaver, D. A., Kemm, R. E., Dodds, A., Evans, D., Petrovic, T., Delbridge, L. & Harris, P. J (1999a) CD-ROM: *'Gastric Acid Secretion'*, University of Melbourne, Melbourne Australia, ISBN 0 7340 1741 3

Weaver, D.A., Kemm, R.E., Petrovic, T., Harris, P.J. & Delbridge, L. (1999b) *Learning about control systems by model building - A biological case study* ASCILITE '99 Responding to Diversity, Queensland University of Technology, Brisbane 381-390

Weaver, D.A., Petrovic, T., Harris P. J., Dodds A., Delbridge L.M., & Kemm R. E. (1996) Interactive tutorials designed to encourage deeper learning practices. pp. 501-515 in A. Christie, P. James & B. Vaughan (Eds.). *Making new connections*. Proceedings of the ASCILITE '96 conference, University of South Australia.

Wiggins, G. (1990). *The Case for Authentic Assessment*. ERIC Digest ED328611 TM016142

Acknowledgements

Assistance in the design of study process questionnaires is gratefully acknowledged from Agnes Dodds of the Medical Faculty Education Unit and Glen Evans of the Multimedia Education Unit. Other staff members in Physiology also contributed significantly to the development of various multimedia tutorials.

Funding was provided by: competitive government grants from the Committee for the Advancement of University Teaching, the Committee for University Staff Training and Development; competitive grants from the Teaching and Learning Multimedia and Technologies Committee of the University of Melbourne and the Apple University Developer Fund; together with additional financial support from the Department of Physiology, Glaxo-Wellcome and Astra Hassle.

FULL PAPERS

The Applicability and Utility of Fault Tree Analysis Prior to the Diffusion of a Technological Innovation in an Educational Setting

Mandie Aaron
Educational Technology
Concordia University
Canada
aaron@vax2.concordia.ca

Abstract: The purpose of this paper is to discuss the applicability and utility of Fault Tree Analysis in the diffusion of a technological innovation in a higher education setting. Diffusion of innovation literature suggests that the involvement of the intended users in the diffusion process will increase the subsequent use of the innovation. The educational literature has suggested there are six factors which inhibit or influence the use of technology in schools: time; expertise; access; resources; support (Leggett & Persichitte, 1998) and perceived need (Sherwood, 1999). By modifying the Fault Tree Analysis process to be more inclusive, it is theorized that the process will be both applicable and utile and that intended users of the technology in question will be more likely to successfully integrate the innovation into their educational milieu.

Introduction

> I believe that the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, the use of textbooks. The education of the future, as I see it, will be conducted through the medium of the motion picture ... where it should be possible to obtain one hundred percent efficiency.
>
> Thomas Edison, 1922

> The history of modern education is littered with the trash of technology left behind by unrealistic purchases, naive users, and vendor representatives working on a quota system.
>
> Polley, 1977 (in Albright & Graf, 1992)

> ... the very efficiency of the machine was drastically curtailed by the failure to achieve in society a set of harmonious and integrated purposes.
>
> Lewis Mumford, 1934

I begin with these quotes in order to establish the arc of thought that my research will follow. The first quote highlights the promise of a panacea that many people see in any new technology destined for use in educational settings. Substitute "computer technology", or any other previous new technology touted as the greatest thing to hit education, for "motion picture" and a statement made in 1922 becomes as relevant, repeated and potentially unrealistic today. People seem all too ready to accept technology as something which is value-free and necessary (Cornell, 1999; Kerr, 1996). Perhaps even more disturbing, is the idea that if a technology can do something it therefore follows that it should be done. If medical technology was used with as little thought for consequences there would be a huge public outcry yet very little such outcry occurs in education. As Postman writes in his book "The End of Education" (1996, p. 41), the role that new technology should play in schools or anywhere else is something that needs to be discussed without the "hyperactive fantasies of cheerleaders". He goes on to call computers and their accompanying technology "Faustian bargains". We must be more mindful regarding the choices and decisions we make concerning our use of technology in education lest we end up with something cheered about by many but wholly inadequate and inappropriate for the majority of our needs. I have attempted to apply this mindfulness in my examination of the applicability and utility of Fault Tree Analysis.

Like Postman's "Faustian bargains", Polley (in Albright & Graf, 1992) also felt that perhaps far too much emphasis was placed on the acquisition of technology without first fully understanding what those acquisitions would imply. Polley's words illustrate that the unchecked and poorly thought out use of information technology in the schools has resulted in somewhat of a backlash. Yet this backlash has occurred throughout history with very little consequence. Polley's statement is but one of many such examples of disappointment people feel in the reality new technology often provides. There is a large contingent of technological cautionaries attempting to temper the frequently unchecked enthusiasm the technological advocates put forth. Critics (see, for example, Winner, 1998, 1999; Postman, 1988, 1996; Oppenheimer, 1997; McKibben, 1992; Mander, 1992) of the heavy and costly emphasis of placing the latest information technologies into the schools argue that with so little evidence for their effectiveness, this effort would be much better placed on other aspects of schooling.

Experience with technology seems to indicate that the crux of the problem lies between acquisition and use. It is clear that the diffusion of innovation is not merely a matter of purchase. What happens between the promise and the reality? Why do some technologies take hold and others collect dust in a corner? Why is it that some schools, such as Appleby Elementary School in Marathon, New York (Sherwood, 1999) and even entire school districts, such as Chittenden, Vermont, for example, which is widely renowned for its use of technology (Brauer, 1995) are able to seamlessly integrate technology into their curricula while others can only manage the most rudimentary use of technology? This situation regarding the use of technology in education does not only apply to the elementary grades. It seems particularly acute in the higher education setting. Dalton (1989) notes that in spite of the impact computer technology has had on society in general, the impact on the practice of education has been relatively minor. According to Spotts and Bowman (1995), the influence of technology on higher education pedagogy has been weak to almost non-existent. The results of a survey measuring instructional technology awareness and use amongst faculty members indicated that, while faculty recognize the importance of instructional technology, they do not currently use, nor plan to use, instructional technology in their teaching (Spotts & Bowman, 1995). The results also indicated that, while the majority of faculty have a high degree of knowledge and experience concerning older technology such as video and film, fewer than 20% of them actually use *any* technology on a regular basis.

Recent findings are somewhat more encouraging but use still seems to be concentrated on the communication aspects of computers (e-mail, presentations, etc.) rather than on integration with the curriculum (Mitra, Steffensmeier, Lenzmeier & Massoni, 1999). Faculty has long been resistant to advanced technology-based education and while, as Rickard (1999) argues, faculty seem more willing to use new technology and are even engaging in the development of such courses, there remains a well-entrenched skepticism not in the technology necessarily but in the ability of the educational institution in which they work to support its use. Support for the technology, then, seems to be one area to which attention should be paid. Fault Tree Analysis, by virtue of its inclusivity (at least my variation of it to promote inclusivity) and involvement of members from the entire focal system, engenders this notion of support. Others believe that too much is being invested, at too great a speed, in technology that has yet to be proved to increase educational quality and productivity (Larson, in Rickard, 1999). Larson also argues that where evidence does exist that technology "can actually help improve educational quality [it] is really just the tendency of technology to make course material more engaging" (para. 12). In other words, paying more attention to engaging our students in the learning process may, even without technology, be all that is needed to make education more effective. If one applies this rationale to Fault Tree Analysis, which engages participants in the process, it may add value to the process of diffusion.

Mumford's understanding, gained sixty-five years ago, that the society in which a technology is to be implemented needs to be in agreement over the implementation process and desired outcomes, may hold the key to successful technological diffusion in educational settings. The process of Fault Tree Analysis and the modifications which have been proposed clearly attempts to achieve this agreement. The supposition that the manner in which technology is introduced, and the elements at play in the context in which this introduction occurs, will, by virtue of its systemic nature, come to the fore while conducting the Fault Tree Analysis. Fault Tree Analysis is "a logic diagramming technique relating combinations of possible events (or subsystems within a system) which interact to produce a predefined undesired event [and can be] generally thought of as a technique for increasing the likelihood of success in any system by analyzing the most likely modes of failure, in order to prevent future failures". (Stephens, 1972, p. 2). The main purpose of this technique is to improve the likelihood of success in any system by understanding potential areas and causes for failure, with the goal being to prevent future failures. The first step in Fault Tree Analysis is system definition – a definition which includes a discussion of the factors, both positive and negative, which serve to influence the system. I believe, and there is literature (c.f., Akrich, 1993; Burt, 1973; Van Den Akker, Keursten, & Plomp, 1991; Walsh, 1991; Walsh & Bayma, 1996) to substantiate and support this belief, that Mumford's words concerning the importance of social context highlight what is frequently an absent element in the diffusion of new information technologies into educational settings – the direct involvement of the intended users of the innovation. The modifications I have proposed to Fault Tree Analysis clearly attempts to address this void. It seems apparent that, in spite of the critics and the lack of concrete and unconfounded proof of effectiveness, information technologies are going to be bought and attempts are going to be made to integrate them into educational settings (an effect that has been described as the "bandwagon effect" (Abrahmson & Rosenkopf, 1993)) – it therefore behooves us to research and understand the most effective ways in which this can be accomplished.

The above is not to say that technological determinism is inevitable, but past patterns of use of technology seemingly indicate that educators use what is offered, perhaps looking for a solution to the "problem" of education. Given this initial willingness to use technology (though history also indicates that continued use rarely occurs), finding ways to help ensure responsible and productive use is crucial. An understanding of why one wants to use a particular innovation, how and even if it should be used and whether, given ideal circumstances, it will succeed when used is essential. As others have indicated, I too believe that there is far too much emphasis on technology for technology's sake without nearly enough emphasis on the surroundings in which the technology will be utilized or even if it should be utilized at all. Technology may not be entirely pernicious but it is also most certainly not a panacea. In any case, it is rarely innocuous. Some circumstances warrant the use of technology but some situations would be better off without technological intervention. Fault Tree Analysis and the subsequent validation of this analysis by the members of the focal system appears to be an excellent tool by which we can gain insight into these very crucial elements, thereby significantly adding to our understanding of how best to implement technology into educational settings.

> The first teacher ever, the priest in preliterate Mesopotamia who sat down outside the temple with the kids and began to draw figures with a twig in the sand, would be perfectly at home in most classrooms in the world today. Of course, there is a blackboard, but otherwise there has been little change in tools and none in respect to methods. The one new teaching tool in the intervening 8,000 years has been the printed book. And that few teachers really know how to use--or else they would not continue to lecture on what is already in the book.
>
> The priest in ancient Mesopotamia was also the first doctor. If he returned today to a modern operating room in the hospital, he would not conclude that he could do as well. Yet today's doctors are no better men than the first doctors were. They certainly are no better than the "father of medicine," Hippocrates. They stand on his shoulders. They know more, and above all, they know better. They have a different methodology. They have different tools. As a result, they do entirely different things, and do them differently.
>
> Drucker, 1969, p. 347

Whether or not one fully agrees with Drucker, the contrast between medicine and education is striking and it is also obvious to any educator or student that there is truth to his idea that very little has changed in today's classrooms. One need only sit in on a majority of university classes to see that generally, as was the case hundreds of years ago, the teacher talks while the pupils listen. That is not to say, of course, that new technologies have not been developed and attempts at use have not been made. In fact, introducing, implementing and ultimately integrating technology into classrooms, as well as businesses, government facilities, etc., is not a new phenomenon. From slate to radio to the overhead projector to the multi-media computer platform, a variety of technologies have been introduced into various environments with varying degrees of success and failure (Cuban, 1986; 1993; Pellegrino & Altman, 1997; Cornell, 1999; Rickard, 1999). It is not sufficient to have functional equipment – the equipment must be accepted and integrated in order for it to be used. The best of intentions are one thing – actual use another. Recently, Drucker (1999) reiterated the same conclusions he made in 1969 regarding the use of technology in education, though on this occasion he turns primarily to the influence the information revolution has had on the business community. According to Drucker, while routinization of traditional processes has occurred, "almost none of the effects of information envisaged forty years ago have actually happened (1999, par. 16). He argues, though, that the psychological impact of technology has been far greater, especially on the manner in which children learn. Drucker maintains, as he did in 1969, that the manner in which schools teach is inconsistent with the way children learn. In other words, schools are still behind where they should be.

Five critical factors, culled from decades of literature, inhibiting the use of technology in the schools have been identified by Leggett and Persichitte (1998). These factors are: time; expertise; access; resources and support. Perceived need has also been identified as an essential factor when it comes to the successful integration of technology (Sherwood, 1999). Technology programmes therefore need to be developed which are systemic and intentional or purposive (Coughlin, 1999). Based on the findings in the literature regarding examples of the failure of diffusion of information technology in different settings, and using the above six characteristics as a means of categorizing the findings, it may be possible to develop a model of successful diffusion of innovation easily applicable and suited to the needs of educational institutions implementing a new technology. It will be interesting to see if the Fault Tree Analysis uncovers these factors as those contributing to the failure (or potential failure) of the innovation in question.

Large sums of money and huge investments of time are being expended on technology in the schools with, seemingly, very little success (Coughlin, 1999; Sherwood, 1999). In light of the technological failures in the past and the continued amount of money that is being spent on technology, Fault Tree Analysis may prove to be a viable and practicable method schools can use when dealing with the influx of a new technological innovation, thereby saving huge amounts of time, money and frustration. While practitioners and researchers alike currently agree that there are problems with the use of technology in the schools and efforts have been made to look into these problems, there has been no systemic and systematic study of failure of the sort Fault Tree Analysis offers. Education is clearly a success-oriented endeavour. Indeed, it has oft been said that if one focuses on failure, one probably will. Fault Tree Analysis may focus on failure but it does so with the goal of success in mind. Furthermore, the very process of Fault Tree Analysis improves the individual sense of ownership and control over the technological diffusion, loss of which, as previously discussed, teachers fear. The process, which includes direct involvement and system-wide representation, also serves to build a cohesive team which improves and strengthens the social environment into which the technology is being diffused (Jonassen, Tessmer & Hannum, 1999; Stephens, 1972; Wood, Stephens & Barker, 1979) – factors which have been previously identified as essential in the diffusion of innovation. The current study clearly involves the individuals to whom the innovation is being targeted. Fault Tree Analysis appears to be the ideal method to address some of the problems of technological diffusion in educational settings. I believe that this technique will prove to be a useful tool in helping schools face the daunting challenge of integrating technology into their educational environments.

Fault Tree Analysis Site

The site chosen for this study is a college in Montreal. The college is a multicultural institution and reflects the international and cosmopolitan nature of the city in which it is situated. In the last five years courses have been offered on how to use the internal, e-mail, web page design, FirstClass, etc. Most have met with an enthusiastic response but little follow through. Loss of interest seems to be a particularly common problem. The technological innovation currently challenging the administrators is the use of the Internet as an integral element of the teaching process. Their goal is to increase the use of the Internet in the current classroom model as well as develop on-line courses with an eye towards increasing the schools potential for distance education courses. Fault Tree Analysis seems to be a practical tool that may help the college face their goal of technological integration. Testing its applicability and utility in this environment will provide a rich basis upon which applicability can be assessed.

Using Fault Tree Analysis, I will attempt to gain an understanding of the college's outlook on the diffusion of technology into their system. I believe that this technique will prove to be a useful tool in helping schools face the daunting challenge of integrating technology into their educational environments. Examining and understanding how technological innovations fail will, according to advocates of Fault Tree Analysis, increase future probability of success. Participating in the fault tree process, will provide faculty members at the college with a unique opportunity to have a voice in the manner in which a new technology is introduced in their environment. They will be given an opportunity to have a direct say in how, and even whether, a new technology will be implemented. They will be involved in a direct and concrete manner. They will not only be asked their opinion but will be asked to shape the final result as well. The participants (the majority of whom are faculty members) will also see that administrators are being willing and cooperative partners in the decision-making process of technological implementation. Lawler, Rossett and Hoffman (1998) have clearly indicated the importance of a supportive environment in the integration of technology in an educational environment.

Significance of the Research

The potential significance of this research is fourfold. Firstly, this is the first study that will examine in a rigorous fashion the applicability and utility of Fault Tree Analysis. It is the first study to apply this method specifically to the diffusion of a technological innovation in an educational setting. In previous documented uses of Fault Tree Analysis, the purpose was to analyze a problem using Fault Tree Analysis, not to study Fault Tree Analysis itself as a tool. In addition to being the first "process" study of Fault Tree Analysis, this study also investigates an innovation in the process for the first time – specifically, it addresses the utility of contributions from the focal system, beyond the appointed FTA team, and the match or mismatch between the contributions of the two groups.

Secondly, the research will also have practical significance to the technology planners, implementers and faculty at the college. The results of this study will be directly applicable to a reality-based situation. The members of the focal system will have developed a plan of how best to proceed with the diffusion of the innovation in question – a plan shaped by the direct input and validation of the intended users of the technology – elements which the diffusion literature indicates as crucial to the process of implementation.

Thirdly, by providing a detailed description of the Fault Tree Analysis process (as experienced by the members of the focal system and experienced and observed by the researcher), this study will attempt to fill a gap in the literature concerning the diffusion of technology into educational settings. The research clearly indicates that the best way to proceed to ensure use when implementing technology is to directly involve the intended users in the decision-making and implementation stages of the plan. Stephens' original model of Fault Tree Analysis, while including members of the focal system on the FTA team, does not allow for the direct contribution of the members of the entire system – the modification proposed herein clearly does. This study will be examining whether what has been identified as important in theory, works in practice.

Finally, based on the results of this study, a model of Fault Tree Analysis in the process of diffusion of innovation in a higher education setting will be proposed which can then serve to inform the diffusion of innovation literature and have direct utility in other educational systems.

Conclusion

The purpose of this research is to determine the applicability and utility of Fault Tree Analysis in the diffusion of technological innovations in educational settings. Once the applicability and utility is established it is believed that the development of a fault tree may, by feeding into the systemic process of diffusion of innovation and as feedback and feedforward loops, help shape the way technology is integrated, implemented and perhaps even developed in the future. Developing a fault tree of a school currently dealing with the influx of technology may help to provide insight into how and why people adapt to and adopt a new technology. It may also serve to highlight the roadblocks people face and whether or not these impediments are different than those identified in the diffusion of innovation literature. Insight gained from such an analysis may, in the medium and long term, allow for more effective implementation, training and use expectation policies. Underlying my belief in the importance of Fault Tree Analysis is that by merely illuminating to the participants the reasons for failure and the areas in which they are most likely to occur is sufficient to cause a shift in behaviour and attitude.

The important contribution this research in general, and in specific relation to the educational milieu, is clear. If we are to discern the impact technology has had and will have in higher education processes, understanding the elements that influence that impact and providing a systemic approach to address the needs of the technology's intended users will have strong sociological, economical, educational and policy-making benefits. If we know how to uncover, and then correct, the failure events that influence the acceptance and integration of technology, savings of time, effort and money can be had by overcoming the impediments to the diffusion of technology in educational settings before they have a chance to occur.

Diffusion of innovation occurs for a multitude of reasons and within a variety of contexts. Understanding loci of failure and the contexts in which they occur will help allow for a much more efficient process of technological integration. Understanding these failure elements may also help us recognize when technology is not warranted and feel confident in the decision not to use it. This Fault Tree Analysis will serve to help gain insight into the implementation process of technological innovation. This insight and the subsequent development of a systemic diffusion of innovation model using Fault Tree Analysis may help to inform policy and decision makers in their implementation strategies – necessary and desirable goals in light of the speed at which new technologies are being developed and introduced to schools in North America and the frequent failure these implementations meet.

References

Abrahamson, E., & Rosenkoph, L. (1993). Institutional and competitive bandwagons: Using mathematical modeling as a tool to explore innovation diffusion. *Academy of Management Review, 18*(3), 487-517.

Akrich, M. (1993). A gagozene in Costa Rica: An experiment in technosociology. In P. Lemonnier (Ed.), *Technological choices: Transformation in material cultures since the Neolithic.* (pp. 289-337). London: Routledge.

Albright, M. J., & Graf, D. L. (Eds.). (1992b). *Teaching in the information age: The role of educational technology.* San Francisco: Jossey-Bass.

Brauer, R. (1995). The internet as school, or welcome to our MUD room. *Technos, 4*(3), 14-21.

Burt, R. S. (1973). The differential impact of social integration on participation in the diffusion of innovations. *Social Science Research, 2*, 125-144.
Cornell, R. (1999). Paradigms for the new millennium: How professors will certainly change! *Educational Media International, 36*(2), 89-96.
Coughlin, E. (1999). Professional competencies. *Learning and Leading with Technology, 27*(3), 22-27.
Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920.* New York: Teachers College Press.
Cuban, L. (1993). How teachers taught: Constancy and change in American classrooms, 1890-1990 (2nd ed.). New York: Teachers College Press.
Dalton, D. W. (1989). Computers in the schools: A diffusion/adoption perspective. Educational Technology, 29(11), 20-27.
Davis, F. D. (1993). User acceptance of information technology: Systems characteristics, user perceptions and behavioral impacts. International Journal of Man-Machine Studies, 38(3), 475-487.
Drucker, P. F. (1969). *The age of discontinuity: Guidelines to our changing society.* New York: Harper Row.
Drucker, P. F. (1999). Beyond the information revolution. [48 paragraphs]. *The Atlantic Monthly* [On-line serial], *284*(4). Available: http://www.theatlantic.com/issues/99oct/9910drucker.htm
Gould, J. D., Boies, S. J., & Lewis, C. (1991). Making usable, useful, productivity-enhancing computer applications. Communications of the ACM, 34(1), 74-85.
Jonassen, D. H., Tessmer, M., & Hannum, W. H. (1999). *Task analysis for instructional design.* Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.
Kerr, S. T. (1996). Visions of sugarplums: Technology, education, and schools. In S. T. Kerr (Ed.), *Technology and the future of schooling: Ninety-fifth yearbook of the National Society for the Study of Education, Part II*, (pp. 127). Chicago: NSSE.
Lawler, C., Rossett, A., & Hoffman, R. (1998). Using supportive planning software to help teachers integrate technology into teaching. *Educational Technology, 38*(5), 29-34.
Leggett, W. P., & Persichitte, K. A. (1998). Blood, sweat, and TEARS: 50 years of technology implementation obstacles. *Techtrends, 43*(3), 33-39.
McKibben, B. (1992). *The age of missing information.* New York: Random House.
Mander, J. (1992). *In the absence of the sacred: The failure of technology and the survival of the indian nations.* San Francisco: Sierra Club Books.
Mitra, A., Steffensmeier, T., Lenzmeier, S., and Massoni, A. (1999). Changes in attitude toward computers and use of computers by university faculty. *Journal of Research on Computing in Education, 32*, (1).
Mumford, L. (1934). *Technics and civilization.* New York: Harcourt, Brace and Company.
Nickerson, R. S. (1981). Why interactive computer systems are sometimes not used by people who might benefit from them. *International Journal of Man-Machine Studies, 15*(4), 469-483.
Oppenheimer, T. (1997, July). The computer delusion. *The Atlantic Monthly, 280* (1), 45-62.
Pellegrino, J. W., & Altman, J. E. (1997). Information technology and teacher preparation: Some critical issues and illustrative solutions. *Peabody Journal of Education, 72(*1x), 89-121.
Postman, N. (1988). *Conscientious objections.* New York: Elisabeth Sifton Books.
Postman, N. (1996). *The end of education: Redefining the value of school.* New York: Knopf.
Rickard, W. (1999). Technology, education, and the changing nature of resistance. [22 paragraphs]. *Educom Review* [On-line serial], *34*(1). Available: http://www.educause.edu/ir/library/html/erm9915.html
Rogers, E. M. (1995). Diffusion of innovations (4th ed.). New York: The Free Press.
Sherwood, S. (1999). I hear, and I forget. I see, and I remember. I do, and I understand. *Learning & Leading with Technology, 27*(3), 28-31.
Spitzer, D. (1980). Try fault tree analysis, a step-by-step way to improve organization development. *Training, 17*(2), 58, 64, 68-69.
Spotts, T. H., & Bowman, M. A. (March-April, 1995). Faculty use of instructional technologies in higher education. *Educational Technology, 35*(2), 56-64.
Stephens, K. G. (1972). *A fault tree approach to analysis of educational systems as demonstrated in vocational education.* Unpublished doctoral dissertation, University of Washington.
Van Den Akker, J., Keursen, P., & Plomp, Tj. (1991). The integration of computer use in education. *International Journal of Educational Research, 17,* 65-76.
Walsh, J. P. (1993). The social context of technological change: The case of the retail food industry. *The Sociological Quarterly, 32*(3), 447-468.
Walsh, J. P., & Bayma, T. (1996). Computer networks and scientific work. *Social Studies of Science, 26*(3), 661-703.
Winner, L. (1998). Technology as "big magic" [Special feature: T & S interview with Langdon Winner]. *IEEE Technology and Society Magazine, 17*(3), 4-16.
Winner, L. (1999). Building the basics [Special feature: Interview with Langdon Winner]. January/February 1999, [44 paragraphs]. *Educom Review* [On-line serial], 34(1). Available: http://www.educause.edu/ir/library/html/erm9910.html
Wood, R. K., Stephens, K. G., & Barker, B. O. (1979). Fault Tree Analysis: An emerging methodology for instructional science. *Instructional Science*, 8, 1-22.
Zemke, R., & Kremlinger, T. (1982). *Figuring things out: A trainer's guide to needs and task analysis.* Reading, MA: Addison-Wesley Publishing.

Changing Interaction Paradigms in Annotation Environments

Christian M. Adriano, Alberto B. Raposo, Ivan L. M. Ricarte, Léo P. Magalhães
Department of Computer Engineering and Industrial Automation (DCA)
School of Electrical and Computer Engineering (FEEC)
State University of Campinas (Unicamp) – Brazil
{medeiros, alberto, ricarte, leopini}@dca.fee.unicamp.br

Abstract: Implementation of novel learning scenarios frequently implies the adoption of new interaction paradigms provided by new media. Changes on media bring several issues to educational metaphors, such as deciding which characteristics should be maintained, removed and improved. This paper discusses these issues by means of a case study comparing evolving scenarios for the annotation metaphor: from paper-based to hypertext and virtual reality.

Introduction

The design of innovative educational environments involves providing novel learning scenarios, which most of the time requires the support of new interaction paradigms. We start from the aspect stated by the following hypothesis: changes on the medium enable the introduction of new interaction paradigms and further opportunities to improve educational metaphors.

By using "metaphor" we mean the transposition of the meaning of one thing to a different one. For instance, the "text metaphor" supposes a place with visual information (words, graphs, etc.). "Paradigm" is understood as a model for relationships among metaphors and rules responsible to turn them into concrete entities. In other words, a metaphor implies a model (paradigm) and a paradigm is not easily grasped without metaphors (Winograd 98). Metaphors and paradigms exist only over a medium that provides perceivable features. In parallel, media inexorably affect the corresponding interaction paradigm, because each medium is identified by a proper set of rules, which defines possible paradigms. In the case of hypertext paradigm the decisive importance of media in defining the corresponding paradigms is shown. This paradigm was described by Vannevar Bush (Bush 45) to be implemented on microfilm medium, but it really succeeded when a more adequate medium was adopted (the digital text).

Therefore, the adoption of new media requires a careful study of how they affect the current paradigm. A second problem is then stated: how to deal with metaphors in consequence of changes on paradigms and media? Which characteristics should be maintained, eliminated and improved in the new implementation of the metaphor?

The first difficulty is the different features of source and target media, causing trouble to see beyond well-known metaphors and use all the functionality of the target medium (Halasz & Moran 82). For example, considering a word processor as a typewriter would not make it clear that there could be facilities such as "copy" and "paste". This problem is particularly serious in the shift of computer applications towards a 3D paradigm, because we tend to use 2D desktop-like metaphors of current systems to guide the development of 3D interactive environments. In order to decide on features that must be supported by new metaphors, a careful study of how media affect new interaction paradigms is necessary.

The next section presents a discussion about different interaction paradigms within daily practices. These ideas are then analyzed by means of a case study on different scenarios for the annotation metaphor. This metaphor usually appears in text-based educational environments (Adriano et al. 99, Davis & Huttenlocher 98, Harger 96), but it lacks appreciation for some new media, like 3D virtual environments.

Interaction Paradigm Ruptures

The rupture of interaction paradigms has been a recurrent fact throughout the history of many artifacts for knowledge transmission. A good example was the advent of the medieval *codex* (sewn paper pages, not much different from the current books), substituting the parchment of antiquity. Among the consequences of this change, there was the possibility for readers to work simultaneously with several books and make annotations on them. Such facility was not feasible with the parchment because readers had to use both hands to keep it opened (Chartier 97). Even though soundly benefic, some historical changes were not immediate and a lot of years are needed to overcome the natural resistance to the new interaction paradigm. Thus, in order to minimize resistance and provide adequate paradigms for new media, it is necessary to understand how current metaphors are affected.

In search for paradigm ruptures within daily practices, Michel de Certeau, in an anthropological study (Certeau 90), identified the following ruptures in modes of describing places: place *vs.* space, map *vs.* trail, frontier *vs.* bridge. These ruptures obey the following patterns: from personal to unpersonal, from biased to unbiased, from transient to permanent and from static to dynamic. These patterns distinguish different uses for the narrative metaphor. The word metaphor (from the greek *metaphorai*) denote "public means of transportation", which is the sense applied to the narrative and annotation metaphors. The former conveys the speaker to the described places, while the latter helps the reader move among cores of ideas in a text.

According to Certeau, a *place* is a referential, static, and permanent organization of things. On the other hand, a *space* is perceived when vectors of direction, velocity and time are used. The "city *place*", for example, is composed of streets, parks and buildings, while the "city *space*" involves the circulation of people and a sum of every citizen's instantaneous impressions. Similarly, the "text *place*" is the stylistic design of paragraphs, phrases and figures. The "text *space*" is the interaction with the written word, like annotating, discussing and summarizing. A similar analysis, but with interchanged terminology, was made by (Harrison & Dourish 96). According to them, a place is a space with some additional features, like social meaning and cultural knowledge about individual roles.

The distinction between *trail* and *map* stems from narratives of *space* and *place*. *Trail* was the prevailing paradigm in medieval descriptions of geographic extensions, which involved cities where to visit, stop, rest and pray. Nowadays, the *map* paradigm prevails, describing regions by global landmarks like meridians, names of cities, roads, etc. Annotations on paper compose a total and reduced vision of a commented text, which corresponds to the *map* paradigm. The *trail* paradigm imposes the traverse of links in order to obtain an annotation.

Narratives of region demarcations inhabit the paradigms of *frontier* and *bridge*. A region is a meeting of actions and there are as many regions as the number of possible inter-actions. The *frontier* delimits the static division among parts, like geographic references (rivers and mountains). The *bridge* separates by the opportunity of interacting or crossing, like the narrative of Columbus' navigation to the Antilles. As with the case of hyperlinks in a hypertext, an annotation-place is a *bridge* between two regions, the annotation and the text. On the other hand, annotations on paper are ruled by the *frontier* paradigm.

The ideas of Certeau seem very appropriate to guide our case study about changing interaction paradigms for the annotation metaphor, which is the topic of the following section.

Case Study: Annotation Metaphor

Annotations are contents appended to a text; they have well-defined boundaries and are resultant of some cognitive effort. Removing an annotation inflicts no damage to the corresponding text. Annotation-places are responsible to structure groupings of annotations, provide contexts and define interaction paradigms. Annotation-places are also superstructures holding relevant metadata about annotations.

The learning scenarios for this case study were built in CALM (Computer Aided Learning Material) (Adriano et al. 99), a recommender-like system developed at the University of Campinas.

Text-Based Annotations

A learning scenario in CALM starts with a student selecting learning goals. A learning goal is a set of subjects of interest, which are mapped to topics recommended by the system. The student sets a specific goal by choosing one topic to accomplish. The learning goal is accomplished by doing delivered study units. A study unit is composed of a topic, a list of related topics, some tests and exercises, which are defined according to the student's learning goal and a history of previous interactions.

Annotations are made during the study unit. In the context of a study unit, three interactive learning scenarios based on annotations were investigated: *commenting*, *authoring* and *discussing*. The first one corresponds to annotating to raise a doubt or include a link to another point in the material. In this scenario, the underlying text being annotated is self-contained with respect to the specific objective it intends to accomplish. Therefore, the original text is not modified. Two annotation-places support this scenario: *bridge* and *in-line* (Fig. 1), a and c, respectively.

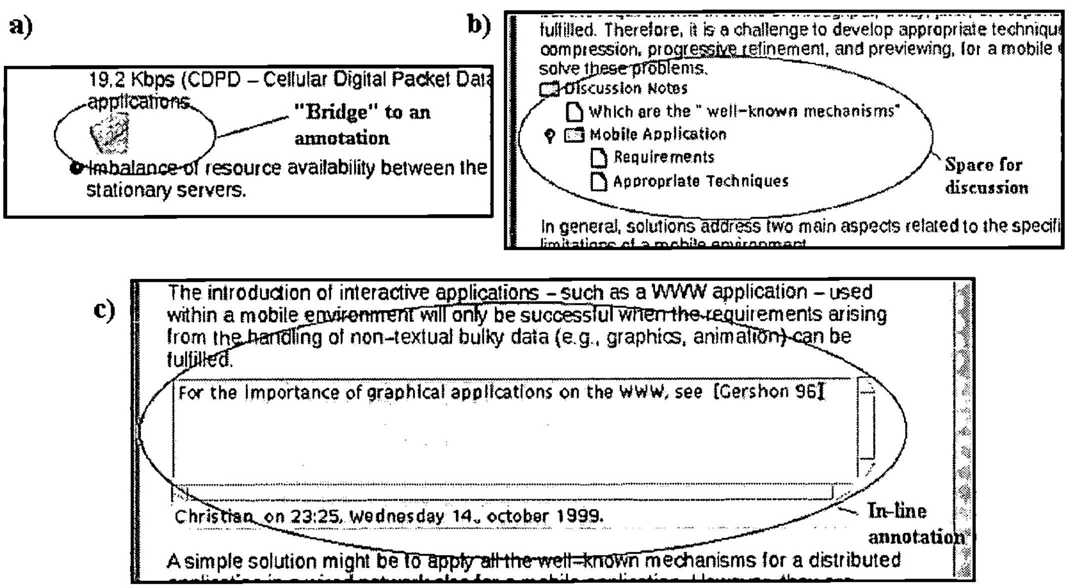


Figure 1: Three annotation scenarios in CALM.

Annotations on paper use the *frontier* paradigm that distinguishes annotations by a colored pen or a handwriting style. The *bridge* paradigm cannot be established over paper medium. The *frontier* paradigm is adopted in the digital text by means of the *in-line* annotation-place (Fig. 1), c. Shifts between these paradigms depend on the necessity to reduce the stylistic pollution (excess of annotations) or to undermine the difficulty of navigation (excess of links). This scenario demonstrates the necessity to modify features of a metaphor according to media changes.

The second scenario is the collaborative authoring by means of *in-line* annotations. This scenario requires a total vision of the work (the vision of author). Insofar, it is paramount not to miss the distinction between what is annotation and what is text. The association of two paradigms, *frontier* and *map*, obtains the desired vision. These paradigms support an appropriate annotation-place that not only provides version and date information, but also displays the annotation contents within the commented text. The *frontier* paradigm displays the annotation distinguished from the text contents and the *map* paradigm organizes the annotations under an authoring vision. Since text on paper already supports both paradigms, this scenario demonstrates the necessity to maintain features of a metaphor when changing the medium.

The third scenario comprehends the discussion by means of annotations (Fig. 1), b. A newsgroup-like annotation-place was implemented to organize the annotations hierarchically. The text is the motivation of discussion and it must not be modified. Therefore, this new accomplishment of the annotation metaphor could not be done over the hypertext paradigm that would mean inserting hyperlinks in the text. The annotation-place for discussion permits the insertion of annotations without modifying the text. This annotation-place shares the paradigm of *trail* with the hypertext, but they diverge with respect to the paradigms of *place* and *space*. A "*space* of discussion" is necessarily dynamic, while the non-modifiable hypertext defines only a *place* (static). This is an example of an innovation in consequence of changing the medium, since the paper medium cannot support such scenario.

Virtual Reality Annotations

A motivation for the shift towards a 3D paradigm would be the need to introduce more appropriate and novel interaction among metaphors in a learning situation. For learning situations in which interaction is greatly based on real objects, a text based-scenario becomes too cumbersome, due to highly descriptive narratives of positions, appearance and movement. Virtual reality based learning can bring convenient interaction and visualization features (McLellan 96).

Moving the annotation to a 3D environment would impose at first a creation of a 3D metaphor for the annotation-place. Which are then the implications of having the annotation-place as a 3D metaphor?

As in the case of text-based annotations, it is necessary to investigate how the 3D spatial notion affects interaction paradigms in order to decide about features of annotation metaphors. The ideas of Certeau were also shown to be an appropriate strategy to define interaction paradigms in 3D environments (Jensen 99).

The implemented learning scenario is a virtual reality model based on VRML (VRML 97), combining a 3D paradigm with the world metaphor. The consequences to the annotation metaphor and the annotation-place are numerous. First, annotation-places are connected to objects that provide richer context to the annotations. For example, a grocery shopping list will probably be placed on the refrigerator door or on some other agreed place in the kitchen. Second, relations between annotation-places can be drawn more easily, based on the objects they are attached. Third, the expected readers of the annotations can be selected by these different relationships. For example, a virtual classroom may have an annotation place on the entrance door, available to every one at school, a group-available annotation-place on the blackboard, and also a private one on each student desk.

We implemented an illustrative prototype of an annotation-place located on a refrigerator door. Such place enables addition, removal and edition of annotations that are located all over the door. When moving the mouse over an annotation, its author name, date and keywords are displayed. A click on annotation displays its content in an editable dialog (Fig. 2).

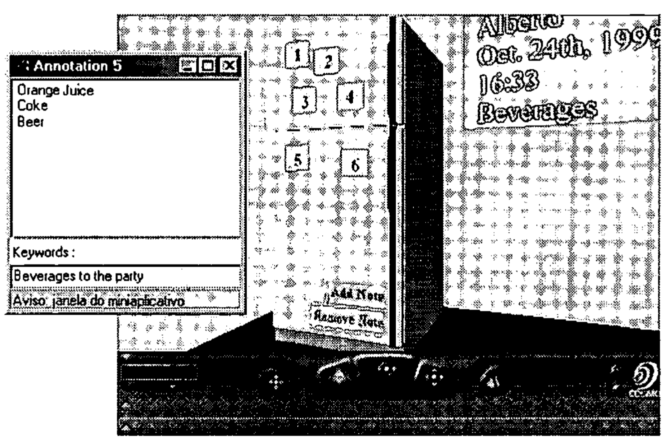


Figure 2: VR-based annotations.

The implemented 3D-annotation environment corresponds to the commenting scenario discussed in the previous section. Regarding the paradigm ruptures described by Certeau, the 3D annotation is dynamic in every aspect. It is considered a *space* due to the interaction opportunities for editing, removing or adding annotations. The paradigm of *bridge* is present in the links relating the post-it like object and the annotation contents. The *trail* paradigm was used because it is difficult to offer a total vision of textual information (*map*) in 3D environments.

Conclusions

Thinking of annotations as metaphors subjected to paradigms, and these latter as direct outcomes of adopting and combining media, is a complementary approach to investigate the effects of changing paradigms when designing interactive learning scenarios. Annotations on paper and the classic 3M post-its are well-proofed successful implementations of the annotation metaphor. Moving them to digital media is still a challenge that needs further understanding on how actors in an educational environment perceive spaces and places for annotation. Corroborating these ideas, there is some work investigating effects of interfaces for annotation (Wohjan et al. 98), student learning improvement by use of annotations (Armel & Shrock 96), and architectures for annotate-capable documents (Phelps & Wilensky 97).

The 3D prototype was an interesting experience and opened the possibility for innovative uses of annotation-places such as: audio and video annotations, 3D annotation-places for authoring and discussion, and annotation-places defining a specific text format (e.g., via XML - Extensible Markup Language with an appropriate style definition).

The study of paradigm ruptures can also be applied to other educational metaphors, such as interface agents, user avatars, 3D spatial notion, etc. When interaction paradigms for certain metaphors become clear to designers of educational environments, new media will be better used and the risk of rejection to changes will be reduced. Therefore, it will be given a further step towards the definition of a more general paradigm to be used in the transmission and manipulation of knowledge in the digital era.

References

Adriano, C.M. *et al.* (1999). Inquiring the Course Paradigm with CALM. *International Conference on Engineering and Computer Education (ICECE), 1999*, 265-269.

Armel, D. & Shrock, S.A. (1996). The Effects of Required and Optional Computer-Based Note Taking on Achievement and Instructional Completion Time. *Journal of Educational Computing Research*, 14 (4), 329-344.

Bush, V. (1945). As We May Think. *Atlantic Monthly*. Also available at <http://www.aldus.unipr.it/tbd/bush.htm>.

de Certeau, M. (1990). *L'invention du Quotidien – 1a. arts de faire*. Éditions Gallimard.

Chartier, R. (1997). *Le Livre en Révolutions*. Les Editions Textuel.

Davis, J.R. & Huttenlocher, D.P. (1998). *Shared Annotations for Cooperative Learning*. Available at <http://dri.cornell.edu/ pub/davis/annotation.html>.

Halasz, F. & Moran, T.P. (1982). Analogy considered harmful. *Conference on Human Factors in Computer Systems (CHI), 1982*, Association for Computing Machinery, 383-386.

Harger, R.O. (1996). Teaching in a Computer Classroom with a Hyperlinked, Interactive Book. *IEEE Transactions on Education*, 39 (3), 327-335.

Harrison, S. & Dourish, P. (1996). Re-Place-ing Space: The Roles of Place and Space in Collaborative Systems. *Conference on Computer Supported Cooperative Work (CSCW), 1996*, Association for Computing Machinery, 67-76.

Jensen, J.F. (1999). From “Flatland” to “Spaceland” – Spatial Representation, Enunciation and Interaction in 3D-Virtual Worlds. *WebNet Journal*, 1 (1), 44-57.

McLellan, H. (1996). Virtual Realities. In D. H. Jonassen (Ed.), *Handbook of Research for Educational Communications and Technology* (pp. 457-487). Simon & Schuster Macmillan.

Phelps, T.A. & Wilensky, R. (1997). Multivalent Annotations. *Lecture Notes on Computer Science 1324* (pp. 287-303). Springer-Verlag.

VRML Consortium (1997). *The Virtual Reality Modeling Language Specification*. International Standard ISO/IEC DIS 14772-1.

Winograd, T. (1998). *The Stanford HCI Design Learning Space: Metaphor*. Available at <http://hci.stanford.edu/hcils/concepts/metaphor.html>.

Wohjan, P., Neuwirth, C.M. & Bullock, B. (1998). Effects of Interfaces for Annotation on Communication in a Collaborative Task. *Conference on Human Factors in Computer Systems (CHI), 1998*, Association for Computing Machinery, 456-463.

Acknowledgements

The first two authors are sponsored by FAPESP (Foundation for Research Support of the State of São Paulo), processes number 98/00083-1 and 96/06288-9. The authors also would like to thank the FEEC – Unicamp for the expressive support granted to this research.

Design of Educational Multimedia
A Review of Literature

Ahmed Al-Hunaiyyan*, Jill Hewitt**, Sara Jones***
University of Hertfordshire
Faculty of Engineering and Information Sciences- Computer Science Dept.
College Lane, Hatfield, Hertfordshire. AL10 9AB, UK.
Tel.: 00441(707)284321 Fax: 00441(707)284303
Emails: * a.al-hunaiyyan@herts.ac.uk, ** J.a.hewitt@herts.ac.uk
*** s.jones@herts.ac.uk

David Messer
University of Hertfordshire
Faculty of Human Sciences- Psychology Department
College Lane, Hatfield, Hertfordshire. AL10 9AB, UK
Tel.: 00441(707)284622 Fax: 00441(707)285073
Email: d.j.messer@herts.ac.uk

Abstract: The transition from text-based computer systems with a narrow band of interactivity, to multimedia systems with much broader potential for interaction, has urged designers to consider human-factor issues to increase usability. In terms of machine intelligence, multimedia technology is no different from earlier text-based systems. But in terms of human use, there is a strong need for the development of guidelines in designing those systems and more research is required in this field. This section starts by highlighting some multimedia design issues such as design layers, navigation, interactivity, and user control, then the researcher describes three categories of multimedia design, which are: learning design, interface design, and screen design. The summary highlights important issues for consideration by multimedia designers, pitfalls to be avoided, and areas where more research is needed.

1. Introduction

The advent of interactive multimedia has resulted in a greater consideration of presentation and interaction styles and methods (Ring and Ring, 1997). The design of multimedia learning environments may be considered in two broad design layers: the conceptual design layer and the presentation design layer. The conceptual design layer deals with the structural organisation of the learning environment and involves creating the deep learning architecture of the system, the presentation design layer however, deals with the realisation of the system as a computer based artefact. In presentation design, the abstractions of conceptual design are mapped onto a real multimedia environment (Boyle, 1997).

Since interactive multimedia uses a variety of media and sophisticated interactions via several sensory channels, and taking into account the fact that learner's brain has limited capabilities, it can easily be overloaded with information, Ring and Ring emphasise that designers of interactive multimedia must understand the memory limitations of the learners and should think about how to create meaningful environments that require minimal effort to learn and remember (Ring and Ring, 1997). As users have different types of language, background, values, and traditions, each needs to work at different paces and in different styles. Vossen states that effective multimedia design requires the involvement of a systematic and comprehensive approach to analyse the context of use which includes modelling all the components and aspects such as the user, task, and setting. He identifies four elements of multimedia design: content, structure, access, and style (Vossen et al, 1997).

2. Design for Interaction

The major difference between traditional instruction and instruction delivered by multimedia is interaction (Schwier and Misanchuk, 1993). Good design of interactive multimedia is measured by interactivity which makes the application more useful. The powerful feature of multimedia is that it allows individual learners to be active participants in the multimedia application, by enabling them to interact with, and control the flow of information within the application. Hannafin emphasises that it is important to design as much meaningful interactivity as possible into a multimedia application (Hannafin, 1989). McAteer and Shaw see that the well designed human-computer interface prompts the user to explore and learn (McAteer and Shaw, 1995).

Gillham and Buckner identify interactivity as a term that implies an existing involvement in the way the information is presented and retrieved (Gillham and Buckner, 1997). Deegan states that multimedia systems are generally designed to be interactive in that they allow users to interrogate the programme in a linear and non-linear way (Deegan et al, 1996). Some useful guidelines which are believed to promote learner's interactivity are provided by (Poncelet and Proctor, 1993).

3. Design for User Control

Multimedia designers are concerned with user control which is believed to be a central topic to the design of interactive instruction, it includes the aspects of interface and instructional design (Stoney and Wild, 1997). McKerlie and Preece state that learner control takes three forms: control over the structure, control over the media, and control over the working environment (McKerlie and Preece, 1993). It is suggested to put control in the hand of the user to enhance learning, Laurillard believes that learners should be given more control over the content by providing the ability to navigate through the multimedia application at their own pace (Laurillard, 1987). In addition, McAtecr and Shaw advise designers to put as much control of the package as possible in the hands of the user, so they can proceed at their own pace, but they point out that this control should be at a certain point (McAteer and Shaw, 1995). Merideth and Richards indicate as a result of their study that multimedia positively impact students' learning by giving the learners control over the learning materials and by supporting their higher order thinking skills (Merideth and Richards, 1997).

4. Design of Educational Multimedia

The following is a description of the three categories of the design of educational multimedia. Theses are: learning design, interface design, and screen design.

4.1 Learning Design

As multimedia resources add pedagogical value to the learning materials, the instructional design has a significant impact on the quality of learning. Hedberg suggests that consideration must be given to the cognitive load placed on the user if designers want the user to access the information effectively and efficiently. He believes that improvement in learning outcomes can be supported by allowing learners to focus on metacognitive processes as a component support incorporated within the interface (Hedberg et al, 1994). Harasim argues that the use of new technology does not improve educational outcomes by itself. She sees the need to focus on new designs for learning as well as new ways to design the technological environments that can support learners' cognitive process (Harasim, 1995).

Edward states that computer based learning (CBL) has a long history from the early text based to today's virtual reality multimedia offering. He believes that the majority of multimedia learning packages are concerned with teaching and testing the acquisition of large scale factual information. He suggests the need for designing multimedia learning packages that facilitate conceptual understanding approaches (Edwards, 1997). Kennedy claims that many educators think that interactive multimedia learning programmes have failed to deliver their promised potential, he refers to the use of an inappropriate design model for computer assisted learning (CAL) and hypermedia. He sees that these instructional design models, are developed from the assumptions that underlie the behavioural/objectivist pedagogy of teaching and learning (Kennedy, 1995).

Suni and Ross argue that instructional design is a systematic process for creating learning and instructional principles, and combine them into instructional materials (Suni and Ross, 1997). This argument is supported by Boyle who sees three stages of instructional development: needs analysis, selection of instructional methods and materials, and evaluation (Boyle, 1997).

Fortunately hypertext and hypermedia authoring packages allow designers of multimedia courseware to design the learning materials in a structured and unstructured way, and allow them to design the programme giving greater flexibility for the learners to structure the learning environment to suit their own learning needs, benefited from the non-linearity of the programme (Stanton and Stammers, 1989). In this regard, Jonassen believes that there is a benefit of hypertext in which it permits text presentation to be locally modified by the learners in order to meet their individual needs (Jonassen, 1986).

A classifications of instructional design models can help in deciding on an appropriate multimedia design to achieve the educational objectives for any specified course. Developers must understand and distinguish between various learning and instructional strategies. Boyle discusses two approaches to the design of computer based learning environments: traditional instructional design and constructivism. He believes that the traditional instructional design has been criticised. He sees constructivism as a dominant paradigm in educational multimedia design, it has a much stronger base in the psychology of learning and cognitive development (Boyle, 1997).

Midoro warns educators against creating multimedia systems for doing old tasks. He suggests the use such systems to open up new possibilities. He urges researchers to fully exploit the multimedia features to enhance the teaching and the learning practices (Midoro, 1993). Compagnoni and Ehrlich conclude in their study two significant issues. The first one is that individuals with better visualisation skills were faster in accessing information in hypertext learning systems compared to those with poorer visualisation skills. The second one is that, hypertext seems to cause learning by browsing, which is a better strategy compared to the use of predetermined menus (Compagnoni and Ehrlich, 1989).

Montgomery identifies four characteristics which seem to contribute to the success of any multimedia courseware package. These are engaging the learner, the ability to provide immediate access to information, the ability to provide alternative explanations or examples, finally a practice to provide practical opportunities for skill development (Montgomery et al, 1993). Authoring packages allow the use of multimedia components such as sound, graphics, and moving images which provide a powerful opportunity. McAteer and Shaw however, warn that authors might be seduced into focusing on the impressive technology and losing sight of engaging, informing and educating the students (McAteer and Shaw, 1995).

4.2 Interface Design

A multimedia learning package is meaningless if there is no means to navigate through it or experience it. User interface design as described by Lisa Lopuck "is the process of ergonomically and strategically presenting media in order to communicate a message" (Lopuck, 1996). The emergence of interactive multimedia has raised several new issues in interface design. Ring and Ring emphasise that interfaces of interactive multimedia products should be aesthetically pleasing, and should offer the learner sophisticated interactions insuring the ease of use. They state that good interface design makes use of a variety of functions and visual entities to enhance both interactivity and appearance. They argue that the goal of the interface is to facilitate interaction and to make the organisational structure and content visible (Ring and Ring, 1997).

Davies stresses that designers should create a conceptual model "which is the overall view of the system, or part of the system, as conceptualised by the designer". Also they should create a mental model "which is how users actually view the system which will vary with the level and experience of the user". The reason for the creation of conceptual and mental models is to make the interaction as comfortable and efficient as possible (Davies et al, 1994). The goal of the mental model is "to create an environment that facilitates the mapping of the designers model onto the user model" (Ring and Ring, 1997). If users can easily build mental models of multimedia computer assisted learning environments they will perceive the systems as *user friendly* and easy to learn. If the models are too complex, the system will be perceived as confusing and unfriendly. The mental model should not focus on what the computer is doing, but rather on what is going on in the context, objects, and other representations (Calvi, 1997).

Designers of multimedia learning programmes should help users to develop an appropriate conceptual model by providing them with a familiar, clear, and consistent metaphor that represents the way the system actually works and behaves. There is now general agreement that consistency enhances usability (Waterworth, 1992). Some common metaphors are "office", "book", "encyclopaedia", "tutorial", "discovery", "exploration", etc. The desktop metaphor is used at the top level of the application, and it should be enhanced with application-specific actions or replaced with other appropriate real-world metaphors. After an application is opened, it should use a real-world metaphor appropriate to its functions. For example, in an inventory application, displays might reflect the actual equipment they represent, and equipment could be placed or removed from locations which look like shelves and slots.

The issue of users being disoriented *"getting lost in the hypermedia/multimedia application"* has been a concern. Conklin warns interface designers from the disorientation problems which may get the user lost in the program, or may make the user not sure where he/she is in relation to other parts of the program network (Conklin, 1987). However, Mayes sees that the disadvantage of disorientation may be an advantage for the learner in some type of exploratory learning. The problem may not be whether a map can be found but how a map can be created by the learner (Mayes et al, 1990). Calvi believes that getting lost in the hyperspace is not only about multimedia or hypermedia systems, she sees that printed text books do entail a certain degree of disorientation (Calvi, 1997).

In addition, Riley believes that there is a risk that learners will lose their bearings and be "lost in the hyperspace". He suggests that designers should provide sufficient navigational aids for users to navigate a program with ease (Riley, 1995). However, some research indicates that designing multimedia and hypermedia with complete user control leads to a deeper level of understanding (Suni and Ross, 1997). Elliott sees a great weakness in the use of hypermedia applications which lies in the degree of learners' control, he suggests that to give direction when a user engages with the application can overcome this weakness (Elliott et al, 1995). Further guidelines on learner control are given by (Orr et al., 1994).

One of the most common ways of identifying or accessing information in a multimedia programme is by navigating its interface. By creating a motivating style for interaction control and access, learners may quickly learn where to look in the programme to interact with the interface. Calvin believes that an easy navigation depends upon learners' ability to abstract the application and its display in order to build a conceptual representation of its architecture (Calvin, 1997). Search suggests the need to develop interfaces with orientation cues that help learners navigate through the multimedia applications (Search, 1993).

4.3 Screen Design

Good screen design attempts to impose a consistency on the layout of the screens of a multimedia program. Visual organisation of media in the application will undoubtedly influences the ease and quality of learning, and has an important impact on cognitive load (Stoney and Wild, 1997). McAteer and Shaw believe that consistency in screen design and visual organisation of media in the application influences the ease and quality of learning (McAteer and Shaw, 1995). Preece suggests that organising information in an easily accessible form can reduce the time taken to find a specific piece of information (Preece, 1990).

Screens include some visual parts and areas that should be associated with specific tasks such as titles or headings, information area, instruction area, navigation area, and feedback area. Hannafin and Hooper emphasise that designers should consider the visual aspects including the design and placement of text, graphics, and various navigational elements and keep the screen as simple and uncluttered as possible

(Hannafin and Hooper, 1989). Milheim and Lavix define some aspects of screen design which include the location of various components on each screen, and the consistency of those locations throughout the multimedia programme (Milheim and Lavix, 1992).

The importance of screen design has been emphasised by many researchers. Mukherjee and Edmonds stress that screen design is becoming a very important issue when developing multimedia learning materials in many different content areas. They introduce a broadened definition of screen design which includes the co-ordination of textual and graphical elements to easily present the content of the learning materials to learners (Mukherjee and Edmonds, 1993). Milheim and Lavix believe that if an instructional screen in a multimedia application provides effective instruction, visual aesthetics, and appropriate navigational tools, it will undoubtedly allow for maximum learning from the materials whilst providing the learner with adequate control of the learning process (Milheim and Lavix, 1992). Hannafin and Hooper stress that screen design should assist the user to easily facilitate the process of accessing the information providing the user with cognitive benefits to perceive, organise, and integrate information (Hannafin and Hooper, 1989).

The proper use of colours is a very important issue for multimedia design, and they should be considered carefully. Boyle states that the aim of the use of appropriate colours is to insure an effective and pleasing visual display (Boyle, 1997). Durrett and Stimmel indicate that the excessive use of colours may have a negative effect on learning (Durrett, Stimmel, 1987). Whilst the use of certain colour combinations can lead to a complete lack of perception (McAteer, Shaw, 1995). Some authors (Milheim and Lavix, 1992; Orr et al., 1994) provided some guidelines for using colours.

In summary, good screen design can fulfil the following requirements: (1) focus learners' attention, (2) develop and maintain interest, (3) promote processing, (4) promote engagement between the learner and the lesson content, (5) help learners find and organise information, and (6) facilitate lesson navigation (Hannafin and Hooper, 1989; Mukherjee and Edmonds, 1993).

5. Summary

5.1 Designer Considerations

- Create a meaningful environment that requires minimal effort, by modelling all the components and aspects (user, task, and educational environment).
- *Constructivism* is better than the traditional design in which it considers the student as a main participant in the knowledge system, through interacting with a given situation.
- Designers should create conceptual and mental models by providing learners with familiar metaphors which represent the way the system actually works and behaves.
- Screens should be designed with consistency and with visual organisation of text, graphics, and various navigational elements.
- Simplicity of the design influences the ease and quality of learning and has an important impact on learners' cognitive load.

5.1 Pitfalls for Designing Educational Multimedia

- Design for complete user control can lead to disorientation.
- The use of an inappropriate design models may mean that the program will fail to deliver the promised potential of multimedia.
- The impressive technology of multimedia may lead designers to lose sight of engaging, informing, and educating the students.
- Current authoring packages provide templates which help designers in laying out the screen in a matter of minutes, but they do not necessarily guard against bad design.

5.3 Further Studies

There is a need to carry out controlled studies to establish the effectiveness of user control paradigms (total control V, guided navigation) and instructional design models. To date little work has been done to analyse the effects of educational setting, environment, and learner culture on multimedia design. The authors' studies highlight the importance of cultural issues in the effectiveness of the design of multimedia learning materials. In addition, a new focus is needed on design for learning in the new technological environment, for example using virtual reality in learning. More research is needed on how to upgrade design guidelines into authoring packages.

References

Boyle, Tom. (1997). *Design for Multimedia Learning.* Prentice Hall Europe. Printed in GB.

Calvi, Licia. ((1997). Navigation and disorientation: A Case Study. *Journal of Educational Multimedia and Hypermedia.* Vol. 6, No. (3/4), P(305-320). AACE.

Compagnoni, F. R. & Ehrlich, K. (1989). Information retrieval using a hypertext-based help system. *ACM Transactions of Office Information Systems*, 7(3), 271-291.

Conklin, J. A survey of Hypertext. *MCC Technical Report.* No. STP-356-86, Rev.2.

Davies, Peter; Brailsford, Tim; McCracken, Richard; Rickard, Stephen. (1994). New Frontiers of Learning: Guidelines for Multimedia Courseware Developers in Higher Education. volume 1. ITTI. University of Nottingham.

Deegan, Marilyn; Lee, Stuart; Timbrell, Nicola. (1996.) *An Introduction to Multimedia for Academic Use.* ITTI, University of Oxford.

Edwards, Norrie., (1997). Development of a cost effective computer assisted learning (CAL) package to facilitate conceptual understanding. In: CAL 97: *Proceeding of the International Conference at University of Exeter,* 23-26 March.

Elliott, G. J., Jones, Eleri., Cooke, A., Barker, P., (1995). Making sense: A Review Of Hypermedia In Higher Education. In: Proccedings of ED-MEDIA 95, *World Conference on Educational Multimedia and Hypermedia.* Assoc. Of Advancement of Computers in Education AACE. 17-21 June, Graz, Australia.

Gillham, Mark; Buckner, Kathy, (1997). User Evaluation of Hypermedia Encyclopedias. *Journal of Educational Multimedia and Hypermedia.* Vol. 6, No. (1), P(77-90). AACE.

Hannafin, M. J. and Hooper, S. (1989). An integrated framework for CBI screen design and layout. *Computers in Human Behaviour.* Vol 5(3). P. 155-165.

Hannafin, M. J. (1989). Interaction Strategies and emerging instructional technologies: Psychological perspectives. *Canadian Journal of Educations Communication.* Vol 18 (3), P. 167-179.

Harasim, Linda. (1995). The virtual University: New Approaches to Higher Education in the 21st Century. In Proceedings of ASCILITE95: *Australian Society for Computers in Learning In Tertiary Education Conference.* Dec. 3-7. Melbourne, Australia.

Hedberg, John; Harper, Banry; Brown, Christine; Corderoy, Robert. (1994). Exploring User Interfaces to improve learning outcomes. In: K. Beattie, C. Mc Naught and S. Wills (Editors). *Interactive Multimedia in University Education. Designing for Change in Teaching and Learning.* In Proceedings of the IFIP TC3/WG 3.2 Working Conference on the Design, Implementation and Evaluation of Interactive Multimedia in University Setting, Melbourne, Victoria, Australia, 6-8 July.

Jonassen, D. H. (1986). Hypertext principles for text and courseware design. *Educational Psychologist*, 21(4), 269-292.

Kennedy, David. (1995). Students' prior knowledge: a pragmatic constructivist view of instructional design of interactive multimedia. In Proceedings of ASCILITE95: *Australian Society for Computers in Learning In Tertiary Education Conference* . Dec. 3-7. Melbourne, Australia.

Laurillard, D. (1987). Computers and emancipation of students: Giving control to the learner. *Instructional Science.* Vol 16(1), P. 3-18.

Lopuck, Lisa. (1996). *Designing Multimedia: A Visual Guide To Multimedia And Online Graphic Design.* Peachpit Press. USA.

Mayes, Terry et al. (1989). Learning About Learning From Hypertext. In: *Designing hypermedia for learning:* Proceeding of the NATO Advanced Research Workshop on Designing hypertext/Hypermedia for learning held in Rohenburg/Neckar, FRG July 3-8. edited by David H. Jonassen, Heinz Mandl. Berlin: Springer, 1990.

McAteer, Erica and Shaw, Robin. (1995). *The Design of Multimedia Learning Programs.* ITTI, University of Glasgow.

Mckerlie, Diane and Preece, Jenny. (1993). The Hype and the Media: Issues Concerned with Designing Hypermedia. *Journal of Micro computer Applications* 16, PP 33-47.

Merideth, Eunice and Richards, Pamela. (1997). CD Repurposing to Focus the Multimedia Experiences for Health Education. *Journal of Educational Multimedia and Hypermedia,* Vol. 6, No. (2), P(221-230). AACE.

Midoro, Vittorio. (1993). What makes multimedia systems interesting for education. In: Hermann Maurer (Editor). *Educational Multimedia and Hypermedia Annual*, In Proceedings or Ed-MEDIA 93 World conference on Educational Multimedial and Hypermedia- Orlando, Florida, USA. June 23-26, 1993.

Milheim, C. L. and Lavix, C. (1992). *Screen design for computer-based training and interactive video: Practical suggestions and overall guidelines.* Performance & Instruction. Vol 31(5). P.13-21.

Montgomery Woods, L.; J. Durlak; P. Hoffert; J. G. Green. (1993). Towards a typology for effective machine mediated learning. Proceedings Multimedia Communications 93. *New direction in Multimedia Technology: how will they affect the way we work, learn, and communicate?* 23-24 Nov. University of British Columbia Continuing Studies. Vancouver. Canada.

Mukherjee, P. and Edmonds, G. S. (1993). *Screen design: A review of research.* (ERIC Document Reproduction Service No. ED 370 561).

Orr, K. L.; Golas, K. C.; Yao, K. (1994). Storyboard development for interactive multimedia training. *Journal of Interactive Instruction Development.* Winter, P. 18-31.

Poncelet, G. M. and Proctor, L. F. (1993). Design and Development Factors in The Production of Hypermedia-based Courseware. *Canadian Journal of educational Communication.* Vol. 22(2). P.91-111.

Preece, Jenny. (1990). A guide to Usability: Usability now! Open University, Dti. BPCC wheatons LTD, Exeter.

Riley, Fred. (1995). *Understanding it: Developing Multimedia courseware.* ITTI. University of Hull.

Ring, Geoff; Ring, Janette. (1997). Design Issues In Interactive Multimedia. *Proceeding of The International Conference On Computers in Education* (ICCE97). 2-6 December, Sarawak, Malysia. AACE. P. 762-770.

Schwier, R. A. and Misanchuk, E. R. (1993). *Interactive multimedia instruction.* Englewood Cliffs. NJ: Education Technology Publication.

Search, Patricia., (1993). HyperGlyphs: Using Design and Language to Define Hypermedia Navigation. *Journal of Educational Multimedia and Hypermedia,* Vol 2, No. (4), P(369-380). AACE.

Stanton, N. A. & Stammers, R. B. (1990). Comparison of structured and unstructured navigation throught a CBT package. *Computers and Education,* 15(1-3), 159-163.

Stoney, Sue; Wild, Martyn. (1997). Designing Interfaces For Instructional Multimedia with Motivatipn in Mind. *Proceeding of The International Conference On Computers in Education* (ICCE97). 2-6 December,. Sarawak, Malysia. AACE. P. 781-788.

Suni, Ian and Ross Susan. (1997). Iterative Design and Usability Assessment of a Materials Science Hypermedia Documents. *Journal of Educational Multimedia and Hypermedia,* Vol. 6, No. (2), P(188-199). AACE.

Vossen, P.; Maquire, M.; Graham, R.; Heim, J., (1997). *Design Guide for Multimedia.* 2nd Edition, Version 2.1. INUSE, European Usibility Support Centres.

Waterworth, John A., (1992). *Multimedia Interaction with Computers: human factors issues.* New York: Ellis Horwood.

Building Electronic Catalogs and Retail Storefronts: Enlivening the Electronic Commerce Course with Cooperative Learning-Based Projects

Rebecca Angeles
Montclair State University
Information & Decision Sciences Dept., School of Business
Upper Montclair, New Jersey, USA 07043
Angelesr@mail.montclair.edu

Dennis M. Adams
Montclair State University
Department of Reading and Educational Media, College of Education and Human Services
Upper Montclair, New Jersey, USA 07043
Adamsd@mail.montclair.edu

Abstract: This paper features a study on the use of electronic catalogs and retail storefronts as a concrete collaborative class project for the Electronic Commerce Course in the Business curriculum and a survey of the MBA students that undertook this project in response to the course requirements. The survey results provide positive indications for the achievement of the goals of collaborative inquiry, team-based and active learning, constructivist pedagogical approach, and learning by doing. The technical details of the project are also described in the study.

Introduction

The Internet is providing an extraordinary environment for designing teaching and learning experiences. This paper will focus on how the World Wide Web (WWW) could be utilized for teaching Electronic Commerce (E-Commerce) in Management Information Systems (MIS) program of the Business curriculum. The opening of the Internet to businesses in the early nineties initiated the E-Commerce phenomena that has not only revolutionized the conduct of business online but also overhauled the way E-Commerce-related business courses need to be taught. The unusual aspect of these courses is that the WWW is primarily the environment in which online establishments also conduct their business. This means students can actually simulate the conduct of business via the same environment where their learning takes place. Not only that---the instructional setting can also take advantage of web hosting services used to support online businesses to supplement if not entirely replace inadequate university information technology infrastructure that needs to undergird the activities of electronic merchants.

This paper reports the experiences of the MBA students at the School of Business, Montclair State University, in building electronic storefronts using Merchandizer software, which is a requirement in their Management Information Systems course that has an E-Commerce theme. Using the survey technique, student feedback was gathered from two MBA classes that took the course during the summer and fall 1999. Data was conducted to measure students' perceptions of the quality of their overall learning experience and their ability to gain collaborative team work skills, discipline-specific skills in building an electronic storefront and catalog, skills in using the Merchandizer software, and various forms of thinking skills.

The E-Commerce course could be taught by combining the pedagogical principles that surround a number of appropriate teaching strategies: cooperative learning, constructivist approach, active learning, and learning by doing. These strategies can be used to structure and coordinate electronic learning spaces. In a cooperative learning environment, the instructor organizes content and topical activities around tasks, problems, and projects that student teams with a balanced mix of abilities and backgrounds are designed to undertake (Adams and Hamm, 1996). Cooperative learning also provides valuable opportunities for students to work together across gender and ethnic lines as long as communication skills, prior achievement, expectations, friendships, and group status are factored in (Chizhik, 1999). A meta-analysis of university-level and adult-learning courses found that use of collaborative learning concepts promoted higher achievement, higher-level reasoning, more frequent generation of ideas and solutions, and greater transfer of learning than did individualistic or competitive learning strategies (Johnson et al., 1991). Team members' social skills, also called "interpersonal intelligence" according to Howard Gardner, encompassing interpersonal communication, task management, group interaction, and conflict resolution are constantly honed throughout the process.

The constructivist pedagogical approach invites students to build personal meanings out of the material taught and encourages them to reflect on how new knowledge builds on their previous base of understanding (Pankratius and Young, 1995). In a group setting, the constructivist approach could lead to the social creation of knowledge as a basis of learning.

"The yeast of knowledge, openness, and enterprise raises the need for a multiplicity of learning media and technological tools "(Adams and Hamm, 1996). The very wealth of Web site building tools that is now available allows students to experiment and "play" through "learning by doing" activities and significantly changes the whole instructional experience. Students have more control over the end product via the software tools and they assume greater responsibility over their learning process (Adams and Hamm, 1996). MIS instructors are strongly encouraged to move towards the "learning by doing" mode which is, by far, the most effective way of teaching students "how to" skills. While this is clear to most teachers, it is not easy to do unless certain prerequisites are in place: professional development, teacher preparation, technological infrastructure support (hardware, software, and helpline service), an appropriate incentive system that will reward the countless hours that will go into a more technologically-oriented class (as opposed to a traditional lecture-style one), and above all, an overarching plan that clearly defines the role of technology in the pedagogical process (Adams and Hamm, 1995).

Merchandizer Software Features

Students are asked to build an electronic retail storefront for either consumer-to-business or business-to-business commerce. What this means is that the store can sell a product that individual consumers may be interested in buying such as an Amazon.com for books or a CdNow.com for musical CD-ROMs. Or, the storefront could be an electronic catalog for firms interested in buying materials they need in running their business such as office supplies, for instance---staplers, bond paper, paper clips, etc.---in other words, these will be businesses buying from another business. The product used in the project is Merchandizer Software, which is an online solution that allows users to build and manage an electronic storefront with just a browser software such as Netscape Communicator or Microsoft Internet Explorer and an Internet connection which an Internet Service Provider (ISP) or web hosting service can provide for a fee. In designing the site, students could either enter all product information using a step-by-step wizard or they could work directly with hypertext markup language (HTML) forms to both make and modify their sites. In building the electronic catalog itself, students either enter information manually using the wizard templates or they may import extensive information using Microsoft Access database tables which are loaded onto the servers.

Merchandizer software makes use of frames or windows appearing within the browser's display area, each of which displays the contents of a different HTML file (Carey, 1998). The software also allows storebuilders to divide their product lines in a hierarchical fashion, first into groups, then, into subgroups, and finally, into catalog items. The group and subgroup headers become navigational links in one frame, displaying product pages or other HTML pages or entire web sites altogether created by the students. The frame concept facilitates the navigation of the customer through the storefront.

Once groups, subgroups, and catalog items have been defined, students enter product information either of two ways. They can enter the information using simple electronic forms that allow them to submit information like product name, code, description, and price. Alternatively, they could use preformatted Microsoft Access tables that essentially mimic the wizard online templates. These tables are more convenient to fill out when merchants have hundreds or even thousands of product items to enter. Since students are building only prototype stores with a limited product line, they end of using the forms, although the use of the Access table is demonstrated to them should they be interested in trying it.

Merchandizer has features like a search function that will allow hypothetical customers to search the storefront using any word or phrase related to the products on sale. Merchandizer also incorporates a shipping table for UPS directly into the software so that the students do not have to be concerned with this. They need to specify the appropriate sales tax, though. Merchandizer keeps track of all sales transactions, customers, and prospects (those who visit but do not buy). A report generating facility gives students information on the most saleable products, customers who buy most from the store, aggregate sales figures for the week or the month, and areas of interest of prospects, among other things. The software can also autogenerate email messages to prospects about special promotional activities the store is conducting.

Version 3.0 of Merchandizer offers students a wide range of features to play with to simulate a real online store even more realistically: easy translation of the web site into any language; ability to insert forms with special buying instructions before the shopper checks out; offer global coupon numbers to shoppers so that they can accumulate their purchases and eventually received discounts on items; ability to submit the store site to top search engines; more managerial report forms that can be generated from the sales transaction data; a personalization field for each catalog item for shopper input that will be carried over to the order tables; ease of uploading and downloading Access tables, among other more advanced features.

HipHip software, the company behind the Merchandizer storefront building tool, is also a web hosting service. A merchant that does not have networking facilities to support the store could subscribe to this service and pay a one-time setup fee and monthly maintenance fees that vary depending on the number of catalog items supported in the store. HipHip software offers educational pricing for universities interested in using their hosting services for the purpose of instruction. This arrangement is a boon for universities and colleges that do not have adequate information technology infrastructure to allow E-Commerce instructors to mount interesting student projects.

The web hosting service is important because of the backend office component of the online store. Sales transaction information submitted by customers and personal information keyed in by interested prospects who do not purchase during their visit to the store need to be stored in web servers so that the order could be processed and sales prospects could be reached through promotional email messages in the future. Backend office processing requires the availability of web servers that can store order transaction data in databases that can later be accessed using some form of structured query language so that reports and statistics could be generated for managerial decision making. The extensive requirements of the storefront make the storefront project too challenging for the normal capabilities of a typical university's academic technology support group. It is far better to sign up with the web hosting service---if reasonable fees could be negotiated with the company---and have their technical support staff provide the services neccssary for optimizing all functionalities and features of the storefront.

Methodology

This study used the survey technique using a written questionnaire, which was administered to two classes of the MIS 503, Management Information Systems course at the MBA level. Data was gathered during the Summer and Fall of 1999. Both classes had the theme of "Electronic Commerce" and the project assigned to the students was the construction of an online retail storefront for either consumer-to-business or business-to-business commerce. Students were assigned in teams of four to five students. Each team was in charge of a storefront web site, which was maintained and supported by HipHip Software. The technical support staff that advises the students and oversees the web servers that host the software and product information entered by the students is located in Miami, Florida. Survey data was analyzed using descriptive statistics, correlations, and simple regressions among key variables.

Findings

The sample size consists of 43 students in the MBA program of the School of Business, Montclair State University, who all took the INFO 503 class in Management Information Systems, with special emphasis on Electronic Commerce. The students were at various stages in the MBA program and majority of them hold full-time jobs in industry.

Students were asked to respond to a five-point Likert scale for different items where 1=Strongly disagree, 2=Disagree to some extent, 3=Uncertain, 4=Agree to some extent, and 5=Strongly agree. Most of the students felt that the retail storefront project was an important learning experience overall (mean=4.44). Students found the project instructive in terms of teaching them new ways of doing business over the World Wide Web (mean=4.35). They also thought that the project taught them skills they could use after the completion of the course, particularly the setting up of an online Web site for a product or service (mean=4.30). They also felt the project gave them a chance to create Web site content that was meaningful to the entire team (mean=4.30). In the construction of the storefront site, they thought that they learned the following specific skill sets in decreasing order of importance: design issues for creating an online catalog (mean=4.30); overall planning issues for preparing an online retail web site (mean=4.14); web site product information and content issues (mean=4.07); advertising (mean=3.84); and product/service promotional activities (mean=3.74).

The next important set of findings relate to the students' perceptions of how this project enhanced their ability to collaborate with peers in a team setting. Most students found the project a good venue for encouraging collaborative teamwork (mean=4.40). Communication skills were paramount in getting the work done (mean=4.33). While standards for personal accountability were set within the team setting (mean=4.30), members made sure they also helped each other out (mean=4.28). The project clearly taught the students a variety of group process skills: (a) looking out for the best interest of all concerned over and above one's own personal interests (mean=4.26); (b) arriving at mutually acceptable solutions (mean=4.26); (c) dividing the work equitably among members (mean=4.23); (d) practising interpersonal social skills (mean=4.21); (e) learning from members' different ways of thinking (mean=4.21); (f) learning positive interdependence (mean=4.21); (g) respecting a diversity of opinions (mean=4.16); and (h) striving for goals as a team rather than as individuals (mean=4.12).

They gained a better understanding E-Commerce as a subarea of Management Information Systems (MIS) in the School of Business curriculum (mean=4.07). The storefront project, which is a natural cross-over between marketing and MIS, made them more aware of the interdisciplinary connections within the business curriculum (mean=3.95). They perceived the project as a venue for learning about E-Commerce vendors of hardware and software (mean=4.28), consulting services (mean=4.12), professional associations (mean=3.79), and job openings (mean=3.63).

It is very likely that the positive experiences reported, thus, far would not have been possible if the Merchandizer storefront software itself was difficult to use. Most students found learning the software a fairly easy task (mean=4.19) and that they found it was a reachable goal to be skillful in the use of it (mean=4.14). The Merchandizer software templates were easy to understand (mean=4.07) so that students were able to learn them on their own without extensive instruction (mean=4.05).

Two important attributes of students in the sample were measured: frequency of computer use and length of time spent working with the computer. In a simple regression procedure, it was found that frequency of computer use significantly predicts students' perception of the ease of learning the Merchandizer software at the significance level of $p<.10$ ($F=3.24284$; $p=.0791$). In two other simple regression runs, it was found that the students' perception of the project as having enhanced collaborative team work predicts their perception of the storefront as being an important learning experience overall ($F=11.42868$; $p=.0016$) and their ability to create a web site with content that is meaningful to the entire team ($F=3.59981$; $p=.0648$). Then, students' perception of Merchandizer as an application software that was easy to use predicted their organizing skills in arranging web site information so that the site could be presented more effectively ($F=12.27518$; $p=.0011$).

When taken together as two independent variables in a regression equation, both the students' perception of the project as having enhanced collaborative team work and their perception of Merchandizer as an application software that was easy to use predict a number of dependent variables. Significance levels were tightest for their organizing skills in arranging web site information so that the site could be presented more effectively ($F=7.28378$; $p=.0020$) and their perception of the storefront as being an important learning experience overall ($F=7.14604$; $p=.0022$). Both independent variables in a regression equation also significantly predicted student's perception that the storefront project encouraged creative thinking ($F=4.12591$; $p=.0235$), their perception that the project enhanced their integrating skills or their ability to put information or content together ($F=3.40767$; $p=.0430$), and their perception that the project developed useful skills in web site development they could use even after the course was over ($F=2.62482$; $p=.0849$).

The association among selected variables using Pearson's correlation values was also investigated. Only those variables that bonded very strongly at the significance level of $p<.0001$ are shown here.

Learning important lessons in determining web site product information and content issues correlated strongly with the following seven variables: learning positive interdependence in the team (.4999); learning different ways of thinking in the team (.5271); achieving the goals as a team (.5511); considering the storefront project an important learning experience overall (.5193); creating web site content meaningful to the team (.4843); developing skills usable even after the course such as building a web site (.6225); learning overall planning issues in a storefront (.6334); and learning design issues for an electronic catalog (.6854).

Learning how to achieve goals as a team correlated strongly with five other variables: perceiving the project as encouraging collaborative team work (.7380); learning to communicate with team members (.7264); learning positive interdependence (.8872); learning interpersonal social skills (.8041); and learning how to achieve goals as a team (.9168).

Learning design issues for creating an online catalog correlated strongly with the following four variables: perceiving the project as encouraging collaborative team work (.5269); learning to communicate with team members (.5038); learning different ways of thinking in the team (.5784); and learning how to achieve goals as a team (.5380).

Learning different ways of thinking in the team correlated strongly with four other variables: perceiving the project as encouraging collaborative team work (.7333); learning to communicate with team members (.7026); learning positive interdependence in the team (.8792); and learning interpersonal social skills (.8245).

Conclusion

This paper has shown concrete data supporting the promise of the use of the WWW for instructional purposes in the area of E-Commerce in the business curriculum. Not only does the WWW provide an environment that perfectly simulates the subject of the course itself, but the web hosting service arrangement also provides information technology infrastructure support to universities that are resource poor or unable to afford the hardware, software, and manpower requirements of mounting E-Commerce projects. The survey results provide positive indications for the achievement of the goals of collaborative inquiry, team-based and active learning, constructivist pedagogical approach, and learning by doing.

References

Adams, D., & Hamm, M. (1996). *Cooperative Learning: Critical Thinking and Collaboration Across the Curriculum.* Springfield, IL: Charles Thomas Publisher.

Adams, D., & Hamm, M. (1995). *New Designs for Teaching and Learning: Promoting Active Learning in Tomorrow's Schools.* San Francisco, CA: Jossey-Bass, Inc. Publishers.

Carey, P. (1998). *Creating Web Pages with HTML.* Cambridge, MA: Course Technology.

Chizhik, A.W. (1998). Collaborative learning through high-level verbal interaction: From theory to practice. *Clearing House*, 72(1), September, 58-61.

Johnson, D.W., Johnson, R.T., & Smith, K.A. (1991). Cooperative learning: Increasing college faculty instructional productivity. *ASHE-ERIC Higher Education Report No. 4,* Washington, DC: The George Washington University School of Education and Human Development.

Pankratius, W.J., Young, M.W. (1995). Perspectives on education: A constructivist approach to an introductory course. *Education*, 115(3), Spring, 363-370.

Teacher Education by Hypermedia learning Environments – An Example from Germany

Stefan Aufenanger, University of Hamburg/Germany, Stefan@aufenanger.de

In Germany the problem of teacher education for school in the information society has been recognized in the last years. But there are many obstacles to change concepts of traditional curricula for teacher education, to train the teacher educators, to implement new media at the university, and so on. The necessarity of educating teachers and teacher students for using computers and the internet for educational purposes became also aware by the government. There are many interested teachers but there are not enough teacher educators to face that challenge. Media in general and television especially are rarely used in German schools. German teachers mostly think of electronic media as a virus which is infecting the children with not good ideas so they try to keep them out of their classroom. Only the computer and the internet had changed some teachers mind. The pressure of using computers in every day life and in all areas of economy is now reaching the schools. Now schools are equipped with computers and internet access but teachers are rarely prepared to pedagogical settings for the use of its.

Supported by a grant from the Bertelsmann Stiftung in Germany seven universities in Germany have built a network to cooperate in teacher education or media education for teachers, respectively. Teacher educators of he Department of Education of each of the seven universities came together to develop a concept for educating teachers for media education and computer technology at schools. The challenge of that network is to develop and to implement a curricula that could be accepted by each of the seven universities. All participating universities have a center for media education and some experiences for teaching with computers and internet but all have not enough capacities and resources to implement a whole curricula for teaching the teachers in media education and computer technologies. For that reason the network could offer each university the chance to develop a curriculum on the one hand, and to implement that curriculum on the other hand, if new media would be used. The aim of the network is in general to exchange experiences in media education for teachers, and especially to develop together hypermedia learning environments for that topic. If each part of the networking would develop one part of the curriculum and one part of a hypermedia learning module system resources could be better shared and different views to the same topic could be offered.

In a first step the general task of the network was break down to the theme "Teaching and Learning in the Informational Age". In a second step the main issues of that theme has been outlined. So it is important to understand what are the main topics of the informational age. Or it had to be clarified what are the main concepts of teaching with computers and concepts of learning with computers. In a further step different concepts for the educational approach has been developed.

The aims of the curricula has been formulated as follows:

- To help teachers to get media competencies
- To have an understanding of media education and the pedagogical aspects of computers use
- To create learning environments for better learning with computers and the internet
- To manage the hardware and the software problems and to be aware of school development for the new media

One decision was to use hypermedia learning environments for teacher education at the universities. That's the aspect of distant learning which

Three working groups has been put on the way: one for the educational aspects, one for the didactic aspects, and one for the information technology aspects. The paper will concentrate on the work of first working group.

The members of that working group decided to develop a modular system in which each aspect of the theme can be produced if the resources need are available. Two of the possible modules will be presented. The first one is called 'media competencies' and offers a concept of the competencies which are necessary to use the new media – f.e. computers and the internet – in a probate way. The learning environment offers the user the different dimensions of media competencies – a cognitive dimension, a social dimension, a ethical dimension, an esthetical dimension, an affective dimension, and the dimension of handling media – by a hypermedia text with different examples for each dimension.

The second example is a case-based learning environment called 'media ethics'. The user will be confronted with a critical case of media content which could harm children. The underlying learning theory of that hypermedia learning environment is taken from Roger Schank's case-based multimedia learning approach. It is the aim of that hypermedia text to challenge the user to find a solution which is not given to her or him but which has to be constructed by her or him.

These two examples will show how that modular system will work. The aim of the workgroups is to develop a pool of modules which could be used by each department of education. The process of implementation in teacher education will be evaluated. First results will be presented.

Dynamic Coordination Policy for Cooperative Learning System

YeongTae Baek
Dept. of Multimedia, Kimpo College, KOREA
hannae@kimpo.ac.kr

SeiHoon Lee
Dept. of Computer Engineering, Inha Technical College, KREA
seihoon@true.inhatc.ac.kr

KyungSeob Yoon
Dept. of Computer and Information System, Inha Technical College, KOREA
ksyoon@true.inhatc.ac.kr

ChangJong Wang
Dept. of Computer&Science and Engineering, InhaUniversity, KOREA
cjwangse@inha.ac.kr

Abstract: Most of these cooperative learning systems have a static type that the learning policy decided the beginning of system development. In this paper, we proposed the model of coordination policy that can change policy dynamically through separating of coordination and implementation. The proposed coordination policy model provided interaction structure which import two concept of virtual bus to cooperative learning system developers and defined CPDL(Coordination Policy Definition Language) to model coordination policy.

1. Introduction

Through the improvement of computer system capabilities and extension of information network communication system, it is increased to request of Computer Supported Cooperative Work (CSCW) applications which support that a number of people globally distributed make a decision and do their cooperative work through the sharing their information(ACM, 1998). Especially, the research about cooperative learning to get educative effectiveness is being actively performed (Makrakis, 1998).

Most of these cooperative learning systems have a static type that the learning policy decided the beginning of system development(Sistemas & Borges & Santos, 1999). There is a problem that these static policy models can't change dynamically when people perform learning system. Because it is possible to static modification, it includes problem that every policy for cooperative learning should be decided before the execution of learning system. This prevents performing of the original facility of cooperative learning.

In this paper, therefore, we propose the model of coordination policy that can change policy dynamically through separating of coordination and implementation. The proposed coordination policy model provides interaction structure which import two concept of virtual bus to cooperative learning system developers and defines CPDL(Coordination Policy Definition Language) to model coordination policy. Also, using rule base method not procedural method to control and process defined policy with CPDL, it is possible to process flexibly about changing status dynamically.

2. Coordination Policy

It is the aim that cooperative learning system easily provides works for learning happens to between many learners using computer. Cooperative learning is coordinated by special policy. In other words, cooperative learning can restrict role and interaction of participating learners. So, in order that cooperative learning system supports group learning effectively, it should include these rules in software. These rules are coordination policies. Coordination policy include access control, concurrency control, floor control, role/session constraints, exception handling(Edwards, 1995, Gustafsson & Shahmehi, 1996, Sikkel, 1997).

Coordination policy can be made by working type and organization structure of learning groups, and that can be coordinated by other policy according to learning stage. The development of cooperative learning system is made by communication of experts, developers, or users for defining of coordination policy generally. These method are defined when system is developed, this policy is called once-and-for-all policy which is applied every case. A lot of research is being progressed about very various cooperative learning system in CSCW during past 10 years. Most of these systems developed by once-and-for-all policy. These approaches don't provide flexible cooperative learning because the decided policy on system development applies to every case. So, it is required development of cooperative learning system which import method separates system and policy.

3. Dynamic Coordination Policy

In this chapter, we propose coordination policy model. A necessary coordination policy on overall cooperative learning is separated learning group policy and learner policy in proposed model. And it is possible that dynamic policy changing through separating system implementation

3.1 CPDL(Coodination Policy Description Language)

CPDL is a language to define learning group policy and learner policy. It is used to define policy about overall cooperative learning. As developer of cooperative learning system defines policy with CPDL besides general application such as white board or tele-conferencing, he can provide cooperative learning applications with new policy to learner without modification of application in spite of dynamic change. Policy with CPDL consist of part about type of learning group, definition of sharing application to use in learning group, definition of necessary events in learning group and each rules.

Policy about learning group type

The type of learning group consists of title of learning group, its role, stage of learning group, list of application, number of learners, openncss of learning group, control method of right to speak, sorts of events, and rules of learning group. Role of learning group and stage of learning group operation is defined List 1. Objects and events used group can composed of object definition list and event definition list. And numbers of learner which can participate groups are able to be defined overall number of learners and each role base number of learners. Group property has only one property either PUBLIC or PROTECTED. If group property is PROTECTED, group can restrict learners participate groups using secret numbers. The control of right to speak among learners groups are TOKEN_CONTROL, ROUND-ROBIN, FREE method.

List 1: Group Grammar

```
Group_definition ::= Group identifier :
        Title role_list stage_list object_list
                participantNum group_attribute floor_control
                event_list rule_definition
role_list ::= ROLES : id_list
stage_list ::= STAGES : id_list
object_list ::= OBJECTS : object_defintionlist | nothing
event_list ::= EVENTS : event_definition | nothing
id_list ::= identifier, id_list | identifier
object_definitionlist ::= object_definition | object_definition object_defintionlist
participantNum ::= P_N : total_number number_per_roles
number_per_roles ::= (identifier => total_number) +
group_attribute ::= PUBLIC | PROTECTED : password
floor_control ::= TOKEN_CONTROL | ROUND_ROBIN | FREE
```

Objects and event definition

Group can share object and it can different from sharing application according to role. Also it can use object to different right though it shares same object. Object definition consists of object name, class name, role, and right used object.

List 2 : Object Grammar

```
object_definition ::= OBJECT : objectname classname objectactivity right
objectname ::= NAME : identifier
classname ::= CLASS : identifier
objectactivity ::= USING_BY : identifier
right ::= W | R
```

Events happen to interaction process of learners and participated groups. And appropriate processes of events need to support smooth learning activity. The event type is consisted of events source, events destination, and field list consisting of events.

List 3 : Event Grammar
event_definition ::= EVENT identifier : simple_event
simple_event ::= event_src event_des event_fieldlist
event_src ::= SRC : context_list
event_des ::= DST : context_list
event_fieldlist ::= FIELDS : fieldlist / nothing
fieldlist ::= FIELD : fieldlist / nothing

Rule definition for group activity

It defines that how interaction of learners happen to learning group and pass event of learners process through rules. The rules consist of condition and behavior list. If the condition is satisfied, the descriptive behavior is performed to appropriate learner. In the case of learner, the target can be restricted to itself, and can be the learner performing the specific roles and all learners. The condition is appropriated to the case of input or output of specific data.

List 4 : Rules using group
rule_definition ::= RULES : rule_list
rule_list ::= rule_declare / rule_declare rule_list
rule_declare ::= RULE : rule
rule ::= targetlist : condition => actionlist WHEN stage BY actor
targetlist ::= LOCAL / ALL / rolelist
condition ::= mode :- datatype
mode ::= IN / OUT
datatype ::= session_command / media_data / event_data
session_command ::= JOIN / LEAVE / LIST_MEMBER / GET_ACT_INFO/ SET_STAGE / GET_MEMBER_INFO
/ LIST_POSSIBLE_ROLES / IS_MEMBER / TOKEN_OWNER / END_ACTIVITY
media_data ::= connector_name
connector_name ::= string
event_data ::= identifier
stage ::= ALL / id_list
actor ::= ALL / id_list
actionlist ::= action_declare / action_declare actionlist
action_declare ::= string

3.2 Two way coordination policy

Learners participated in cooperative learning has common topic. So, coordination policy about group affects on interaction among all participants. Also, learners interact with other people according to purpose and policy of itself. However, because the legacy study defined only group coordination policy, individual policies of each learner don't be considered.

In this paper, it supports both group coordination policy and individual policies of each learner, coordination policy of overall cooperative learning perform through harmony of two coordination policy. To this, the bus concept is imported. The bus consists of collaboration bus that affects on learning group coordination policy and coordination bus which affect on learner's policy. Because learners participating group is connected with collaboration bus, it is controlled by collaboration bus learning group coordination policy. Coordination bus is connected between cooperative learning applications like whiteboard and tele-conferencing and private coordinator for controlling learner policy. So, because each application is connected Coordination bus, it is controlled by Coordination bus learner coordination policy.

learning group coordination policy

Learning group policy is defined with CPDL by group creator. Group policy defined by group creator apply to every learner participated in group and use the basic policy of group activity. So, it has higher priority than learner policy and is valid as long as a group exists. The following is item group coordination policy.

- *Group Name*
- *used Role in group*
- *used shared object in group*
- *the number of all learner and learner per role participated in group*
- *property of group*
- *group title*
- *type of right to speak*
- a way of processing when the defined events are generated

Learner coordination policy
Learner policy defines rule about transferred data by system. So, most of learner coordination policy is rule definition.

3.3 Coordinator

Cooperative learning policy is described by CPDL and it is managed and is executed by Coordinator. Composition of Coordinator is illustrated in Figure 1. Coordinator consists of text editor, translator, coordination manager, working memory, reasoning engine, knowledge base and actor. Text editor is a tool that learner can describe with CPDL. Translator is a parser that converts CPDL into coordination grammar type. Coordination manager controls policies of overall cooperative learning.

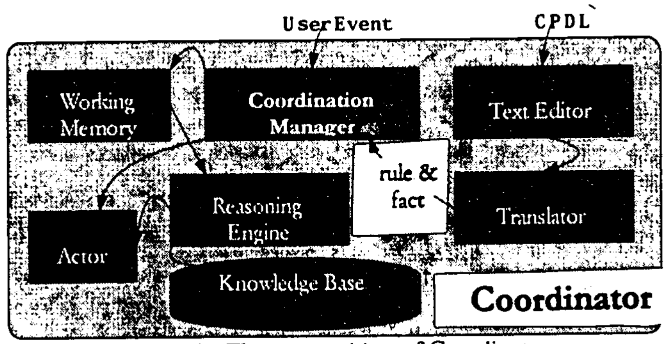


Figure 1 : The composition of Coordinator

4. Experiments

We implement cooperative learning system to show propriety of the proposed dynamic coordination policy. And we show that possible interaction of users groups according to learning group policy and learner policy through processing of implemented system.

4.1 Development environment and cooperative learning system

Experiment environment consists of one teacher, two learners, and one attendance, and in this class, teacher decides the type of cooperative learning group and group policy.
The overall cooperative learning system consists of white board and video-conferencing using real time stream. And, audio/video data of system and image data of whiteboard is controlled flowing according to group policy.

To do cooperative learning, first teacher decides cooperative learning group policy. After that, if group is created, learners and attendants participates group, and decide their policy. The necessary information which makes group is consisted of group name, roles to be used by group, working steps of group, number of learners and role to participate group, information of objects to be used by learners of group, control type of right to speak, group property, definition of event to use group, and rules of group activity. These group types and group policy are described in List 5 using designed CPDL in this paper.

List 5 : Group policy of education system

```
Classroom : "Overview of CSCW"
ROLES : Lecturer Student Attendant
STAGES : Teaching Question Discussion Reporting
..........
EVENTS :
  EVENT CommandTeaching
    SRC : Lecturer
    DST : Student Attendant
    FILEDS :
      FIELD : Content
  EVENT ReportResult
    SRC : Student
    DST : Student
    FILEDS :
      FIELD : Content
  RULES :
    RULE :
      LOCAL : IN :- REQUEST_TOKEN WHEN Teaching BY Student
      => "Deny Request"
```

BEST COPY AVAILABLE

```
RULE :
  Lecture : IN :- ReportResult WHEN Discussion BY Student
     => "Report Result"
RULE :
  ALL : IN :- CommandTeaching WHEN ALL BY Lecturer
     => "Command by Lecture"
RULE :
  LOCAL : IN :- sound WHEN Teaching BY Student Attendant
          =>"Prohibit Speech"
```

In the case of lecture step, group rules ignore request of right to speak of learners, and in the case of discussion step, if learners try to pass to teacher discussion result, it describe CPDL which can receive discussion result. Also, during lecture, teacher can pass image data from learner or attendance, but data transmission through audio data and whiteboard restrict for smooth lecture.

4.2 Group creation

CPDL described in List 5 change to necessary information for group creation through parser. The necessary information for group creation consists of rules to be used group policy management as saving knowledge base. The Parser uses template such as List 6 to change CPDL type to CLIPS(C Language Integrated Production System) (Friedman-Hill, 1998) type.

List 6 : Template for changing CPDL to CLIPS

```
(deftemplate ROLELIST (multislot rolelist))
(deftemplate STAGELIST (multislot stagelist))
(deftemplate OBJECTLIST (multislot objectlist))
(deftemplate EVENTLIST (multislot eventlist))
(deftemplate STAGES (slot (stage)))
(deftemplate RULE (slot tagetlist)
          (slot mode)
          (slot datatype)
          (slot WHEN)
          (multislot by))
```

The contents of CPDL is changed by parser is transmitted manager handling a portion and then, it used. List 7 are rules to connect definition rules with CPDL with java method. This rule becomes of knowledge base of Jess, it is applied appropriate rule about several accident happen during group activity.

List 7 : The changed rule of CLIPS type

```
(defrule Group_RULE1
  (RULE (targetlist LOCAL)(mode IN)(datatype REQUEST_TOKEN)
          (WHEN Teaching)(By Student))
  (STAGES (stage Teaching))
  = > (printout t "Deny Request" crlf)
    (call RequestHandling LOCAL IN REQUEST_TOKEN Teaching Student
     Deny_Request))
(defrule Group_RULE2
  (RULE (targetlist ALL)(mode IN)(datatype CommandTeaching)
     (WHEN ALL)(By Lecturer))
  (STAGES (stage ALL)
  = > (printout t "Command by Lecture" crlf)
    (call RequestHandling ALL IN CommandTeaching ALL Lecturer Command by Lecture))
(defrule Group_RULE3
  (RULE (targetlist LOCAL)(mode IN)(datatype sound)
     (WHEN Teaching)(By Student Attendant))
  (STAGES (stage Teaching)
  = > (printout t "Prohibit sound" crlf)
    (call RequestHandling LOCAL IN sound Teaching Student Attendant Prohibit sound))
```

4.3 Participation of learner

Learner can owns policy on group activity and defines owns group activity in addition to group policy defined by group chairman. When the change of event is receiving to a teacher, Learner-A's System makes the overall application step change by generating "Change Mode" message. Also, if received data from learner or attendant in question time, System should not show the received data and if don't show the received data on whiteboard in reporting the result of conversation, learner-A describes like the following list.

```
RULES :
  RULE :
    LOCAL : IN :- CommandTeaching WHEN ALL BY Lecturer
=> "Change Mode"
```

```
RULE :
  LOCAL : IN :- whiteboard WHEN Question BY Student Attendant
=> "Prohibit whiteboard"
RULE :
  LOCAL : IN :- whiteboard WHEN Report BY Student Attendant
=> "Prohibit whiteboard"
```

Learner-B like learner-A changes the application step on receiving step change event in overall step. Also, if received the voice data from learner or attendant in question time, it describes with CPDL like the following list for no receiving the receiving data.

```
RULES :
  RULE :
    LOCAL : IN :- CommandTeaching WHEN ALL BY Lecturer
=> "Change Mode"
  RULE :
    LOCAL : IN :- sound WHEN QUESTION BY Student Attendant
=> "Prohibit sound"
```

CPDL of learner A and B convert CLIPS using template like group CPDL and it saves in Knowledge Base. If the condition is satisfied, Reasoning Engine transmits message, and makes it launch java object connected message.

4.4 Policy change of teacher

In the case of adding new policy after it decided policy, System can execute new policy just compiling new rules and adding to knowledge base without recompiling overall policy. For example, if group stage is not "Teaching" group stage, and try to prohibit access of other users, it add the following CPDL

```
RULE :
    LOCAL : IN :- JOIN WHEN Question BY Student Attendant
          => "Prohibit JOIN"
RULE :
    LOCAL : IN :- JOIN WHEN Discussion BY Student Attendant
          => "Prohibit JOIN"
RULE :
    LOCAL : IN :- JOIN WHEN Reporting BY Student Attendant
          => "Prohibit JOIN"
```

5. Conclusion

In this paper, we proposed the model of coordination policy that can change policy dynamically through separating of coordination and implementation. The proposed coordination policy model provided interaction structure which import two concept of virtual bus to cooperative learning system developers and defined CPDL(Coordination Policy Definition Language) to model coordination policy. Also, using rule base method not procedural method to control and process defined policy with CPDL, it was possible to process flexibly about changing status dynamically. The proposed coordination policy model solves problem of static policy model, which it can't change policies dynamically on the execution of learning system, and can provide various learning step and learning way through changing coordination policy dynamically.

References

ACM(1998). Proceedings of computer Supported Cooperative Work, ACM.

Edwards, W.K.(1995). Coordination Infrastructure in Collaborative Systems, A Dissertation Degree of Doctor of Computer Science, Georgia Institute of Technology.

Gustafsson, M. , Shahmehi, N.(1996). A Role Description Framework and its Applications to Role-Based Access control, Proceedings of IEEE Fifth Workshops on Enabling Technology: Infrastructure for Collaborative Enterprises(WETICE).

Sikkel, K.(1997). A Group-based Authorization Model for Cooperative Systems", Proceedings of European Conference on Computer-Supported Cooperative Work (ECSCW).

Friedman-Hill, E.J.(1998). Jess, The Java Expert System Shell, http://herzberg.ca.sandia.gov/jess/.

Sistemas, C., Borges, M.R.S., Santos, N.(1999). Computer-Supported Cooperative Learning Environments:A Framework for Analysis, ED-MEDIA..

Makrakis, V.(1998). Guidelines for the Design and Development of Computer-Mediated Collaborative Open Distance Learning Courseware, ED-MEDIA.

Developing Teaching Webs: Advantages, Problems and Pitfalls

Philip Barker
Human-Computer Interaction Laboratory
School of Computing and Mathematics
University of Teesside
United Kingdom
Email: Philip.Barker@tees.ac.uk

Abstract: This paper discusses the growing importance of teaching webs - both as an augmentation aid to conventional teaching and as a replacement for '*stand and deliver*' courses. The development of teaching webs is discussed within the framework of a case study relating to the development of an intranet/Internet facility to support the teaching of a two-semester, final-year, BSc degree module in human-computer interaction. Some of the advantages, problems and pitfalls of this approach to educational delivery are briefly discussed.

1. Introduction

Increasingly, the Internet and other related technologies such as intranets and extranets are being used as support aids to facilitate the delivery of teaching and learning materials (Hopkins, 1998; French et al, 1999). Indeed, web-based training (WBT) and Internet-based training (IBT) are now rapidly becoming two of the most popular mechanisms for making training materials available within both academic and commercial organisations (Steed, 1999; Horton, 2000). There are two main ways in which WBT and IBT are currently being used. First, as an augmentation aid in order to facilitate the delivery of conventional courses (Gillham et al, 1999; Hall and Dalgleish, 1999). Second, as a complete and integrated solution to the presentation of courses that are to be used by students in a self-study environment or in an open learning fashion (Barker, 1999a; 1999b; Duggleby, 2000). This latter technique forms the basis of many of the new Web-based approaches to distance learning using the principles of 'electronic classrooms' and 'virtual university' environments (Whittington and Sclater, 1998; Barker, 1998). Although these are important, this paper is primarily concerned with the first of these two approaches. It considers the various ways in which a teaching web - running on an Internet and/or an intranet server - might be used in order to improve the quality of the educational experiences available to students studying within a conventional university environment and who are exposed to conventional '*stand and deliver*' lecture courses as their main mechanism of information delivery.

Internet-based technologies can be used for a variety of purposes within an educational setting. Typical uses include: making reference material available, providing access to course documentation and the collection of student demographic data. In contrast to these basic information provision and data acquisition roles, the purpose of a 'teaching web' is to facilitate the development of knowledge and skills within the user population for which it is designed. As well as achieving knowledge and skill transfer, teaching webs are intended to monitor, assess and record students' progress and performance - giving appropriate feedback both to students and course administrators. As well as providing access to teaching and learning materials, teaching webs must therefore be closely integrated with assessment tools and databases that can keep records of performance data.

Creating teaching webs is a much more difficult task than just authoring some informational pages and mounting them on an Internet or intranet server. Because of the more complex tasks that are involved, this paper describes and discusses some of the principles involved in creating a teaching web. It illustrates these principles by means of a case study that describes a dynamic teaching web facility that we have recently built in order to support the teaching of the subject of human-computer interaction (HCI). As well as describing the operational system, the paper outlines some of the advantages of using this approach and identifies a number of problems and pitfalls that we have encountered.

2. Creating Teaching Webs

Before a teaching web is constructed it is necessary to make a number of important decisions relating to how, if at all, the development process should proceed. It is also necessary to decide upon the form the web should take, its content, structure and the way in which it should be produced. Some of the more important initial questions that need to be answered therefore include:

Can the development of a web be justified?
What institutional infrastructures currently exist to support a web?
What parts of an existing course, if any, should be made available on the web?
What type of platform is to be used?
What financial, human and technical resources will be available?
What materials currently exist?
Should these be imported into the web facility?
Can they be imported into the new system?
What relevant 'off-the-shelf' web-based teaching materials currently exist?
Can these be easily imported into the new system?
What new materials need to be developed?
What types of facility should they include?
What development tools are available?
What will be the roles of teaching staff?
How will students access the course materials?

The questions listed above are presented in order to stimulate thoughts and ideas about what, in any given situation, has to be done in order to establish a successful operational teaching web facility. These questions will not be discussed and debated in any depth here. Instead, the intention of this paper is to concentrate on just three basic areas: the hardware support that is needed; the range of software development tools that are required; and the organisational infrastructures that need to be in place in order to facilitate the use of a teaching web. Each of these issues is briefly discussed below.

Hardware Resources

The important types of hardware resource that need to be decided upon include: the nature of the servers that are to be employed; the network infrastructure that has to be in place; the types of computer terminal that will be used to gain access to the web; and, whether or not remote access via modems will be supported. In the HCI case study that is presented in the following section, an in-house server farm was used to host the main part of the teaching web. However, some use was also made of external Information Service Providers - as and when this became necessary for certain parts of the course. A campus-wide Novell network was employed as a means of providing access to the servers. Both desktop computers (local and remote) and laptop computers were used (by students and staff) to access the network and the teaching webs held on the servers. For remote access, the public switched network was employed - this required modems at both ends of the connection.

Software Resources

Prior to the advent of sophisticated authoring packages (such as HotMetal Pro, FrontPage and DreamWeaver), the creation of learning materials in HTML format for use on a web was quite a labour-intensive process. Although it was not difficult, it was both tedious and prone to errors. Nowadays, however, it is a relatively easy matter to create learning materials as Word Documents and then import them into an appropriate HTML development system for integration and linking with other relevant resources. In addition, the wide range of browser plug-ins and add-ons that is now available means that interactive learning materials can still be developed in particular development environments (such as Delphi, ToolBook, Director, and so on) and then 'run' by the browser. Of course, the availability of JavaScript and Java programming tools means that enhanced interactivity can be built into web-based materials without placing too great an overhead on the server that is used to deliver the course materials. In situations where special types of interactivity and data storage mechanisms have to be implemented, server-side software may need to be developed using languages such as Perl or C. For the HCI case study that is discussed in the next section, all of these techniques were used. However, apart from the browser software (both Internet Explorer and Netscape Navigator were used), the three packages that were most heavily used were SoftQuad's HotMetal Pro, FrontPage and Microsoft's Word for Windows.

Organisational Infrastructures

In addition to the technical infrastructures mentioned above, a number of organisational infrastructures have to exist in order to facilitate the effective use of teaching webs. Undoubtedly the most important of these relate to the administrative infrastructure and the organisation of the teaching and learning environment. One of the main administrative issues that we had to consider in the HCI teaching web was the way in which students' '*attendance*' and assessment data were collected and managed - and subsequently integrated into overall organisation-wide student performance measures. As is discussed later, this was achieved through the use of electronic registers and assessment mechanisms; the results being stored and processed centrally on one of the servers. An important consideration from the perspective of the teaching and learning environment was the flexible way in which the teaching web allowed the integration of new and old mechanisms of course delivery. As is discussed later, although lectures were given, attendance at them was not compulsory since all of the HCI course was available on and could be accessed via the teaching web.

3. Case Study – The HCI Teaching Web

This section contains a short description of a teaching web that we have developed to support the teaching and self-supported study of material relating to the subject of human-computer interaction. The web has been operational for about three years. Despite this, we do not feel that it is yet complete! We continue to modify and fine-tune its content and structure in order to improve its performance and its appeal to students. In the remainder of this section, the following major perspectives are briefly discussed: web structure; resources available; notice boards and schedules; monitoring and assessment; technical and academic support; data files; providing access to additional support materials; future developments; and potential application areas.

Web Structure

The HCI teaching web is organised primarily as a hierarchical structure embedded within which are numerous cross-references that are implemented as hyperlinks. From the options available on the home page (see table 1), users can navigate to those parts of the web that are of particular interest to them at any given time. This may involve browsing the online material associated with any of the 40 lectures or participating (in self-study mode) in one of the 20 practical classes. The exercises contained in these are based on the principle of active learning. This involves students having to do things (relating to HCI) for themselves - sometimes individually and sometimes in groups. Each practical class usually has associated with it appropriate *support data*, a *hints file* and a *worked solutions file*. As is discussed later, students are required to submit an *electronic register* for each of the practicals that they attempt; they must also fill in an *electronic checklist* for every practical that they complete. The home page for the HCI Teaching Web is available for inspection at the following Internet address:

http://www-scm.tees.ac.uk/users/philip.barker/hcihome.htm

Because the bulk of the HCI material is made available using an in-house intranet facility, the links from the above Web address are all password protected so that only authorised users can gain access to the underlying resources.

Resources Available

The nature of the resources available on the teaching web is reflected in the '*contents*' list that appears on the home page when students access the web using their browsers. The options currently available are listed in table 1.

A Riddle - Why Study (HCI)? Aims and Objectives of the Course Course Description Course Content Computer Accounts Lecture Material Practical Classes The Electronic Register, Checklists and Schedules Books on HCI Other Information Sources The HCI Notice Board Past Examination Papers Research Opportunities in HCI

Table 1: The Main Options on the Home Page of the HCI Teaching Web

The two most heavily used options in this list are the *'Practical Classes'* and the *'Lecture Material'*. Each of these options leads to a screen-based, interactive, rectilinear matrix of options (*'Practical 1'* through *'Practical 20'* and *'Lecture 1'* through *'Lecture 40'*, respectively) that give students access to the underlying course material. This can be browsed, printed or copied to students' individual machines for later use. In principle, all of the material that students need to study the HCI course is available in electronic form from the teaching web.

Notice Boards and Schedules

One of the reasons for introducing the HCI teaching web was to encourage greater degrees of independent, self-managed learning. Students are therefore encouraged to be flexible with respect to how and when they study. Naturally, although flexibility is encouraged, some mechanisms need to be available in order to ensure that students 'move forward' with respect to progressing through the course. Two embedded web-based bulletin boards are therefore used to provide sources of 'motivation' for students. The first of these is the '*HCI Notice Board*'; this is used to post both general messages and news items that are relevant to the course. The second online bulletin board is the '*Schedules Notice Board*'. This is used as a means of giving students details of the 'recommended' start dates and completion dates for Practical Classes and Lecture Units.

Monitoring and Assessment

As was mentioned previously, the HCI teaching web provides two basic automated mechanisms for monitoring what students are doing as they progress through the course. First, there is the electronic register that keeps details of students' 'attendance' at the 'virtual' laboratory classes. Second, there are the online checklists that students complete at the end of each laboratory session. Each of these monitoring tools is implemented as a HTML form. Form handlers on the server are then used to process the data that is submitted by students. The form handlers are fairly standard CGI scripts that are written in Perl. The data that is obtained from these monitoring and assessment processes is extracted and imported into a data base that can be used (in conjunction with dynamic HTML programming techniques) to generate feedback both for course administrators and for students.

Technical and Academic Support

Students using the HCI teaching web are provided with a range of academic and technical support facilities that they can call upon as and when they need to. Two basic types of support mechanism are used: face-to-face and online (Duggleby, 2000). Face-to-face support is provided both by means of a help-desk facility (that is manned during normal working hours) and through a series of regular time-tabled '*come if you need to*', open-access laboratory sessions. Online support is provided both through email and, at particular times of day, via online chat facilities.

Data Files

An important aspect of the HCI work that students undertake during the course is the development of practical competencies with respect to various types of data manipulation and data analysis. In order to facilitate this, the teaching web facility makes available a large data bank of material of various sorts that students can use as part of their practical exercises. Typical examples of the material that is held on the underlying intranet include: raw questionnaire data, spreadsheet files and experimental data from HCI experiments (such as reading rates and reaction times for various visual and audible stimuli).

Additional Support Material

The intranet facility that is associated with the HCI teaching web provides a powerful mechanism for making available a wide range of ancillary course support materials. Typical examples of the types of resource we provide to students include: electronic documents (relating to particular course topics) that are hyperlinked to other Internet resources; image sequences that are chosen to illustrate particular end-user interfaces to various consumer products (such as MP3 audio players, digital radios and mobile telephones); and hyperlinked reference lists for students to follow up as part of their self-managed study activities.

Future Developments

Although the HCI teaching web has now been operational for over three years, there are still a number of features and improvements that we feel we would like to make to the system. These fall into short-term and long-term development goals. The two most important short-term future developments that we would like to make are: (1) the addition of a 'user-friendly' help system that would provide new users with general help, guided walk-throughs and advice relating to using the system; and (2) the provision of a topic index and global web search facility to enable students to search the teaching web in order to locate particular items of interest to them. Some prototype software to test out each of these requirements has already been written and evaluated. From the perspective of longer-term developments, the most important major change that we would like to make would be to incorporate XML as the basic mark-up language (Eckstein, 1999). We believe this is important because it will facilitate the preparation of the catalogues and indexes that we need in order to implement efficient and effective searching of the teaching web. In our view, the use of XML will also simplify data exchange with respect to the administrative tasks associated with monitoring and assessment - and subsequent reporting of feedback to both students and teaching staff.

Potential Application Areas

We believe that during the next few years there will be tremendous opportunities for using teaching webs in a wide variety of different contexts both within conventional educational environments and for the support of lifelong learning and continuing professional development (Barker, 1999b; Barker et al, 1998). One important application area that we are currently exploring is the utility of such webs within the context of patient education within hospital and health-care environments (Kaur, 1999; Barker and van Schaik, 2000). Within this project we have obtained some interesting results and we are very optimistic about future developments in this and other related areas.

4. Conclusions

There have been a number of advantages associated with the introduction of a teaching web into the HCI course described in this paper - there have also been a number of 'problems and pitfalls'! One of the major advantages is the fact that because all the course materials are available online in electronic form, students can gain access to them at any time they wish to. Furthermore, because the intranet facility can be accessed over the Internet, both local (campus-based) and remote (from home) access is available. Another important feature of the teaching web is the support it offers for self-managed study and the realisation of the constructivist approach to learning. Students can download copies of the HCI teaching web and store it on their own computers - usually on a 100-megabyte Iomega ZIP disk. They can then modify and extend their personal version of the web in ways that are appropriate to their own individual needs.

In our view, the advantages associated with using teaching webs are an ongoing motivation for their further future development. However, there are a number of drawbacks associated with their use and implementation. From the perspective of a staff member, developing 'quality' web pages for use in teaching webs is undoubtedly a very time consuming process. Naturally, this can substantially detract from an academic's primary role as a teacher and researcher. It is therefore unfair to expect the 'average' academic to develop the specialist skills needed to produce such pages. Institutional support with respect to HTML and multimedia resource development is therefore a necessary pre-requisite if this approach to teaching and learning is to succeed. Admittedly, there are automation tools available (such as Microsoft's FrontPage and MacroMedia's DreamWeaver) that can help the development process. Unfortunately, however, there are also many pitfalls associated with the use of these - if the intent of a development project is to produce highly portable code that is independent of any particular manufacturer's development environment. Of course, there are also numerous security issues that need to be addressed - for example, the use of CGI scripts may be allowed on an in-house intranet server but is a facility that is often not available on many Internet servers. This again can create problems with respect to having a system that is totally portable and transparent to its users.

We still have many technical problems to solve in our future work. Despite this, we strongly believe that the benefits associated with using an interactive teaching web (to support the ideas underlying constructivist learning principles) far outweigh the problems and pitfalls that we have encountered with respect to the realisation of this approach to teaching and learning. We are therefore very optimistic about the future development plans that we have with respect to enhancing the quality of the learning environments that we offer to our students through the use of teaching webs.

References

Barker, P.G., (1998). The Role of Digital Libraries in Future Educational Systems, 301-310 in *Proceedings of Online Information 98*, 22nd International Online Information Meeting, Edited by D. Raitt and B. McKenna, Learned Information Ltd, Oxford, UK.

Barker, P.G., (1999a). Using Intranets to Support Teaching and Learning, *Innovations in Education and Training International*, 36(1), 3-10.

Barker, P.G., (1999b). 87-90 in Libraries as Agents for Lifelong Learning, *Proceedings of Online Information 99*, 23rd International Online Information Meeting, Edited by D. Raitt and B. McKenna, Learned Information Ltd, Oxford, UK

Barker, P.G., and van Schaik, P., (2000). *Using Multimedia Software for Patient Education*, Working Paper, HCI Laboratory, University of Teesside, UK.

Barker, P.G., van Schaik, P. and Hudson, S.R.G., (1998). Mental Models and Lifelong Learning, *Innovations in Education and Training International*, 35(4), 310-318.

Duggleby, J., (2000). *How to be an Online Tutor*, Gower, London.

Eckstein, R., (1999). *XML Pocket Guide*, O'Reilly, Sebastopol, CA, USA.

French, D., Hale, C., Hohnson, C. and Farr, G., (1999). *Internet-Based Learning - An Introduction and Framework for Higher Education and Business*, Kogan Page, London.

Gillham, M., Buckner, K. and Butt, R., (1999). The Cautious Student - a User-Centred Evaluation of Web-Supported Learning, *Innovations in Education and Training International*, 36(4), 327-333.

Hall, R. and Dalgleish, A., (1999). Undergraduates' Experiences of Using the World Wide Web as an Information Resource, *Innovations in Education and Training International*, 36(4), 334-345.

Hopkins, B., (1998). *How to Design and Post Information on a Corporate Intranet*, Gower, London.

Horton, W., (2000). *Developing Web-Based Training*, John Wiley & Sons, New York, NY, USA.

Kaur, N., (1999). *Patient Education in a Networked Multimedia Environment*, MSc Dissertation, University of Teesside, UK.

Steed, C., (1999). *Web-Based Training*, Gower, London.

Whittington, C.D. and Sclater, N., (1998). Building and Testing a Virtual University, *Computers and Education*, 30(1/2), 41-47.

On the logic of Bricolage - a case study in system design

Peter Baumgartner
Department of Organization and Learning,
Innsbruck University
Universitaetsstr. 15
A 6020 Innsbruck..
Peter.Baumgartner@uibk.ac.at

Stefan Salzgeber
Department of Organization and Learning,
Innsbruck University
Stefan.Salzgeber@uibk.ac.at

Detlef Wydra
Wydra Grafik Design
Werderstrasse 11
D-44143 Dortmund
wydr@wydra.de

Abstract: This paper describes the development of an internet-based 3-D service system for students. Starting as an information service for just one major field of study (business education), the anarchic implementation process permanently enlarged the system boundaries. From the viewpoint of technical rationality, the system design of the reported project was badly planned and designed. It is argued, that following the directions of a technical engineer approach would have resulted in a stop of the project. In contrast to the traditional technical solution, we will, based on lessons learned from organzition theories, show that the logic of bricolage (a mental model of handcraft) is an adequate metaphor for describing and maybe even for planning design processes.

The Project

The project started with the idea to offer all relevant information services for Business Education students via the internet with a 3-D interface (Baumgartner & Wydra 1999). This idea was motivated by four basic cognitive principles:

- *Linking and remembering relevant study information:* Empirical studies in Cognitive Science demonstrated that information embedded in space or linked with spacial structures is easier to remember and learn (eg Günther 1998). The prototype of this idea can be explored at: http://iol1.uibk.ac.at/wipaed/.
- *Building up mental models of the study organization procedures:* Moving around in a 3-D virtual representation helps to build up mental models of the correlated and interconnected information which is relevant for mastering the situations in question. From the constructionist point of view, it is important to interact with the (virtual) environment in order to reach viable solutions for problems. Instead of passively looking up study problems like "what do I have to do to register my thesis" in a database of Frequently Asked Questions (FAQs) we could implement a robot avatar which guides the students around and shows them where to pick up the relevant information, forms etc.
- *Building up social virtual communities:* In our faculty we have a lot of students who spend many hours travelling to and from Innsbruck. For this reason we want to provide our students with an online service where they can get relevant information without having to come to the university in person. Clearly for faster access we have implemented this information in normal 2-D HTML. Due to a 3-D multi-user world our students cannot only communicate in real-time to exchange their views, but this also leads to closer contacts among the students. Tools like the avatar studio by blaxxun (http://www.blaxxun.de) can provide the necessary personal information to facilitate the process of building a community of students.

In contrast to the original idea our system developed from a student information system to an overall system not only for students but also for lecturers and secretaries. What went wrong? To understand this organizational trajectory we firstly have to examine in detail the different changes in the design process and secondly to generalize this process in the light of organizational theory.

History of the project

February 1998: The new professor (Peter), who is scheduled to get his professorship in Business Education in the winter term 98/99 is launching the idea of a 3-D student information system. An external graphic designer (Detlef, http://www.wydra.de) has been contracted. Additionally another lecturer brought in the context of the Business Education program.
During this early stage it was realized that for the planned project different departments had to work together. Impossible! – There is simply nobody who has got the time, who is willing and/or has enough power to bring the different departments together (former efforts already failed). So the project was changed from a Business Education program to a department project.

March 1998: The department planned to merge with another department. Lecturers requested to discuss the quite different business processes at department level. But at this level the secretaries opposed to it. Therefore: nothing happened, but the usage of a database, developed from a lecturer from the other department, to provide the administration of the department, was at this point envisioned.

April 1998: The development of the homepage was assigned to a lecturer (Stefan), an external designer (http://www.ampuls.at) was contracted. A coordinating meeting (3 involved lecturers and the homepage designer) should clarify the relation between the 3-D student information system, the homepage, the database and an existing central www-database of course information implemented by and fitted to the requirements of the central EDP-department.

The following was decided withing two hours:

- to connect the administration database with the central course database and to use the database with small changes for the whole department.
- to use the central course database to provide the homepage with data of the courses. Because of financial reasons, we decided to connect these two systems with cgi-scripts. It was a general agreement that a database solution would be more efficient for the whole system, but there was no budget available.
- that the 3-D information system should be based on the existing administration database, on the homepage and course database. Only additional data should be captured in a separately linked database.

Finally, in a short discussion all existing, prospective and isolated planned systems were canned. Only small corrections were discussed, interfaces were defined on an abstract level. The 3-D information system should build on a various mixed systems.

September 99: The homepage is finished, the graphic designer and a lecturer meet to make a detailed plan for the info system. 3 points were discussed: 1. A lot of data from different systems must be imported in the database, because we need them for different inquiries from the database. 2. Secretaries and lecturers would not be able to see where to put in the data, due to a lack of a logic system. 3. Through a simple database important data for administration (eg marks) have to be brought in the system via different sets of www-forms (from the homepage, eg consultation hours, from the central database, eg schedule for the courses and from the 3-D info system, eg. information for a special course).
At the same time, the secretaries announced that they would not support the much less complex database for administration purposes.
Crises hits: two days later it was clear financial support (more than the homepage budget!) was needed to develop an integrated system with one database, and the system had to meet the needs of secretaries and lecturers too.

November (plan!): 7 months after the first coordinating meeting a second one will take place. The secretaries and one professor will be in the meeting too. Business processes will be discussed and fixed in detail. In addition to the central course one integrated database for the department will be modelled. This database will be handled only via a www-surface. A new collaboration with another department and new budgeting rules make it possible to get a budget for this.

The result will be an integrated system with two databases (central and department) with two sets of www-forms. It is a system for a department and its students (some of them study Business Education) and not a system for the Business Education program, which would need a lot of information from other departments. Attention is not only drawn on students, but also on the lecturers and secretaries. The difference between 'outside' (infos for the students) and 'inside' (the administration at department and lecturer level) vanished.

the necessity of systematically analysing the business processes and the need of disobey the systemic approach

So what? In every text book (eg. Scheer 1998) we will find the recommendation that first of all we have to analyse systemic (on a gestalt level) and systemtically all the different flows of the business process. This means you have to identify different entities (jobs, departments, ...) and their relations and describe in a very detailled and formal way the task-, performance and information flows. The description of the organization and the different flows should result in integrated, generalized business process models that do not depend on the actual human and incidental characteristics of the processes. When these tasks are finished the system engineer can generate a respository, a data-, function-, process-, organization-, performance and control system. For the purpose of analysis we will call this approach of system engineers the mental model of technical rationality.

No question - our strategy was stuporous. We developed isolated systems which became obsolete before they started. Specifically under the perspective of an engineer model it is, and really was, inefficient and expensive. The question is why didn't we follow this seemingly logical, obvious and coercive strategy? Already in our first meeting the question of the integration on gestalt level for the whole system raised, we failed to deal with it over 7 months.

Our anticipated conclusion: Until the day we are confident, that the project would have broken down, if we had had analysed the business processes and started to develop an integrated system at the first meeting. Why?

- At this time, the three departments were still two different institutions with quite different business processes. Especially the secretaries felt uncertain about the results of the merging process. At that time efficient and systematical clarification of the business processes would have resulted in a highly explosive atmosphere in the departments.
- Due to its time consuming aspects none of the staff members wanted to chair the project.
- It would have been difficult to raise additional financing.
- Designing one integrated system would have resulted in difficulties in sharing work responsibilities on the part of the agency and the graphic designer.
- Planning the entire project from scratch would have caused a major delay in starting the homepage.

The arguments mentioned above do not defeat the potential usefulness of a system design process based on a systemic and systemically analyses of the business processes. Strictly speaking they even do not refute the standard textbook procedure. But a common discursive reflection in retrospect showed convincingly that the financial shortcoming as well as the motivation of all the particpants opposed a “cleaner” and more general approach. This assessment accepted, we were lucky that persons involved had not been practiced the engineer model: According to this model the design process would have to be interrupted when the pre-established goals could not be reached.

So what? - as Weik (1985, 242) noted, a reasonable question in organizations. We continued and succeeded. In order to explore the logic (!) behind the success of our case, we now refer to some concepts from the organization theory which give us valuable insights in the process of (the) organisation (of System Design).

Lessons learned from organization theory

Lesson 1: In the mental model of technical rationality you need to find solutions for existing clearly defined problems. In the garbage can model (Cohen/March/Olsen 1972; March/Olson 1976) problems, solutions, participants and choice opportunities are independent streams of events that flow into and through organizations, much like a random selection of waste gets mixed together in a garbage can.

As in our case study demonstrated problems followed envisioned solutions. The starting point was the vision of a solution (Schön 1983 and 1987): The perspective of an interactive 3-D virtual multiuser world. A fascinating idea and, as you can see, a good research object. Of course much more fascinating than dull problems on both administration and technical level. A budget was there and a producer for the system was found. Participants, who were willing to invest a considerable part of her working time were difficult to find and at the beginning the choice opportunities simply didn't exist. Therefore a lot of interlocked smaller (homepage, administration database) and larger (central course database) solutions exist, which are partly claimed to solve the information problems of the students and partly to solve other problems, eg from lecturers and secretaries. At the beginning nobody saw the ability to actualize a more systemic and systematical process and/or nobody was willing to invest more time than developing her/his small solution. As a consequence (eg with the garbage can model) we ignored emerging problems without reflecting on them.

Lession 2 and 3: Ortmann (1990, 391ff) introduced the concept of a 'micopolitic bricolage' in the organization theory. The concept based on the bricolage-engineer concept from Lévi-Strauss lesson 2), enriched with micropolitics aspects of power and control (lesson 3)

The mental model of the engineer is described above. The mental model of the participants in this case was that of a 'Bricoleur' (a handicraft man). A Bricoleur looks a the actual situation and tries to find a solution with the tool box available. For her/him the result is not fixed established, it is accepted that the planned system is undergoing a continuous change depending on available resources. Even goals can be adapted and compromises are allowed. For a Bricoleur it is okay to accept limited budgets, to patch consisting systems together etc. And when he plans substantial changes in the system - like the two described movements - s/he will not ask wether the original goal is achieved, s/he will ask, whether the new solution is useful, even for another persons.

The bricoleur metaphor has got limited in scope when more Bricoleurs with different interests and world views have to work together or maybe work against each other (see Ortmann et al 1990, 395). Therefore you have to bring up the social process in mind. In the micropolitic approach of organization theory the developing and implementation of a service system can be interpreted as 'games of innovation' (Ortmann 1992, 465), games which challenge the consisting 'routine games,' the existing regime of division of tasks, the negotiated arrangements etc. It is a meta-game, which defines interests, rules, structures, profits and losses and possible strategies of future games of routines. Hence, these games were played with high interests, in particular from those, who see the existing chances endangered.

In this view the implementation of a system is not only a technical process, but has also his social characteristics. In the model of technical rationality this is only another problem ("to raise the level of acceptance", "to reduce the resistance") to be solved by participation and information. In the model of a 'micropolitic bricolage' the technical and social process can't be divided. The social process will influence the technical solution and vice versa.

Lesson 4: In the mental model of technical rationality one has to follow a certain procedure to get to the solution. The goal is optimization of different variables for the purpose of efficient functionality. The "know how" of these procedures provides the professional knowledge of the specialist. In the mental model of bricolage knowing how is replaced by "to be able to" the usable skill in an actual situation. To know how to change a spare tire is not the same as to be able to do it. If someone confuses "knowing how" with "to be able to do" then there is the intrinsic fundamental risc of failure (Baumgartner 1993, 76).

Supplements of two logics: dream and reality

As you can see in the time-table, we are in an ongoing process and we are actually dreaming to change from the bricolage to the engineer model. The possibilities to change the project from bricolage to technical rationality (eg to the engineer model) are quite good. It appears, that there is now one of these seldom lucky chances, when solutions, problems, participants and choice opportunities come together and results in a problem solution on a system level. Our minds are full of rational concepts, nonetheless we are sure, that the ongoing social process and (not) available resources will jumble our concepts and will influence the database, respectively the information system.

In this sense, the two different logics as summarized in the table below are not only excluding each other, but are supplements (Derrida) in the process of organization.

Dimensions	Technical Rationality ("engineer")	micropolitic bricolage
focus	the whole system and the purpose of the system	the tool box available, the system and the purpose
orientation	the "objective" reality, the world out there	the tool box, the actors, the situation
result	generated by the analysis of the problem; should not be changed	is not fixed established, is undergoing a continuous change depending of actors, their influence, power and strategies
means-end relation	the goal is the priority; the solution is subordinated and has to fulfill the purpose	solution and problems are co-existent; solutions generate new problems
organization of the design process	paradigm of technical rationality; the social process is just one of the marginal conditions	social and technical process can't be divided, the actual actors and decision makers are important
social process	... is only a question of resistance and acceptance, actual social practices are not important	... are social practices, the situation of power, hierarchy and negotiation between participiants are important
failure	if pre-established ends can't be reached	goals can be adapted, compromises are allowed
organisation is	... a set of fixed relation and their formal connections	... a set of social practices which have to be negotiated all the time
direction	from the formal function to the real application (deduction)	from the (possible) solution to the formal functions (induction)
evaluation	if the goal is achieved	one has also to reexamine the goal itself

Table 1: Two logics of system design

References

Baumgartner, P. and D. Wydra. 1999. VR Studying Business Edcuation. In: *Proceedings of ED-MEDIA 99 - World Conference on Educational Multimedia and Hypermedia*. Charlottesville: AACE. 1430-1431.

Baumgartner, P. 1993. *Der Hintergrund des Wissens. Vorarbeiten zu einer Kritik der programmierbaren Vernunft.* Klagenfurt: Kärntner Druck- und Verlagsges.m.b.H.

Günther, A. 1998. Topographische Wissensanbindung als Gedächtnisunterstützung in multimedialen Lern- und Informationssystemen. doctoral thesis, TU Berlin.

Ortmann, G. et al. 1990. Computer und Macht. Opladen: Westdeutscher Verlag.

Weick, K. E. 1985. Der Prozeß des Organisierens. Frankfurt aM: suhrkamp taschenbuch wissenschaft. (english: Weik, K. E. 1979. The Social Psychology of Organizing. Addison-Wesley Publishing Company.)

Cohen, M., March J.G. and Olsen J.P. 1972. A garbage can model of organizational choice. In: ASQ 17, 1-25

March, J.G. and J.P. Olson 1976. Ambiguity and Choice in Organizations. Bergen.

Scheer, A.-W. 1999. ARIS, Business Process Frameworks. New York et al.: Springer Verlag

Schön, D. A. 1983. *The Reflective Practitioner. How Professionals Think in Action.* New York: Basic Books.

Schön, D. A. 1987. The Art of Managing: Reflection-in-Action within an Organizational Learning System. In: *Interpretive Social Science*, Hg. von P. Rabinow und W. Sullivan. Berkeley/Los Angeles/London: California Press. 302-326.

Schön, D. A. 1987. *Educating The Reflective Practitioner. Toward a New Design for Teaching and Learning.* San Francisco: Jossey-Bass.

Learning in the Labyrinth: Hypertext and the Changing Roles of Instructor and Learner in Higher Education

Siân Bayne
University of Bristol
England, UK
sian.bayne@bristol.ac.uk

Ray Land
University of Edinburgh
Scotland, UK
ray.land@ed.ac.uk

Abstract: The media through which academic discourses are conducted are rapidly shifting from the printed text and face to face dialogue, to the new electronic forms enabled by web-based hypertext, hypermedia and computer mediated conferencing. These new forms can be seen to embody and make explicit many of the key principles emerging from recent critical theory. Such theory, by radically challenging traditional notions of textual stability and the nature of language, also draw into question the possibility of stable meaning and systems of knowledge, the pursuit of which lie at the basis of traditional, positivist academic thought. This paper draws on such theory to consider not only how, by 'de-stabilising' the academic text, the new educational media are enabling new forms of academic discourse to emerge, but also how such changes in discourse have the potential fundamentally to altcr the roles of instructor and learner, and the nature of the academic institution itself.

The Printed Text and the University

As learners and teachers in higher education, we work from within a scholarly paradigm predicated on print technology. Where the early manifestation of scholarly activity in the copying and annotating of manuscripts necessarily involved textual drift and idiosyncratic intervention – making each manuscript a unique artefact – print allowed us to apparently 'fix' text, to create for ourselves the possibility of a static, unitary, reproducible and 'true' version in which academic knowledge could be inscribed and disseminated. Commentators on the impact of print technology on our culture have shown how it has informed contemporary notions of scholarship (McLuhan 1962), while historians draw our attention to the involvement of the university with the very origins of the book trade (Haskins 1957). The crests and logos of countless academic institutions which are, or wish to appear, ancient and eminent repeatedly show the image of the printed and bound book, sitting at the very heart of the university's symbolic representation of itself.

This central position of the printed text occurs because the notion of textual fixity, or stability, which print technology both symbolises and perpetuates is intrinsically bound up with what has traditionally been seen as the fundamental basis of scholarly activity – the pursuit of truth, authority, objectivity and stable systems of knowledge which characterise 'traditional' academic thought. During the latter half of this century, such ideas have been under sustained attack from literary, cultural, political and scientific theorists and philosophers, but it is only since the advent of hypertext, hypermedia and other manifestations of the new communication technologies that a material and explicit alternative to print has been available to us to question the formulations of meaning and knowledge inherited from print technology.

As Landow reminds us:

> We so tend to take print and print-based culture for granted that...we have 'naturalized' the book by assuming that habits of mind and manners of working associated with it have naturally and inevitably always existed. (Landow 1997)

Electronic texts – in the form of hypertext and hypermedia-based learning materials, web-based and hyperlinked computer-mediated conferencing exchanges, and even simple email – are rapidly gaining ground in universities as means of generating and sharing academic knowledge. While we must take care not to subscribe blindly to what Duguid (1996) describes as a preoccupation with technological 'supersession' (the idea that each new technological type vanquishes or subsumes its predecessors), or to other forms of technological determinism, we might reasonably predict that such technologies will in time displace print as the primary, 'naturalized' medium through which academic discourses are conducted. As this occurs, we face fundamental changes in every area of the academy, from the ways in which the relations between instructor and learner are formulated, through the discourses and structures of our institutions and ultimately to our very perceptions of the nature of the 'scholarly' and what it means to pursue academic knowledge. The university, an essentially modernist institution (Bloland 1995), is being driven towards postmodernity by the postmodern artefacts of hypermedia.

The Electronic Text and the Transformed Role of the Reader

Such fundamental changes are predicated on the fact that hypertext and hypermedia force us to change both the way we read and our ideas about what constitutes 'text'. Hypertext theory teaches us that texts created in the electronic writing space do not conform to the Aristotelian notion that texts should have a beginning, middle and end, and be structured and read sequentially. Readers of hypertext enter the textual world at any point (in the case of web-based hypertext this world is almost infinite), determine for themselves a path through that world by following links in an order not determined by an author or instructor but by their own inclination, and emerge not when a text is 'finished', but when they feel ready to abandon it. Hypertext challenges traditional models of sequential progression, based on centuries of print-based technology, and presents a multi-linear, reader-defined model of interaction with text. The text does not exist in singular, static form but varies with each reading.

Hypertext theory emerges from critical theories of the last three or four decades, in particular those of post-structuralism. The latter have fundamentally altered our conception of the nature of text (regardless of what media it is presented in) and strikingly anticipate the emergence of hypertext and hypermedia, and the new ways of reading necessitated by these forms. It will be useful at this point briefly to outline such theories, and the ways in which they alter the relationships – forged in the context of the dominance of print technology – between author, reader and text. We will then consider how these new relationships are extended into the learning context and what the implications might be for institutions of higher education.

'Traditional' theory, or that which has its roots in the Romantic movement of the nineteenth century, assumes a fundamentally hierarchical relationship between the writer of a text and its reader. The writer is seen as the originator of the text, as the owner or inventor of the text's meaning (the word 'author' itself clearly implies this authoritative position). The author is, in the Romantic view, the possessor of a superior creative soul, one capable of communion with higher truths with which they enlighten the rest of the world through the medium of the written word. The reader in this scheme is the lowly recipient of the writer's vision (it is his or her duty to attempt to extract from the text its true meaning, i.e. that which the author has put into it).

This assumption was much questioned by twentieth century theorists. In particular, those of the reader-response school articulated theories which stressed the primary role of the reader in the construction of meaning. Iser claims that the literary work is not simply the text itself, but a synthesis of the text and its 'realization' in the mind of the reader (Iser 1972), while Fish goes further, suggesting that there is no meaning inherent in the text itself. A work is only ever a product of the reader's interpretive processes, and has no objective existence independent of the reading experience (the reader *is* the writer) (Fish 1980). Barthes distinguishes between the *lisible* ('readerly') classic text which places the reader in the position of passive consumer of narrative and meaning controlled by the author, and the *scriptible* ('writerly') modern work which forces its readers to be active in the construction of meanings which are multiple and inexhaustible (Barthes 1970).

Though none of these theorists refers explicitly to hypertext or other forms of electronic writing, the connection is clear. Hypertext forces the reader to take control of his or her own experience of the text by requiring choices to be made about how and in what order connections between blocks of text, or units of meaning, are made. With certain forms of electronic text, including that generated in hyperlinked computer-mediated conferencing environments, the vision of the author as the single originator of the text and possessor of its meaning is submerged completely (the reader quite literally is the writer). The reader, figuratively of central importance to the reader response theorists, is made materially central in the electronic medium. As Bolter puts it:

> The computer makes concrete the act of reading (or misreading) as interpretation and challenges the reader to engage the author for control of the writing space... The computer makes visible the contest between author and reader that in previous technologies has gone on out of sight, 'behind' the page. (Bolter 1991)

Alongside such theories of reader response, we must also consider the ideas of the post-structuralist theorists (the philosopher Derrida, the historian Foucault and the psychoanalyst Lacan), and their focus on the indeterminacy or instability of meaning, the fragmentation of individual identity, and the centrality of discourse (Land & Bayne 1998). Post-structuralist thought emphasises that language does not provide us with a set of terms or labels which we use to name entities which already exist independently in the world. Rather language precedes the existence of these entities, enabling us to make the world intelligible by differentiating between concepts in a way which is particular to our own cultural context. The way in which we formulate meaning cannot be fixed and pinned down – language operates as a system of signs in which the relationship between signifiers (words, written or spoken) and signifieds (the concept or meaning referred to) is constantly shifting, always in a state of flux. Meaning cannot be nailed down, it is inherently unstable, 'never fully present in any one sign alone, but rather a kind of constant flickering of presence and absence together' (Eagleton 1983).

Ideas about the nature of text itself are radically affected by the ideas of the post-structuralists. Texts are no longer seen as closed, stable entities, holding within them definite meanings which the reader is required to decipher. Rather, they become a temporary arena for the endless play of signifiers – they cannot be tied down to any one meaning, but remain open and pluralistic, subject to multiple interpretation. All texts are woven out of other texts in that every element of them refers to other writings which surround, precede or follow, much as the sign itself is composed of traces of every other sign. This is broadly referred to as 'inter-textuality'.

What is more, the traditional hierarchical relationship between texts is undermined. Where traditionally a so-called central or 'primary' text takes a prime position, providing a focus for discussion and interpretation in the form of marginal or 'secondary' texts, Derridean deconstructionists would claim not only that the central can become marginal (and vice versa) but that the very difference between the two can be brought into question. Since both are subject to infinite play of meaning and interpretation, we cannot say where one ends and the other begins. The text is 'a differential network, a fabric of traces referring endlessly to something other than itself, to other differential traces. Thus the text overruns all the limits assigned to it so far' (Derrida 1991).

The relevance of all this to the study of electronic text is implied in a passage from Eagleton's *Literary Theory* which describes the post-structuralist vision of language:

> Instead of being a well-defined, clearly demarcated structure containing symmetrical units of signifiers and signifieds, [language] now begins to look much more like a sprawling limitless web where there is a constant interchange and circulation of elements, where none of the elements is absolutely definable and where everything is caught up and traced through by everything else. (Eagleton 1983)

Web-based hypertext and hypermedia can be seen as materialising the concepts of post-structuralist theory. The world wide web, sprawling, limitless, consisting of endless, unstable, changing elements, each one potentially linked to each other and therefore bearing within it infinite traces or connective possibilities, embodies the characteristics the post-structuralists see in language systems. Hypertext is endlessly recenterable. As a reader moves through a hypertext construct, or as a student moves through a virtual learning environment, he or she continually shifts centre or focus, is continually active in creating new possibilities for meaning. Such environments are also explicitly intertextual, stressing connectivity rather than what Bolter calls 'textual independence' – 'the electronic space permits us to visualize intertextuality as no previous medium has done' (Bolter 1991).

This intertextuality enables hypertext, in both art and pedagogy, to break through traditional generic and disciplinary boundaries, in the process violating the hierarchy of centre/margin (primary text/secondary text) identified by deconstructionist theory. Just as a hypertext poem might contain within it links to prose sites, to critical analyses, biographies, video and sound, so a section of online learning material might link to news clips, cartoon animation and discussion fora as well as to pedagogical material drawn from other related subject areas and disciplines. Just as the work itself is not constrained to a single medium, neither does it contain a fixed centre. The centre is where the reader or learner is at any given moment; the marginal becomes central at the click of a mouse button.

Teaching and Learning in the Hypertextual University

How will academic study be affected as electronic text (which as we have seen embodies and makes 'obvious' some radical theoretical principles) begins to replace print-based text as the 'norm'?

> One chief effect of electronic hypertext has been the way it challenges now-conventional assumptions about teachers, learners, and the institutions they inhabit. It changes the roles of teacher and student in much the same way it changes those of writer and reader. Its emphasis upon the active, empowered reader, which fundamentally calls into question general assumptions about reading, writing and texts, similarly calls into question our assumptions about the nature and institutions of education that so depend upon these texts. (Landow 1997)

The transformational implications of hypertext for teaching and learning, and for the academy more generally, can be identified at a number of levels. We have already seen how at the textual level it implies a shift to openness, inconclusivity, infinite recenterability and the empowerment of the reader; the final section of this paper will show how such potential for transformation is extendable to the roles of *instructor and learner*, to the formulations and boundaries of *disciplines*, to the possibility for new forms of *academic discourse*, and finally to the nature of the higher education *institution* and community.

The Role of the Learner

Landow describes ways in which working with hypertext transforms the student learning experience. Because, within hypertextual space, students gain both information and habits of thinking critically in terms of 'multiple approaches or causes', hypertext can be seen to orient students towards developing a habit of 'making connections'. This fosters 'a participatory reading-and-writing environment' which empowers students 'by placing them within – rather than outside – the world of research and scholarly debate'. It thus enables students to explore and create new modes of discourse suited to modes of reading and writing increasingly used in e-space. (Landow 1997)

A clear implication for the role of the learner in such environments is the requirement that they adopt an active approach. Hypertextual systems, argue Jonassen and Grabinger 'place more responsibility on the learner for accessing, sequencing and deriving meaning from the information' (Jonassen & Grabinger 1990). In this regard hypertext is probably best considered as a learning rather than teaching environment in which an exploratory, 'research' approach to learning may flourish. By disposing students towards multilinear and multisequential patterns of thinking, and immersing them in environments of multivocality, hypertextual systems may also stimulate processes of 'integration and contextualization' – high order cognitive skills – in ways not achievable by linear presentation techniques (Mayes et al 1990). This accords with Landow's interpretation of conceptual skill as 'chiefly making connections', a capacity eminently endorsed by hypertext's defining characteristic of connectivity.

The Death of the Tutor?

Barthes once famously proclaimed the 'death of the Author' (Barthes 1977) – announcements of the death of the Tutor may be premature but the pedagogical application of hypertext does alter the role of instructors by shifting some of their authority and function to the learner. As we have seen, engagement with hypertext necessarily empowers the reader or learner so that a transmissive theory of knowledge which characterises teachers as 'the ones who know' and their task as 'to channel what they know into the students' is increasingly difficult to sustain (Spender 1995).

Such shifts in authority imply a transference of power to learners, which imposes upon them a duty of responsibility for autonomy, critical judgement, and a higher degree of tolerance of complexity and ambiguity. This in turn might be seen to have an emancipatory effect upon the role of the teacher, who is freed from the traditional status-oriented informative, didactive and confrontational interventions of traditional practice in favour of more supportive and guidance-oriented cathartic, catalytic and facilitative interventions.

Entwistle, Thomson and Tait (Entwistle et al 1992) argue that encouraging a 'deep approach' as opposed to a 'surface approach' in learners requires both an active approach and interaction with peers and tutors. Hypertext, as Landow shows (Landow 1992) affords excellent opportunity for collaborative learning, whereas such activity, as Ede and Lunsford (Ede & Lunsford 1990) demonstrate, tends to be mistrusted in closed text environments, where 'the pervasive commonsense assumption' is 'that writing is inherently and necessarily a solitary, individual act.' Entwistle and colleagues also show the need both for a 'well-structured learning environment' – a tall order in the hypertextual labyrinth but nonetheless crucial to pre-empt learner disorientation and intimidation – and for 'a motivational base', the support and encouragement needed by all learners. Assessment, too, Landow reminds us, must seek evidence of the connectivity and contextualisation hypertext affords, if it is to have validity. So a rich but challenging role remains for the instructor – one that is hypertextually transformed into that of facilitator-moderator.

Interdisciplinarity

It is no longer possible, Spender argues, for teachers to appear as experts in a computer-based world. 'There is just too much information for any one individual to master' (Spender 1995). Within the print-based university – the society of the closed, static text – knowledge was in short supply, a special commodity. This empowered the gatekeepers, the initiators into disciplines, to determine intellectual boundaries, to regulate entry to the next level of information, and, as the ambivalence of the Latin root of 'discipline' suggests, to *control* and to *teach* simultaneously. Lyman talks of an 'ecology of knowledge' in which, when knowledge is scarce, centralisation and conservation take precedence. In an information-saturated environment, however, 'our distinctive information problem is one of selection, as much as conservation' (Lyman 1994). There is no entry test, Spender reminds us, for TV viewing. The logic of hypertext, a postmodern phenomenon, is to erode the controlling boundaries of the discipline, which, in its unifying and totalizing tendency, is a modernist concept. The impetus of hypertext is inexorably towards interdisciplinary connection. The learner is no longer dominated by the *dominus*.

Democratic Publishing and Contextualised Debate

New hypertextual environments have the potential to transform the way in which scholarly publishing and debate operates. Buckingham Shum and Sumner (Buckingham Shum & Sumner 1998), for example, discuss how hypermedia might enable academic authors to break free of some of the constraints of traditional, paper-based scholarly publishing (its expense, long publication timescales, restriction to static text and image and generally non-existent facility for subsequent debate and discussion). Even the majority of web-based e-journals, they argue, remain 'papyrocentric', using technology to replicate traditional publishing approaches rather than to make meaningful advances on current forms of academic discourse.

Their toolkit for the publishing and discussion of web documents – the 'Digital Document Discourse Environment' (D3E), operates from the premise that 'the intellectual cut and thrust of discussion and debate between peers as they contest the ideas proposed in a document' is a key academic activity. It automates the procedures around publishing a document to the web and integrates the document (which may be in a variety of media) with a discussion environment which opens it up to clearly contextualised debate. Readers' comments link back to the text and vice versa, and authors are able easily to revise and update documents as their research develops or ideas change. The traditional, static, closed, paper-based academic text becomes an accessible dynamic entity, potentially open to immediate input from a worldwide academic community. The toolkit also assists the creation of innovatory student assignments, with modes of student writing mirroring those of their instructor-publishers. This represents another manifestation of hypertext's functioning, in Galegher and Kraut's phrase, as a 'permissive technology', fostering new forms of academic discourse, and allowing 'current practices to be extended into new realms in which they had previously been impracticable'.(Galegher & Kraut 1990)

Boundariless Anxiety, Widened Community

Hypertextual environments, in their protean boundarilessness, pose daunting dilemmas for the university as modernist institution. As Bergquist argues, in modern organisations 'boundaries (and identities defined by roles and rules) serve as "containers" of anxiety' (Bergquist 1995). We can see the function of disciplines, modularisation, academic management and reward structures in this regard. However in the postmodern condition these boundaries are eroded and there is a 'spilling out of anxiety', a 'sense of living on the edge'. Another container of anxiety has traditionally been admission criteria and the division of individuals into those allowed in and those kept out.

But in the fully 'technology-normalized' institution, access becomes virtual and community easily widened, undermining the difference between centre and margin, what is inside the academy and what (or who) must remain outside. Deleuze has used the term 'enclosed environments' to describe territories which are circumscribed within organisations 'to concentrate; to distribute space; to order time; to compose a productive force within the dimension of space-time whose effect will be greater than the sum of its component forces' (Deleuze 1992), while Taylor suggests that terms such as 'boundaries' and 'sites of enclosure' are used 'to describe attempts by institutions to create contexts – enclosed territories – in which only the occupants define the particular rules and practices which govern internal operations' (Taylor 1999). But the educational institution now has the potential to develop as an unbounded environment, with all its anxieties and its emancipatory promise – an environment into which hypertext, in the guise of some neo-Promethean tool, beckons us.

References

Barthes (1970). *S/Z.* trans. by Richard Miller (1975). London: Cape.

Barthes (1977). 'The death of the Author'. *Modern Criticism and Theory.* ed. by David Lodge (1988). London: Longman.

Bergquist (1995). *Quality through Access, Access with Quality: The New Imperative for Higher Education.* San Francisco: Jossey-Bass.

Bloland (1995). Postmodernism and Higher Education. *Journal of Higher Education*, 66 (5).

Bolter (1991). *Writing Space: the computer, hypertext and the history of writing.* New Jersey: Lawrence Erlbaum Associates.

Buckingham Shum and Sumner (1998). The 'Digital Document Discourse Environment. (eds), *The Knowledge Web: Learning and Collaborating on the Net.* ed by Eisenstadt and Vincent London: Kogan Page.

Derrida (1991), quoted in Bolter (1991), p.162.

Duguid (1996). Material matters: the past and futurology of the book. *The future of the Book.* ed. by Nunberg (1996). Berkeley and Los Angeles: University of California Press.

Eagleton (1983). *Literary Theory: an introduction*, Blackwell: Oxford.

Ede and Lunsford (1990). *Singular Texts/Plural Authors: Perspectives on Collaborative Writing.* Southern Illinois University Press.

Entwistle et al (1992). *Guidelines for Promoting Effective Learning in Higher Education.* Centre for Research on Learning and Instruction, University of Edinburgh.

Fish (1980). *Is there a text in this class?* Cambridge Mass: Harvard University Press.

Galegher and Kraut (1990). Technology for Intellectual Teamwork: Perspectives on Research and Desig'. *Intellectual Teamwork.* ed by Galegher , Egido and Kraut. Hillsdale: Lawrence Erlbaum.

Haskins (1957). *The Rise of Universities.* London: Oxford University Press.

Iser (1972). The reading process: a phenomenological approach. *Modern Criticism and Theory.* ed. by David Lodge (1988). London: Longman.

Jonassen and Grabinger (1990). Problems and issues in Designing Hypertext/Hypermedia for Learning. *Designing Hypertext/Hypermedia for Learning.* ed. by Jonassen and Mandl. Heidelberg: Springer-Verlag.

Land and Bayne (1998). Computer mediated learning, synchronicity and the metaphysics of presence. *Educational multimedia, hypermedia and telecommunications, 1998*, Association for the Advancement of Computing in Education, Charlottesville, VA.

Landow (1992). *Hypertext: The Convergence of Contemporary Critical Theory and Technology.* Baltimore: Johns Hopkins University Press.

Landow (1997). *Hypertext 2.0: the convergence of contemporary theory and technology.* Baltimore: John Hopkins University Press.

Lyman (1994). Follett Lecture, cited in Spender 1995, p.103.

Mayes et al (1990). Learning about Learning from Hypertext. *Designing Hypertext/Hypermedia for Learning. ed.* by Jonassen and Mandl. Heidelberg: Springer-Verlag.

McLuhan (1962). *The Gutenberg Galaxy: the making of typographic man.* Toronto: University of Toronto Press.

Spender (1995). *Nattering on the Net: Women, Power and Cyberspace.* Melbourne: Spinifex.

Taylor (1999). *Making Sense of Academic Life: Academics, Universities and Change.* Buckingham: SRHE /Open University Press.

A Study of the Influences and Barriers to Faculty Use of Instructional Technology in Higher Education

Thomas A. Beggs
Director of Learning Resources
State University of West Georgia
Carrollton, GA 30118 USA
tbeggs@westga.edu

Abstract: As instructional technology becomes ubiquitous in classrooms, faculty will be asked to utilize new technologies in their pedagogy. Some will accept new ways to teach with technology while others resist. What are factors that influence faculty to adopt this technology and find effective pedagogy to utilize it? The Department of Learning Resources at the State University of West Georgia asked its faculty about influences to technology adoption while creating a plan to tackle technology resistance. The resulting data showed the faculty recognized common barriers to instructional technology as well as influences that helped them overcome the barriers.

As higher education faculty adopt new instructional technologies, it will be important for influencing factors and barriers to their adoption of instructional technology to be addressed. The success of our faculty in utilizing technology will impact our students' education and ultimately success in their careers. In this technology age, higher education must prepare students to integrate technology in their learning if our institutions expect to continue to be viable avenues for students to prepare for life in the workforce.

Literature

The definition of instructional technology used in this study is one that refers to the use of technology to achieve an instructional objective (Spotts & Bowman, 1995). This technology includes computer hardware and software, networks, email, multimedia, and computer peripherals such as CD players. Traditional media such as video and audio are also defined as instructional technology.

Albright (1996) said in a keynote address to the Southern Regional Faculty and Instructional Development Consortium that so many barriers have existed in higher education to the adoption of instructional technology that faculty use of technology has been accomplished in spite of the campus environment. He notes that education may be the only business that actually discusses that there are barriers to its employees' adoption of technology. Albright also points out that higher education faculty have a conservative approach to its institution and a commitment to the traditional means of teaching – a barrier to innovation and technology in instruction. Approximately 80% of higher education instruction is delivered by lecture, a form in which instructional technology can be utilized, but only in rudimentary ways. Research suggests that lecture is not the best method for developing problem solving and critical thinking, often desired skills in the workplace (Oblinger & Rush, 1997).

Change in higher education has traditionally been slow. In the literature there is a reference to an anonymous quote apparently uttered by a frustrated instructional technologist:

> *The pace of academe is perhaps best measured by the 25 years it took to get the overhead projectors out of the bowling alley and into the classroom (in Gilbert & Green, 1997, p. 25).*

The time span does not matter, but the heart of the issue remains. When faculty began adopting the new instructional technology there were issues that affected its acceptance and slowed its adoption.

The fear of failure in using the technology is a factor that has been cited as an initial barrier (Hannafin & Savenye, 1993). While faculty members are experts in their content area, they are not experts in the use of technology. They are also concerned about instructional technology operating consistently in the classroom (Byron, 1995). When the technology is difficult to use, the faculty would often have problems and refuse to use the technology again (Albright, 1996).

The availability of technical support staff to assist when in-class problems arise is important for faculty if they are going to tackle instructional technology (Nantz & Lundgren, 1998). Improved classroom designs will also alleviate concerns about difficult to use technology. Another anxiety that faculty face in adopting instructional technology is the devaluation of their profession and, consequently, the elimination of their jobs (Novek, 1996). As technologies are promoted as the next best way to reach more students, such as through distance learning, faculty worry about the role of the traditional campus and their possibly diminished place in the education system (Oblinger & Rush, 1997).

Novek (1996) also said faculty were concerned about the dehumanizing potential of technology. These instructors were concerned that students and teachers would become alienated by technologies such as distance learning. Oblinger and Rush (1997) suggest that some professorial functions such as simple transmission of facts may be replaced, but more important functions will continue to be essential. Leading discussions, helping students make sense of the whole, and suggesting resources are among the aspects that will create an improved learning environment. Research in asynchronous learning environments reported students have more access to their professors than in traditional lectures (Oblinger & Rush, 1997).

Whether the use of instructional technology in the classroom is effective for teaching is also an issue which faculty consider important (Byron, 1995). Faculty question whether students' performance will be improved with the use of technology. Research has shown that it is not the technology itself but how the technology is used that improves learning and increases student interest (Albright, 1996; Charp, 1998).

Though students have said that faculty are not ready to make the paradigm shift to use multimedia and instructional technology in the classroom (DeLoughry, 1995), instructional technologists have evangelized for years that there are proven ways to encourage faculty to adopt and develop instructional technology (Albright, 1996). For example, the availability of instructional technology is an influence to its adoption by faculty. Faculty also welcome an effective support system. In a series of faculty focus groups at the University of North Texas, Byron (1995) found that knowledgeable, friendly technical support staff who respond in a timely manner are among the top factors for technology adoption.

Faculty members say it takes time to learn the technology and it takes even more time to develop instructional technology materials (Hirschbuhl & Faseyitan, 1994; Nantz & Lundgren, 1998). Green (1998) says that institutions have not been prepared for the sustained investment in time and support and financial resources needed to develop quality instructional resources. One of the most important support issues influencing faculty to adopt technology is training (Armstrong, 1996). In the Campus Computing Project 1998 National Survey of Information Technology in Higher Education, Green (1998) stated that "assisting faculty integrate technology into instruction" as the single most important issue reported and providing adequate user support as the second (p.1).

As faculty adapt technology to their pedagogy and grow in its use, they deserve recognition for their efforts. There must be a reward system that recognizes the adoption of technology through promotion and tenure (Nantz & Lundgren, 1998). It has become even more important as the adoption of technology has increased, but Green finds the majority of universities and colleges have not addressed this issue (Green, 1997). Technology support centers and faculty mini-grants are needed as well, but failing to recognize and promote faculty who are integrating technology "sends a chilling message about institution commitment," Green says (p. 2). Growth in the adoption of instructional technology requires a continuing investment of time, personnel, and funding (Green, 1996). Administrative commitment is required for this long-term development because only the institution can provide these resources.

Innovative teachers can be adopters or non-adopters of technology, but innovative adopters found significant advantages in the use of technology (Reimers, Rathbun & Goodrum, 1999). Innovative technology adopters discovered instructional technology gave them flexibility in designing course materials (Reimers, Rathbun & Goodrum, 1999).

One of the keys to the success of instructional technology may be the change in pedagogy from students being passive recipients of knowledge to becoming active participants in the instructional process. If students are to become more active learners, faculty must establish more communication and student-centered learning. When faculty are encouraged to utilize instructional technology their pedagogy evolves. In the project at Hofstra University, as faculty adopted multimedia technology they changed teaching styles to focus on guiding and facilitating instead of just lecturing about the material (Haile, 1998).

Interaction between faculty and student has been enhanced with the increased usage of email to transmit class assignments and make faculty available outside of class hours to answer questions (Reimers, Rathbun & Goodrum, 1999). Students can access courses anytime and anywhere by the use of the web and Internet.

During the 1990s, Kenneth Green has tracked the changes in the adoption of technology by surveying college and university computing officials. He reports that faculty technology adoption had reached a self-sustaining point based on Everett Rogers' diffusion of innovation (Green, 1996). Rogers described this point as when 15-20% of individuals have adopted an innovation (Rogers, 1995).

Data from the 1998 National Survey of Information Technology shows there has been a jump from 8.4% in 1997 to 22.5% in 1998 in the use of web pages for class materials and resources (Green, 1998). Email use in support of courses has jumped from 32.8 percent in 1997 to 44 percent in 1998.

Until as late as the mid-1990s, there had not been significant research on the use of instructional technology by faculty in higher education. Green has annually reported since 1990 the results of Campus Computing Project annual National Survey of Information Technology in higher education. However, the survey information is provided by officials at some 500-600 two- and four-year colleges and universities and not directly from faculty members.

The purpose of this study is to examine the aforementioned barriers and influences to faculty adoption of instructional technology as well as to consider the technology that faculty are using in the classroom and the faculty's perceived knowledge of technology.

Methodology

This research studies the influences on faculty adoption of instructional technology and the integration technology into instruction at a state university with 348 full-time faculty and about 8,800 students. A survey with 61 questions was adapted from an instrument previously used by Groves & Zemel (1999). Questions were designed to determine the faculty's self-reported knowledge and use of technology, factors influencing their use of technology, and perceived barriers to the use of technology in the classroom. Faculty were also asked about the importance of instructional technology to their teaching and if they would continue to adopt new technology (Groves & Zemel, 1999). They were also asked about department, home computer use, rank and years in education.

The study was performed in April, 1999. There were 348 surveys sent by campus mail to all full-time faculty members along with a cover letter explaining its purpose and informing respondents they would remain anonymous. There were 156 surveys returned by campus mail for a return of just over 44%.

Results and Conclusions

This study considers questions that technology support personnel have debated for some time. What are the factors that influence faculty in their adoption of instructional technology and what are barriers that restrict faculty from utilizing technology? Closely tied to these factors are the technologies the faculty have adopted in their instruction and their perceived level of knowledge.

The factors that influence faculty to adopt technology in this were rated and ranked. The top two influences to the adoption of instructional technology in this survey are instructional issues - improved student learning (96.8% important to critically important), and clear advantages over traditional methods (96.1% important to critically important). Equipment availability (94.9% important to critically important) ranked third in this study. Increased student interest (93.6% important to critically important) was ranked fourth. This suggests that the faculty perceive that technology must have a significant impact on instruction for faculty to adopt its use even though the technology must be available.

Equipment factors that ranked high were ease of use (93% important to critically important), time to learn technology (91% important to critically important), and training (86.6% important to critically important). The high rankings also reflect critical factors for faculty, which perceive that time to learn technology and training in technology are essential. Personal comfort level (78.2% important to critically important), even though above a majority, does not seem to have a major impact compared to pedagogy and hardware issues.

The second lowest rated influence with positive ranking was administrative support with 80.1% rating it important to critically important. As an influence, faculty perceive administrative support technology as necessary to instructional technology but not necessarily critical. Least important of the influences to adoption in this study was technology use by colleagues. It seems the technology that a colleague is utilizing in class does not sway the respondents to adopt similar technologies. This was the only influence that faculty rated negatively with 36.5% reporting that it was not important and another 26.9% saying it was only somewhat important (Table 1).

Table 1. Factors influencing use of technology

	FACTORS INFLUENCING USE OF TECHNOLOGY *			
	UWG	UWG rank	Groves & Zemel	G & Z rank
Improved student learning	97	1	97	2
Advantage over traditional teaching	96	2	92	4
Equipment availability	95	3	97	1
Increased student interest	94	4	96	3
Ease of use	93	5	91	5
Compatibility with discipline	93	6	86	8
Time needed to learn	91	7	91	6
Materials in discipline	90	8	83	9
Compatibility with materials	90	9	77	12
Training	87	10	87	7
Administrative support	80	11	80	11
Personal comfort	78	12	80	10
Colleague use	13	13	35	13
	* very importantly to critically important			

Issues of influences and barriers are not only linked but in many cases are opposite sides to the certain factors. The top three barriers were equipment-oriented issues that also ranked high as influences - lack of time (87.4% important to critically important), lack of equipment (76% important to critically important), and lack of training (75.8% important to critically important). These factors reflected their comparable influences in their importance to faculty. Even if technology can have a positive impact on student learning, the faculty member must overcome these personal barriers in order to integrate instructional technology into their instructional processes.

Three factors that received strong negative ratings as barriers were lack of interest in technology (70.4% not important to somewhat important), lack of relevance to the discipline (65% not important to somewhat important), and, surprisingly, lack of contribution to professional development (61.4% not important to somewhat important). With pedagogical issues ranking as such strong influences, faculty seem to be saying that the student is the focus and not the teacher.

Influences and barriers are also linked to knowledge of technology. Not surprisingly, this study showed word processing is known almost universally. Ninty-three percent of the respondents ranked their knowledge good to expert. Email ranked second in this study (88.4%).

Internet use for research and content support also was strong in third rank with 70.1% good to expert knowledge. Presentation software and multimedia use ranked near the bottom in this survey. In this survey presentation software rated 37.5% good to expert and multimedia rated 35.1%. Since multimedia/presentation equipment is being installed rapidly, the lower ranking of this knowledge creates a challenge for technology trainers.

A disappointing lack of knowledge in distance learning and computer conferencing is not unexpected but causes concern in the current environment that has state-wide projects focused on the development of distance learning. While 23.5% in this study said their knowledge is good to expert, another 58.8% said they know little to nothing about distance learning. Computer conferencing, which could be defined as a part of distance learning, was ranked last in this study with 21.6% good to expert and 58.6% none to a little. (Table 2).

The faculty's knowledge of technology is reflected by its use of technology in the classroom. Just as word processing and email were ranked at the top in knowledge, they were also ranked at the top in usage. Word processing was frequently used by 93%. Email communication with colleagues ranked second at 86.6% followed by email communication with students at 61.8%. Presentation software and multimedia usage also mirrored its knowledge ratings. Thirty-eight percent said they use presentation software weekly to almost every class. Multimedia usage was 30.7%.

Sixty-one percent of respondents said they used the Internet weekly to almost every class. For this institution and the state university system, this reflects the importance that has been placed on the development of virtual libraries and a continued development of on-line resources by the state of Georgia. The National Survey of Information Technology in Higher Education showed 33% of classes used the Internet as an aspect of the syllabus (Green, 1998).

Just as in a similar survey by Groves and Zemel, distance learning use is ranked low. Just over 10% used it almost every class, but 68.8% said they never use distance learning. Because email with students can be an aspect of distance learning, it may be that faculty have a limited definition of distance learning. Questions on future surveys should be designed differently to reflect use of the components of distance learning and if those components are for distance learning or on-campus classes.

When asked what technologies they use in class, faculty included word processing, email and Internet as the top ranked technologies. When asked what technology they would like to use, faculty in this study said multimedia (27%) and presentation software (13%). When asked if they would adopt a new technology in the coming year, 61% (n = 92) of the faculty respondents said it was very likely to highly likely. Only 6% of the respondents said it was not at all likely that they would adopt a new technology. Spotts and Bowman (1995) reported 22% were very likely to highly likely to adopt new technology and 26% said it was not likely that they would adopt a new technology. This seems to reflect the growth of technology in society as a whole.

How significant is instructional technology perceived to be? More than half of faculty in this survey (53.2%) said technology is essential to instruction with 83 respondents noting it is very important or critically important. Another 24.4% (n = 38) said it is, at the least, important. These results were higher than reported by Grove and Zemel who found that 46% said it was very important or critically important. Spotts and Bowman (1995) reported 38% rated instructional technology very important or critically important. A majority of the faculty also said there were incentives to the adoption of technology (65.9%), but it seems they have a variety of ideas about the definition of incentives.

In conclusion, the higher knowledge and use results in this survey as compared to previous surveys could be explained in various ways. The environment at this state university has become more conducive to the adoption of technology. An Associate Professor in the Library stated in the survey, "It is obvious that the climate on this campus rewards those who appear, at least, to be innovative." There is strong administrative support for technology. The President and Vice President of Academic Affairs are active in the use of new instructional technology, supportive of technology through funding and have encouraged the adoption of a technology plan which has been created by a faculty/technology staff committee. Faculty have stated that equipment availability is important and there has been an on-going development of campus networks as well as video and multimedia development in the classrooms. Two deans have committed significant funds to the development of multimedia. One college's classrooms are all multimedia and the other has almost all multimedia classrooms. Faculty have said training is important and there have been extensive training programs. There is a strong distance learning department and recent development of fully on-line programs.

When this survey is next administered, there are a number of elements that need to be redesigned to fit this institution, its technology, and its programs. Technologies will be defined to reflect more accurately what is being utilized. The extensive use of WebCT is not mentioned in this survey. Distance learning needs to be more appropriately defined for the university. Several additional factors also need to be explored such as the technology environment, availability of technology and training, and administrative support.

The influences and barriers to technology adoption define its use and possible incentives. As the administration and technology support staff continue to improve the environment by funding new technology, and training teachers, faculty will adopt, adapt, and integrate new technology. The faculty at this institution is young and most have technology in their homes. Technology will continue to evolve and become easier to use. Faculty and students will accept and adapt new technology to instruction and learning as they have the overhead projector. But this adoption won't take the 25 years it took to bring the overhead projector from the bowling alley to the classroom (Gilbert & Green, 1997) because the technology wave has already swept across the private sector and our society. Students will expect instructional technology when they attend post secondary education and it must delivered or else they will go to an institution that will provide the technology.

References

Albright, M. (1996). Instructional technology and higher education: Rewards, rights and responsibilities. Keynote Address at the Southern Regional Faculty and Instructional Development Consortium. Baton Rouge, LA. (ERIC Document Reproduction Service No. ED 392 412)

Armstrong, G. (1996). One approach to motivating faculty to use multimedia. THE Journal, 23, 69-71.

Byron, S. (1995). Computing and other instructional technologies: faculty perceptions of current practices and views of future challenges. A focus group study conducted for the information resources council and the office of the provost. (ERIC Document Reproduction Service No. ED 390 381)

Charp, S. (1998). Measuring the effectiveness of educational technology. THE Journal, 25, 6.

DeLoughry, T. J. (1995). Mandatory computers. Chronicle of Higher Education, 41 (34), A37-A38.

Gilbert, S. W., Green, K. C. (1997). Moving information technology into the classroom. In Linda Enghagen (Ed.), Technology and higher education (pp. 25-56). Washington, DC: National Education Association.

Green, K. C. (1998). Colleges struggle with IT planning, The 1998 national survey of information technology in higher education. http:\\ericir.syr.edu/Projects\Campus_computing\1998

Green, K. C. (1997). More technology in the syllabus, more campuses impose IT requirements and student fees. http:\\ericir.syr.edu/Projects\Campus_computing\1997\index.html

Green, K. C. (1996). Instructional integration and user support present continuing technology challenges. http:\\ericir.syr.edu/Projects\Campus_computing\1996\index.html

Green, K. C. (1996). The coming ubiquity of information technology. Change, 28, 24-29.

Groves, M. M., Zemel, P. C. (1999). Instructional technology adoption in higher education: an action research case study. International Journal of Instructional Media, 27, 56-64.

Haile, P. J. (1998). Multimedia instruction initiative: Building faculty competence. Paper presented at the Annual Meeting of the American Association of Colleges for Teacher Education, New Orleans, LA, (ERIC Document Reproduction Service No. ED 418 056)

Hannafin, R. D., Savenye, W. C. (1993). Technology in the classroom: the teacher's new role and resistance to it. Educational Technology, 33, 26-31.

Hirschbuhl, J. J., Faseyitan, S. O. (1994) THE Journal, 21, 64-65.

Nantz, K., Lundgren, T. D. (1998). Lecturing with technology. College Teaching, 46, 53-56.

Novel, E. M. (1996). Do professors dream of electric sheep? Academic aniexty about the information age. Paper presented at the Annual Meeting of the Association for Education in Journalism and Mass Communication, 79, Anaheim, CA. (ERIC Document Reproduction Service No. ED 399 594)

Oblinger, D. G. & Rush, S. C. (1997). The learning revolution. In Oblinger, Diana G. & Rush, Sean C., (Eds.), The learning revolution. The challenge of information technology in the academy. (pp. 2-19, 231-243). Bolton, Mass.: Anker.

Reimers, C., Rathbun, G. A., Goodrum, D. A., (1999). Energizing the innovative teacher: Technology's role. Paper presented at Association for Educational Communication and Technology Annual Conference, Houston, TX.

Resmer, M. A. (1999). IMS: Building the Internet architecture for learning. Keynote address at Mid-South Instructional Technology Conference, Murfreesboro, Tennessee. From the author's personal notes.

Sammons, Martha S. (1994). Motivating faculty to use multimedia as a lecture tool. THE Journal, 21, 88-90.

Spotts, T. H., Bowman, M. A. (1995) Faculty use of instructional technologies in higher education. Educational Technology, 35, 56-64.

Multimedia/Multiliteracy: The multimedia arts education program

J. David Betts, University of Arizona, USA

Introduction

At the heart of the Multimedia Arts Education Program (MAEC) is a strong mix of literacy activities from the several arts disciplines and techniques. This is a descriptive study of this after school arts technology program for middle school youth. This paper describes the first year of an on-going longitudinal research project that will examine the effects of on high school success, graduation, and career aspirations. Data gathered in this phase will serve as part of the base-line data for that extended study.

MAEC is an intensive computer-mediated arts technology program begun in 1996 by the Tucson Pima Arts Council (TPAC). Middle school youth, targeted as being at risk from disadvantaged families, participate in a series of semester-long after school classes. The program is based on several literacies. Central to all the activities are written output from students consisting of journals, proposals, and descriptive abstracts, as well as poems and stories that are realized in video, computer-mediated animation or graphics. Students work in labs with professionals in computer graphics and publishing, language arts and word processing, computer animation, and video production. A final, fifth semester portfolio class capitalizes on cumulative skills and yields a home page a newsletter and a multimedia presentation. This study examines student development of literacies and computer skills as they effect school performance and prepare them for the electronic arts workplace.

Population

Approximately 8 - 10 middle school students were enrolled in each of the five labs each semester. Most were Hispanic and bilingual in Spanish to some extent. Most started the program during their 6th or 7th grade. A balance of male and female students was maintained by selection. Families must qualify for the free or reduced lunch program at their school and not already have a computer in the home. Students are not auditioned for this program.

MAEC youth who were selected based on factors contributing to high-drop out rates. Of the 44 students in the Spring1998 program, all but two were on free or reduced lunch programs at their school. 54% were bilingual Spanish, 79% Hispanic, 7% Native American, 7% African American and 7% Anglo. There is now a waiting list of interested students and families. Most live in neighborhoods near downtown Tucson with low graduation rates. Students are required to maintain a "c" average in school in order to continue in MAEP.

Theory

The integration of art into education facilitates the construction of new knowledge by young people based on this mediation. New facts are engaged with new skills in new media. These skills call forth new ideas and the transmediation of those ideas in a reciprocating spiral of learning (Salomon, 1990). The artistic content of the actions and operations of the MAEC provides a parallel means of connection or engagement for the learner.

Leland and Harste (1994) define literacy in terms of transmediation, or "movement between and among communication systems" (p. 340). MAEC provides many opportunities for students to transmediate between sign systems, such as placing the words of a poem onto an illustration, or animating drawn characters from a storyboard. The computer mediates the artistic expression of the student's new ideas.

Those new ideas can come from any area of a child's life, including, as Moll (1992) writes, the "funds of knowledge" that are in family and neighborhood. The infusion of technology into the students' lives at the MAEC, and ultimately into their families' lives has an effect that ricochets among the several domains including school. Eisner (1994) acknowledges the importance of connections between school knowledge and students' lives outside of the academic environment. Transfer of learning will occur, Eisner asserts, when students encounter tasks and relationships similar to those outside of school.

We can see that the MAEC activities are complex, and as they are in transition into adolescence, their influence on their home and community is changing. In many cases we see evidence of their new learning having an effect on their family.

The Multimedia Arts Education Center

The MAEC views the arts as a critical factor in the mastery of computer and media technology. The MAEC teachers are professionals in their area of art technology, each with several years teaching experience. The large TPAC building, with several computer labs, also includes an art gallery. Many local artists pass through and influence the culture of the facility.

The curricula used in the labs each include art and design, technology, and literacy components. Students learn several professional level application programs and tools. They learn to make æsthetic considerations in design, to develop a critical eye and to revise. They keep journals and write proposals for their projects and create storyboards, video logs and scripts, as well as poems and stories.

The Language Arts lab students do word processing and basic desktop publishing. There is an emphasis on basic English grammar and composition. The Computer Graphics lab students learn to do computer photo-manipulation, drawing and printing. Various projects such as letterhead, calendars and logos involve integration of many electronic arts tools. The Animation students develop narrative storyboards and two-dimensional computer animations. The Video lab has several camera kits with lights and microphones, editors, and a special effects generator. Students learn to use this equipment and basic production techniques as they work through group and individual projects. The Portfolio lab emphasis is on developing multimedia presentations based on their work from previous semesters.

The students receive a small stipend ($25) twice each semester upon attaining the required skill level benchmarks and completion of their individual projects. When they complete of the program, each student receives a desktop computer of his or her own. This has been a very motivating aspect of the program, as most of the families involved are not able to have a computer at home.

Methodology

This longitudinal study of the MAEC activity utilizes several strands of data for analysis of the program in its context, taking into account its history and the history of its stakeholders, the students, faculty and staff. A coordination of qualitative and quantitative data gathering techniques will yield a picture of the nature and dynamics of this program. When we know how the students did finally in their high school careers, hopefully we will also know something of what they brought to the program and what they took from it, what their family lives were like and how it was related to the individual and group story. We know now that all the program graduates are still in school, the first will graduate next year (2000). This study should contribute to the program's continuance because it represents an effort to monitor and be accountable for its continued improvement and ability to adapt to new needs and affordances.

Research questions

This longitudinal study is designed to track: a) students' success in high school; b) the impact of the program on extended families; and c) the impact of the program on students' college and/or career goals.

In addition, the study will look at a) the development of the MAEC, its curricula and management; b) the development of students' perceived self-efficacy and attitudes about art technology; c) literacy skills development; d) evidence of aesthetic response; and e) school-to-work skills acquisition.

Exit interviews

At the end of each semester, this investigator interviewed the students who were about to graduate. They were each asked the following questions, among others: "Are you feeling like you accomplished something here in five semesters?" "What project do you remember the best, the most, what stands out?" "How is your family with this whole activity? Do you get a lot of support?"

It seemed that the students we have interviewed so far, who have all completed five semesters of the MAEC, were pleased to have made it, to be graduating. They were proud of what they had accomplished and each had some aspect of their multimedia work that they were pleased to recall and describe. They saw it as having been substantially different from their school experience. Most felt that the language arts lab was the most helpful in their schoolwork. There was a wide range of plans for after high school. All saw high school graduation as a clear and attainable goal. They had few complaints or suggestions, other than the snacks. A few of the more technologically advanced wished there had been more computer hardware and software for their use. They often reported that their family was proud of their accomplishment. The new computer that they were anticipating would have a place in their home and they were already fielding questions as to access by family members. The goals they had for themselves and the program were generally similar and related to new computer abilities and arts experiences. They were somewhat motivated by the educational incentive payments, several put these checks away for software or a printer to use with their new computer.

Parent interviews

These interviews were conducted shortly after the students graduated. Parents will be interviewed again before their child graduates from high school. Some of the questions asked in these interviews were: "What do you think was the most important thing in your child's participation in MAEC?" "What did the program mean to you, as a parent?"

At the end of each interview, parents were asked to respond to some scaled questions that helped them assign values to various aspects of the program. Such as, "How much did the multimedia program help your child with his/her self-esteem?" And " How much did the multimedia program help your child with his/her writing skill?

Results from these interviews showed a high degree of satisfaction and parental involvement the program. Parents played an important role in helping their children meet the long-term commitment to MAEP. Parents said that the fact that their child completed the program was the most important aspect for them. Many said that it helped them grow up. Several parents remarked about the job-related skills that were required.
Most were unfamiliar with the art technology that lies at the heart of the program, but appreciated the computer skills the students acquired.

Participant observation

Over first school year of the study, university students worked as teaching assistants in the labs. They were asked to record and submit their observations of the activities randomly twice a week. Their duties were to assist the artist/teachers with their teaching and help the students with their projects. They also worked with the teachers in formalizing the learning objectives and curriculum for each lab.

Skill tests

These brief tests, given at the beginning and end of each semester in each lab, were instituted to help the artist-teachers develop a scope and sequence for their arts technology lab. Basically, each teacher developed a series of questions based on what the students will need to learn to meet the requirements of the lab.

Questionnaires

Perceived self-efficacy and attitude questionnaires were administered several times over the course of the first few years of the program. These were designed to elicit student attitudes and perceived self-efficacy. Five of the items were language arts skills designed to determine if any individuals were coming into the program with serious deficits in language. The questionnaires were given several times during the course of each individual's program.

Perceived self-efficacy

The perceived self-efficacy (Bandura, 1993) items covered a variety of activities in literacy, art, technology, and design, as well as social abilities such as collaboration and communication. Items addressed:

1. Technology-based applications
2. Creativity and design
3. Communication
4. Writing

5. Arts awareness
6. Reading

Attitudes

Another group of items on the questionnaire dealt with student attitudes regarding work, school, art, community, and the program. Items addressed:

1. Sense of community
2. Personal goals
3. Real world perceptions

Two of the items were more or less open-ended responses about their expectations for the program and their plans for after high school. Preliminary results indicate that the majority had goals of college and a successful career in mind and they felt that the program would help them attain those goals. These responses will be tabulated and further analyzed for language use.

Works Cited

Bandura, A. (1993) Perceived self-efficacy in cognitive development and functioning. Educational Psychologist. 28(2), 117-148

Eisner, E. W. (1994). Cognition and curriculum reconsidered. New York: Teachers College Press.

Leland, C. H., & J. C. Harste. (1994). Multiple ways of knowing: Curriculum in a new key. Language Arts, 71, 337-344.

Moll, L. and Greenberg, J. "Creating zones of possibilities: Combining social contexts for instruction". In Luis Moll (1992) (Ed) Vygotksy and Education, New York, NY:Cambridge University Press.

Nardi, Bonnie (1996) Context and Consciousness: Activity Theory and Human Computer Interaction. Cambridge, MA:MIT Press.

Rubtsov, V. and Margolis,A. "Activity-oriented models of information-based instructional environments." In Technology and the Future of Schooling. S. Kerr (1996) (Ed.) 95th Yearbook of the National Society for the Study of Education. Chicago IL.

Rogoff B. "Observing sociocultural activity on three planes:" Participatory appropriation, guided participation, and apprenticeship." In Sociocultural Studies of Mind. J. Wertsch, P. Rio, and A, Alvarez (1995) (Eds.) New York, NY:Cambridge University Press.

Pea, R. (1993) "Distributed intelligence and designs for education." In G.Salomon, (Ed.) Distributed Cognitions: Psychological and educational considerations. New York, NY:Cambridge University Press.

Scribner, S. "The future of literacy in a changing world." In E. Tobach, et al (Eds.) (1996) Mind and Social Practice. New York, NY:Cambridge University Press.

Vygotsky, L.S. (1978). Mind in Society: The development of higher psychological processes. Cambridge, MA:MIT Press.

Vygotsky, L.S. (1971). The Psychology of Art. Cambridge, MA:MIT Press.

The Essen Learning Model
A Step Towards a Standard Model of Learning Processes

Heimo H. Adelsberger, Markus Bick, Jan M. Pawlowski

Information Systems for Production and Operations Management
University of Essen, Germany
{H.Adelsberger|Bick|Jan.Pawlowski}@wi-inf.uni-essen.de

Abstract: Several standards like the Learning Technology Systems Architecture (LTSA) or the Instructional Management Systems Project (IMS) provide a format to interchange, reuse, and combine learning contents. They do not cover didactical methods in detail. Therefore we developed an approach to specify methods as a part of the description of learning sequences. This representation and selection of learning and teaching methods is an integral part of the Essen Learning Model (ELM), a generic development model supporting developers, educators, and users on different levels of educational activities. We show how to use structured teaching processes as a guideline to implement learning environments.

Introduction

Due to the enormous amount of developments in the field of educational technologies, a variety of approaches, architectures, and systems have emerged in the last decades. Recent educational concepts like Virtual Universities changed the research focus from single user, local architectures, to a multi-user, globally distributed architecture. The need to combine and integrate different systems has led to several standardization projects, determining standard architectures and formats for learning environments, such as Learning Technology Systems Architecture (Farance, Tonkel, 99) or Instructional Management Systems Project (EDUCAUSE, 99). One of the main issues is to standardize of learning contents in order to make those contents available for integration, e.g., in a Virtual University. Less attention has been devoted to the standardization of learning and teaching methods. When choosing a course for the integration into a curriculum, the decision depends on the one hand on the content, on the other hand, the educator has to consider the teaching method used for a certain content. Therefore we focused on the representation of learning and teaching methods in order to develop a generic description. First of all, this description acts as a decision tool when integrating courses, secondly it guides the author implementing a course or a unit.
The representation and selection of learning and teaching methods is an integral part of the Essen Learning Model, a generic development model supporting developers, educator, and users on different levels of educational activities (Pawlowski, 2000).
In the following we point out the need of a standard representation of methods. The representation of learning processes was modeled in ARIS (Scheer, 98a), a standard modeling tool. Our implementation used this representation, but other process modeling tools could be used as well. We briefly describe ARIS, the implemented methods, the method selection process in the Essen Learning Model, and present a sample implementation from our university.

Essen Learning Model (ELM)

The Essen Learning Model was developed at the University of Essen. It is currently being evaluated to be used in different departments of our university. We will describe the design principles and the general flow of the approach.
The Essen Learning Model is a modular system (Fig. 1), supporting development processes as well as the system's use system on different levels: The support of curriculum design (C-level), the development of learning sequences (D-level), and the development of learning units (E-level). We distinguish between three abstraction levels: the *generic development model* provides knowledge for a variety of contexts. This generic model is customized depending on the user's needs and preferences, and transformed into a specific process model for each project. The *process model* provides a framework for educational technology projects. The third level is the *result* of the development process in form of certain implementations for each module. The result of ELM-C is a detailed network of learning objectives and goals. The structure and

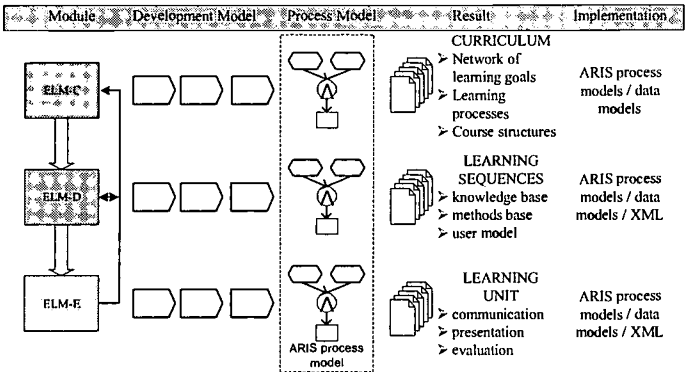


Fig. 1: The Essen Learning Model

each module. The result of ELM-C is a detailed network of learning objectives and goals. The structure and relations of learning sequences (courses) are determined. Based on these results, learning sequences are developed in ELM-D. The focus of this phase is to find an adequate didactical method including the right technology depending on learning objectives and user group. The selection of teaching methods which is supported in ELM-D is modeled in ARIS in this approach. Finally, single learning units are designed and implemented in ELM-E.

Modeling Techniques: ARIS

Modeling of processes is very complex. One approach is to use the Architecture of Integrated Information Systems (ARIS). This architecture is applicable for every type of (business) process: in manufacturing, in the service industry, and in the public services (Scheer, 98a). We will show that teaching methods, respectively teaching/learning processes, can be described as process models as well.

ARIS is a frame concept for a global description (modeling) of computer supported information systems covering the whole life-cycle range: from business process design to information technology deployment (Scheer, 98b). In order to reduce the complexity, the process model is divided into individual views that represent discrete design aspects and can be handled (largely) independently which simplifies the task. The ARIS concept distinguishes four views: organization view, data view, function view, and control view, the latter is used to establish the relationships between the components (Scheer, 98a).

The processes are modeled using the ARIS-Toolset, supporting the user in modeling, analyzing, and navigating through the business processes. It utilizes the event-driven process chain method (EPC). The model of event-driven process chains (EPCM) can be described as a model based on graphs which consist of vertices and edges. Furthermore it is possible to add several attributes to an EPC, like, e.g., the duration of a process, etc. (Keller, Teufel, 97). A detailed presentation of the elements of an event-driven process chain is described in (Keller, Teufel, 97).

Standardized Representation and Selection of Methods

Learning sequences are typically described by certain attributes, characterizing the contents, learning objectives, and sometimes learning materials. These definitions are being standardized in the Learning Object Metadata Model by the Learning Technology Standards Committee of IEEE (LTSC) (Farance, Tonkel, 99) and the Instructional Management Systems Project (EDUCAUSE, 99). The goal of this standardizationis to develop a format for interchange, reuse, and combination of learning contents. An important criteria for choosing an alternative from a variety of learning sequences is the didactical method used for specific learning contents. The above-mentioned standard approaches do not cover a detailed description of didactical methods. Usually only informal information is added, which does not cover all aspects of a method and its usability for certain contents.

Therefore, we developed an approach to specify methods as a part of the description of learning sequences. Learning sequences are represented as process models using ARIS. These models cover the main activities, interactions, information systems, and persons involved. Besides the specification aspect, it helps the author, teacher, and learner to navigate through a learning sequence. It also provides the opportunity to easily combine and reuse learning sequences or parts of a sequence. The approach is not limited to ARIS as a modeling tool. Other specifications like IDEF (Adelsberger, Körner, 95) or UML (Booch, Jacobson,

Rumbaugh, 98) can be integrated easily. A further benefit is the option to integrate business processes and learning processes in order to close the traditional gap between operations and education (Adelsberger, Körner, Pawlowski, 98a, Adelsberger, Körner, Pawlowski, 98b).
In the following, we will present the representation and selection of didactical methods. Furthermore, we will show a sample implementation. A learning sequence on "Simulation in SIMAN" was developed for students of Business Computing, following the Essen Learning Model. The Learning processes were modeled using ARIS, the learning environment was implemented in XML (W3C, 98).

Representation
Within the scope of our research activities (Adelsberger, Bick, Kraus, Pawlowski, 99) we developed and implemented a computer supported simulation game at the University of Essen for a learning sequence on "Simulation in SIMAN". Using the phase model of Kolb, the modeling of this teaching method was implemented as an EPC. Thus the EPC can serve as a guideline for creating simulation games.
A *simulation game* is an active teaching method for processing and solving practical problems by one or more teams. It allows experimental, competitive learning (action learning). The essential pedagogical goal of the simulation game method is to increase the students' thinking flexibility (Geuting, 89).

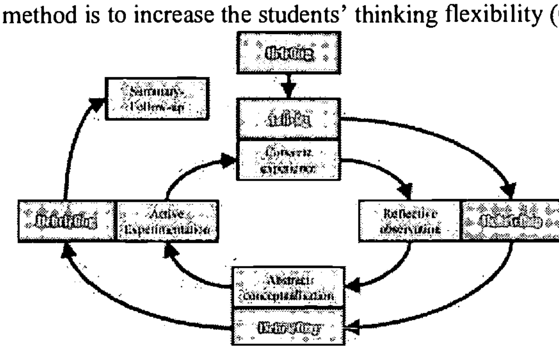


Fig. 2: Kolb's learning cycle and the phases of simulation games (Ruohomäki, 95)

The learning cycle, based on the theory of experiential learning, is commonly accepted for simulation games (Graf, 89, Ruohomäki, 95, Adelsberger, Bick, Kraus, Pawlowski, 99) and has four related stages (Fig. 2): *Concrete Experiences*, *Reflective Observation*, *Abstract Conceptualization*, and *Active Experimentation*.
Learning is understood as a continuous process whereby knowledge is created from experience. The cyclical model is best to be used in simulation games for education and training since they are a type of "controlled experience" which introduces the process mentioned above (Ruohomäki, 95).
It is common to view playing simulation games as a three-phase process, involving *Briefing*, *Activity*, and *Debriefing*. These phases of the simulation game and the experiential learning cycle are closely linked. The learning cycle starts with a *Briefing*. The participants are generally introduced in the game and its surroundings, followed by activities and *Concrete Experiences*. The next phase of the learning cycle offers an opportunity to reflect and observe experiences from many perspectives, e.g., by sharing reactions and observations in discussion with other participants. *Abstract Conceptualization* is the process in which the participants create concepts that transform observations into logical theories. The following *Active Experimentation* could be used to develop hypotheses of reality and to test them during the game. Different kinds of solutions can be tested and probable consequences can be seen. These solutions can then be corrected, modified and retested. *Debriefing* is the process which examines and discusses the experience of the simulation game and thus turns it into learning.

Selection
The selection of a teaching method is supported by a generic process (Fig. 3). It starts with the event *New Course*, ends with the event *Well Trained Student*, and has the processes *Select Method, Activity* and *Evaluation* in between.

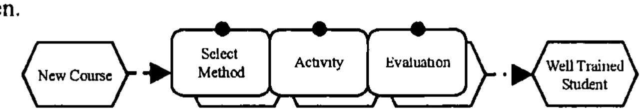
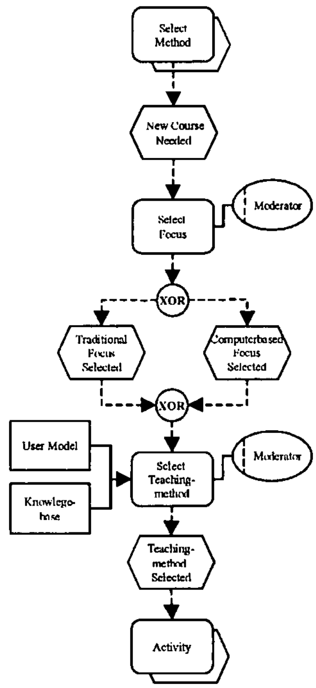
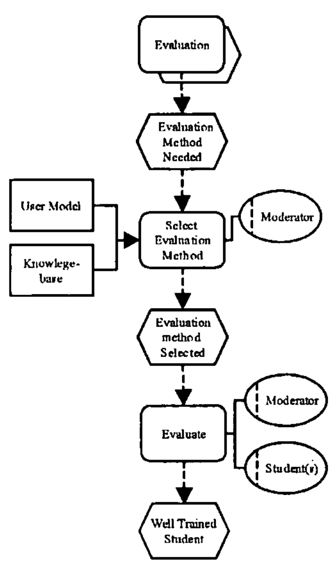


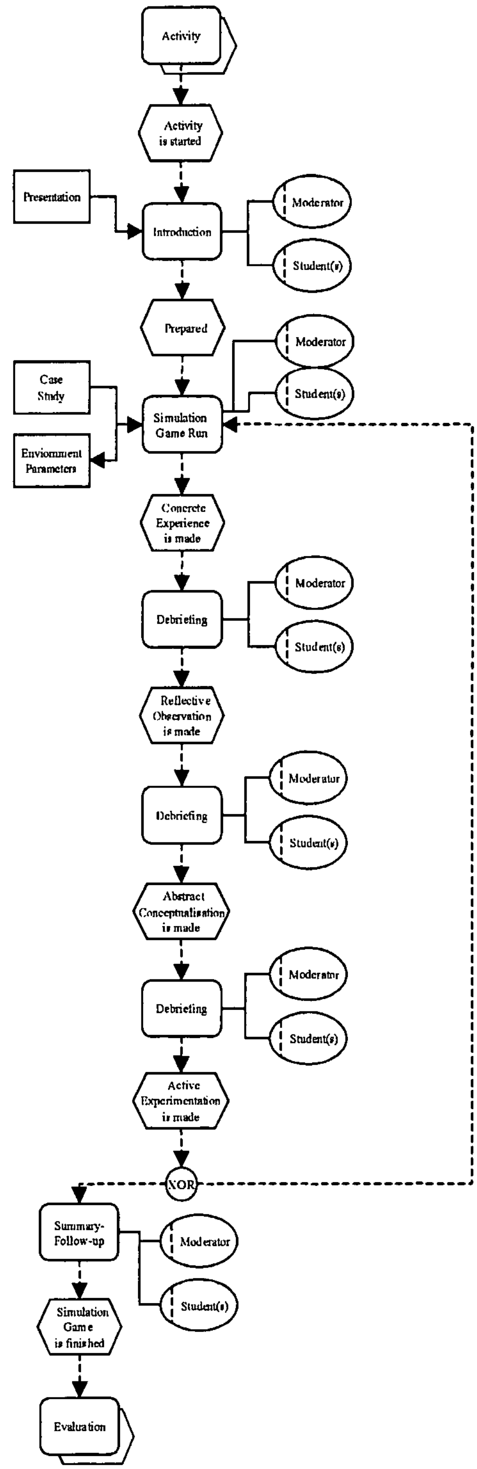
Fig. 3: Generic learning process



Process: Select Method



Process: Evaluation



Example Process: Simulation Game

Fig. 4: Processes

BEST COPY AVAILABLE

The process *Select Method* (Fig. 4) describes the sequence of selecting a method focus, as well as the selection of a teaching method. The selection of the teaching method is being controlled by attributes of the function *Select Teaching Method*.
After choosing the teaching method, the process *Activity* is initiated (Fig. 4). In this approach an exemplary description of the process *Activity* for a simulation game is shown.
After that an evaluation of the learning process follows, both the moderator and the students are participating. The evaluation method's selection is supported by the *Knowledge Base* and the *User Model*.

The development process, supported by ELM, is based on an Architecture of Computer Supported Learning Environments (Adelsberger, Körner, Pawlowski, 98a, Adelsberger, Körner, Pawlowski, 98b). This architecture consists of the components: *Learning Engine*, *Knowledge Base*, *Presentation Component, Communication Component*, *User Model, Evaluation Component*, and *Methods Base*.
The *Methods Base,* used for a method's selection, contains different didactical methods and concepts which have been modeled with ARIS. The moderator/author can use these structured EPC concepts to teach different kinds of learning contents. Traditional static learning environments are usually based on a single learning concept. Recent developments adapt methods depending on user and content characteristics.

Furthermore, the above-mentioned process of selection is supported by the components *Knowlegde Base* and *User Model* (Fig. 5). The *Knowledge Base* contains learning objectives and contents, conceptual modeled in ARIS. The knowledge representation is implemented in XML. The User Model contains attributes, characteristics, and knowledge of a user. Ideally, the knowledge is represented adequately, based on the User Model, regarding individual learning pace, preferred learning method, and preferred presentation format.

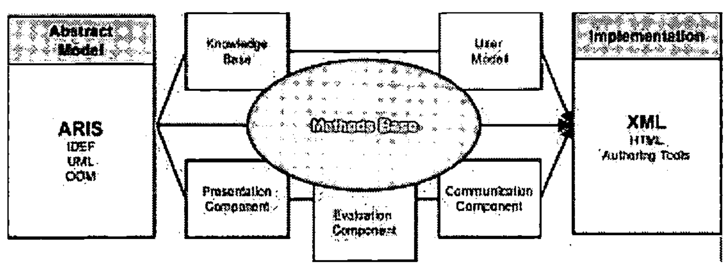


Fig. 5: Methods Base

The attributes contained in the *Knowledge Base* and the *User Model* offer the author a selection of teaching methods by means of an inference mechanism enabling to choose a method according to his preferences. The author is supported by the structured EPCs of the specific methods, the given teaching materials, and the User Model.

The developed sample implementation of a learning sequence on "Simulation in SIMAN" follows the Essen Learning Model (Fig. 6). We have decided to use the simulation game teaching method, because of the learning goals in simulation are so complex, the students have to be trained to be able to work in teams, and our department focuses on application-oriented education.

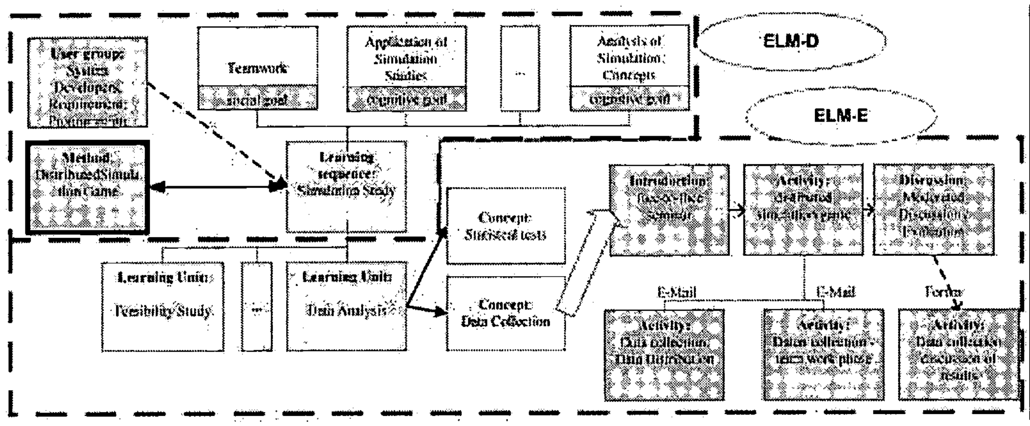


Fig. 6: Learning goals example

The Activity process is used as a guideline for the implementation of the simulation game. During the development process, the Presentation Component, the Communication Component, and the Evaluation Component were specified. The complete implementation of this example is modeled in XML.

References

Adelsberger, H.H., Bick, M.H., Kraus, U.F., Pawlowski, J.M. (1999). A Simulation Game Approach for Efficient Education in Enterprise Resource Planning Systems, *Proc. of ESM 99 - Modelling & Simulation: A Tool for the next Millennium*, Warsaw.

Adelsberger, H.H., Körner, F., (1995). Data Modeling with IDEF1X, In: Adelsberger, Lazansky, Marik (Eds.): Information Management in Computer Integrated Manufacturing, *Lecture Notes in Computer Science 973*. Springer: Berlin.

Adelsberger, H.H., Körner, F., Pawlowski, J.M. (1998a). Computerunterstütztes Lernen als integrierter Bestandteil von Workflow Management Systemen, *Frühjahrstagung Wirtschaftsinformatik*, Hamburg.

Adelsberger, H.H., Körner, F., Pawlowski, J.M. (1998b). A Conceptual Model for an Integrated Design of Computer Supported Learning Environments and Workflow Management Systems, *Proc. of Teleteaching '98: Distance Education, Training and Education,* XV. IFIP World Computer Congress, IFIP Vienna.

Booch, G., Jacobson, I., Rumbaugh, J. (1998). *The Unified Modeling Language Reference Manual*. Addison-Wesley: New York.

EDUCAUSE (1999). IMS Learning Resource Meta-data Best Practises and Implementation Guide. Version 1.0, http://www.imspropject.org/metadata/mdbest01.html, Download 1999-10-12.

Farance, F., Tonkel, J. (1999). LTSA Specification - Learning Technology Systems Architecture, Version 4.0. http://www.edutool.com/ltsa, Download 1999-08-01.

Geuting, M. (1989). *Planspiel und soziale Simulation im Bildungsbereich*. Frankfurt a.M.: Peter Lang.

Graf, J. (1992). Das Prinzip der Komplexität, In: Graf (Ed.): *Planspiele – simulierte Realitäten für den Chef von morgen*. GABAL: Speyer.

Keller, G., Teufel, Th. (1997). *SAP R/3 prozeßorientiert anwenden: Iteratives Prozeß-Prototyping zur Bildung von Wertschöpfungsketten*. Addison-Wesley-Longman: Bonn.

Pawlowski, J.M. (2000). *Continuous Improvement of Workflow Models Using an Explorative Learning Environment.* Paper submitted to EDMEDIA 2000.

Ruohomäki, V. (1995). Viewpoints on learning and education with simulation games, In: Riis, J.O. (Ed.): *Simulation Games and Learning in Production Management*. Chapmann & Hall: London.

Scheer, A.-W. (1998a). ARIS, In: Bernus, Mertins, Schmidt (Eds): *Handbook on Architectures of Information Systems.* Springer: Heidelberg.

Scheer, A.-W. (1998b). *ARIS – Vom Geschäftsprozeß zum Anwendungssystem*. Springer: Berlin.

W3C, 1998, Word Wide Web Consortium, Extensible Markup Language (XML) 1.0, W3C Recommendation 10-February-1998.

Enhancing Learner-Centred Design of Hypermedia Artefacts Through Cognitive and Affective Indicators

José Bidarra
Universidade Aberta
Lisbon, Portugal
bidarra@univ-ab.pt

Teresa Chambel
Departamento de Informática
Faculdade de Ciências de Lisboa
Lisbon, Portugal
tc@di.fc.ul.pt

Nuno Guimarães
Departamento de Informática
Faculdade de Ciências de Lisboa
Lisbon, Portugal
nmg@di.fc.ul.pt

Abstract: This paper discusses some issues and research findings of the project we call UNIBASE. In order to improve the learning processes through hypermedia technology, we investigated the role of cognitive mapping and the application of certain cognitive ambiguities and breakdowns. The addition of clear learning goals, explicitly expressed through cognitive mapping tools, allowed students to acquire the right knowledge and helped them adopt a productive strategy. Complementary to this elicitation process, video information embedded in hypermedia learning environments was used to increase the levels of attention and motivation, using devices such as movement, novelty and appeal. Our aims were to explore and develop the application of innovative hypermedia artefacts.

1. Introduction

The challenges ahead are usually identified with changes in how the learning experience is delivered, changes in who is delivering the learning experience, and changes in the role of the learner as part of a target population. Radical changes have already taken place in the latter and it seems reasonable to acknowledge that a new pedagogical approach is needed to cope with the arrival of a new generation of potential students. We can describe this change as a shift from a “drill generation” to a “play generation”. Somebody already called this new target-group the “playstation” generation.

To cope with these radical changes, digital technology is being increasingly used to create new learning artefacts. At the heart of this technology is the "system" perspective, as proposed by Davenport (1997). Input and output devices serve as surrogate extensions of our senses, providing connectivity to the world. Computers and networks bear some correspondence to our own brains and nervous systems. When connected together into a system, these devices enable the digital creation of systemic worlds and scenarios. The learner’s involvement becomes active and conversational, rather than passively receptive, and leads to the co-construction of meaning.

The UNIBASE project[1] aims were to explore and develop the application of innovative hypermedia artefacts. This paper discusses some issues and research findings of the project. The research activities and design experiments have been carried out with a group of 16 students, whose task was to prepare conceptual maps and hyperspaces, using a particular type of mapping software[2] with editing and

[1] Designed and carried out by Universidade Aberta (Open University in Portugal) and the Informatics Department of the University of Lisbon, Portugal.
[2] MindManager™ (www.mindman.com)

communication tools. A group of instructional designers also participated in the design of an experimental prototype for the Web, using knowledge mapping in the same way as the students did. These activities were embedded in realistic and relevant contexts with rich audio-visual representations and real-world data.

2. Facing the Problem

What learning activities can be supported by hypermedia artefacts? What are the actual cognitive and affective strengths of hypermedia? How do we design for this medium? Much has been said about the potential for interactive learning sustained by the "right" design of hypermedia in systems such as the World Wide Web. But when designers attempt to give choices to the user, as to how to proceed, options seem often to be unengaging and ineffective. A clear sense of the experiential and reflective modes (Norman, 1993) that should support such design efforts is not attained by the users/learners. However, the human mind seems to work like the World Wide Web, in a dynamic, creative, fractal and unpredictable way.

The problem we want to address can be summarised as follows: which combination(s) of interaction processes, authoring functionality and synergy between complementary elements of multimedia information can improve learning in a learner-centred educational environment? Once an author or designer abandons the notion of total control over the learning material and, instead, engages the audience in a process of co-construction, he discovers that a more fundamental question surfaces: can the learning material become organic, adaptive, and generative?

Our approach has favoured the mapping of knowledge and the application of certain cognitive ambiguities and breakdowns, in order to improve the learning processes. The addition of clear learning goals, explicitly expressed through cognitive mapping tools, allowed students to acquire the right knowledge and helped them adopt a productive strategy. Complementary to this elicitation process, video information embedded in hypermedia learning environments was used to increase the levels of attention and motivation, using devices such as movement, novelty and appeal.

3. The use of Reference Models

An adequate usage of reference or mental models, for instance as concept maps or mind maps, stimulates and facilitates the recognition and transfer of information. Basically, we strive to develop mental reference models that are meaningful organisations of information in our brains. Adequate usage of these reference models suggests that we use, for example, meaningful sounds, pictures and graphics to express ideas.

Schadé, cited by Hoogeven (1997), argues that if reference images are added to text, the understanding of a story is about 75% faster than if we are confronted with a text only story. He also hypothesises that by using reference models, innate or acquired in our early childhood, text and picture stories are stored faster and more efficiently in our long-term memory than text-only stories. He states that people tend to remember 25-35% more of a text and pictures story than of a text only story.

The use of reference models is not exclusive to educational practice; it is a well-accepted marketing technique to use basic reference pictures and sounds to improve advertisements and commercials. Often family scenes, romantic environments, status symbols, attractive women and responsible men are weaned into the marketing material. We assume that an adequate use of reference models is an important variable with regard to an effective learner-centred design process.

4. The Role of Audio-Video

The integration of "raw" audio-visual information with the learner's knowledge structure may facilitate retention and retrieval. Training learners "to transform complex visual images (i.e., to analyse, describe, categorise them) can provide an important link between visual and verbal storage and retrieval." (Kozma, 1986, p.16). This has been implemented in UNIBASE by means of cognitive mapping devices that support the integration of audio-video segments. The final result could be easily published as a hypermedia structure.

Hyperlinks could be mouse-clicked by the learner to play short narrative explanations or video clips. It was recognised by students and designers participating in our experiments that one of video's greatest strengths is the power to generate attitudes and emotions as no other medium can. According to Anderson (1983, p.72): "It is an excellent tool for displaying affective information." The affective domain is concerned with the learner's reception and responses to the stimuli presented. Furthering this idea Azarmsa (1996, p. 39) identifies five categories that describe the levels of this domain: (a) receiving, (b) responding, (c) valuing, (d) organisation of values, and (e) internalisation, which is characterised by the learner holding a particular value or set of values.

To enhance the learner involvement in the initial stages, we had to find means to engage the learner in novel and interesting ways. Rather than just trying to simulate existing reality on the computer screen, or trying to create a "virtual reality", we found that it is far more sustainable to create a new experience for the viewer with simple means. In the past, microworlds have been created to provide an entirely new framework for the learner to explore, but today the Web can already provide plenty of worlds to interact with. According to *cognitive flexibility theory* (Spiro and Jengh, 1990), learners are able to spontaneously restructure their knowledge in many ways as they chart their courses through the hypermedia material. So, we constructed artefacts - designated *knowledge hyperscapes* (Bidarra and Guimarães, 1999) initiated by the instructor and further developed by the students in an organic, adaptive and generative manner (see figure 1).

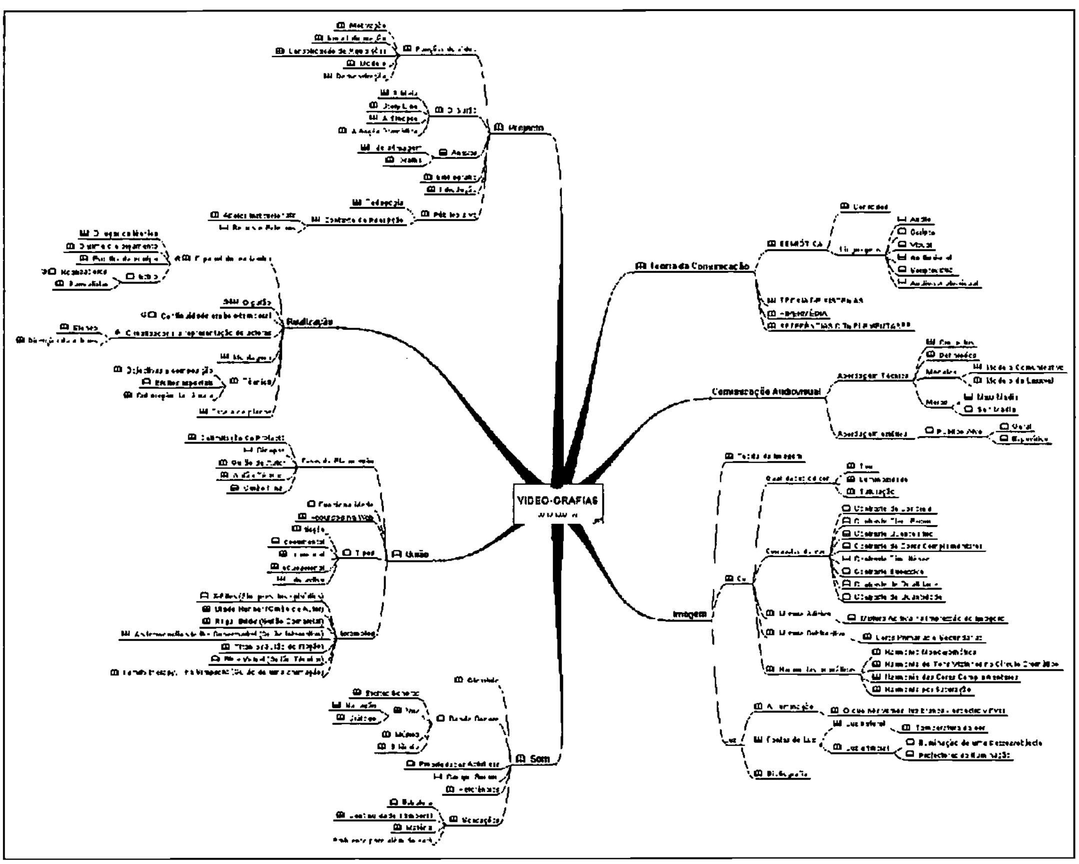


Figure 1. Map representing the hypermedia structure of the site produced.

5. Hypervideo Mechanisms as Authoring and Learning Tools

Constructivists have argued strongly for the need of authentic learning experiences and video is an appropriate tool to support this. Video clips can greatly enhance the authenticity of a computer based learning environment (Boyle, 1997). However, for a system to allow learner reflection, it must have a compositional and representational medium that affords adding new representations, modifying and manipulating old ones, and perform comparisons (Norman, 1993). Reflection also requires the time and ability to elaborate upon and compare ideas. The medium must afford the time for reflection. In this sense, broadcast television cannot augment human reflection, it does not afford composition or the time to reflect. However, television and video, when properly constructed, can be a powerful tool for reflection. If the user can select what is to be seen and control the pace of the material, and it is easy to go back and forth, to stop, to make annotations, to compare and to relate to other materials.

Effective reflection requires some structure and organisation (Norman, 1993). Structuring and organisation of information is the main issue in hypermedia. However, being multimedia is not enough for a system to be *truly* hypermedia. Different media can be used purely as illustration in a system where links are restricted to text. Hypervideo refers to the integration of video in *truly* hypermedia documents. True integration of video requires a more powerful hypermedia model, taking into account its spatial and temporal dimensions, defining the semantic structures and mechanisms for linking video, finding new concepts of navigational support, and taking into account the aesthetic and rhetoric aspects of integrating several media in hypermedia (Chambel, 1999a).

The design rationale we adopted for the educational artefacts being developed, in the context of the UNIBASE project, is based on the notion that the integration of basic elements of information must explore the cognitive bias of the different materials and create added value through adequate bridges between those elements. Effective integration must be sought by allowing the learner to exercise the "natural" cognitive attitude, while inducing proactive "breakdowns" (Winograd, 1986) that trigger reflection processes (Norman, 1993). On a video based material, such as the one we are proposing, this means letting the user enjoy and absorb the video information in very much the same way as it is currently "consumed" in the television type of interaction. On the other hand, as this type of information processing is essentially experiential, the hypervideo environment must be designed to involve the user in such a way that he is led to "stop, think, and correlate" different types of information.

Hypervideo mechanisms are therefore the basic tools for the purposeful and directed integration of video information in learning environments (Chambel, 1999b). In this context, we developed a model and some tools for hypervideo support on the Web (Chambel, 1999a), as extensions to HTML and existing Web tools, that are being used to integrate video in the UNIBASE hypermedia learning environment.

6. Experience with Learners

It is assumed that technologies like interactive multimedia help students to form rich representations of learning events and promote deeper understandings. However, this does not happen by simply adding more information and more (rich) media. We also assume that students learn in very different ways and we expect them to be able to recognise relevant domain information and be able to process it at some depth.

In our experiments, learners used their natural language to argue, question, and make connections to other subjects, other units of study, and their own experience. Many explained the course of the learned events and worked out a knowledge map. Some learners also displayed their understandings by means other than words. They also created new situations, produced images and short videos and represented the theme as a hypermedia production. Finally, they published their work on the World Wide Web (see http://www.univ-ab.pt/~bidarra/hyperscapes).

The experimental set-up was based on a group of 16 students following a course on *video pedagogy and technology* in a master's programme on *multimedia communication*. Their previous experience included teaching for at least one year and Internet common usage skills. They were given a basic conceptual map, with relevant knowledge for the course, which they had to explore and develop further, both in class and online. They were encouraged to proceed from (non-linear) thinking to (non-linear) authoring of *knowledge hyperscapes*.

Our experimental goals were:

- to examine the use of hypermedia and communication tools in their work;
- to investigate the effectiveness of the hypermedia/Web environment that we set up;
- to find ways of improving the usability of hypermedia learning interfaces.

Data on the interactions was gathered by means of direct observation, video recordings, screen capture. These were later interpreted and checked against the evaluation of individual portfolios. Final assessment of the students was accomplished via work portfolios and a final (individual or group) project. Overall, the results were very encouraging when compared with previous years.

7. Conclusions

The approach to build an effective learner-centered system was to collect descriptive, qualitative information on complex real work settings. This required research tools that were capable of examining interaction with the hypermedia environment and also interaction within the surrounding social system. The gathered data was to be later interpreted and integrated into the design process.

Our findings suggest that:

- User control and interactivity are very important. Students appreciated the freedom to access and integrate different resources, to build new materials as hypermedia productions, and to respond to challenges, creating new situations and working out their own knowledge maps.

- The ability to integrate video in hyperdocuments was also an important feature, especially in the context of the *video pedagogy and technology* course, where it could be used to illustrate and demonstrate the concepts being taught and learned, in an integrated manner.

- Constructivist activities were very motivating to the majority of students and MindManager™ software was easily mastered. Precise focus on the objectives was attained by workgroups without wasting time "playing around" with the software.

- We found that user acceptance increases, if tools for interaction, problem formulation, design and system building are supported by reliable information about the needs and desires of potential users and the setting in which systems are to be used.

- However, students are not prepared to contribute themselves and reflect on the main issues, if there is no previous experience with the software tools that enable it. Introductory information, preparation classes or online help are necessary.

- Guidance on the thematic criss-crossing of the subject domain is a must. Students get easily lost if there is no tutor or expert support, no matter the access they have to the Internet and external knowledge bases.

The formal features of our instructional program, especially the video component, could be seen to exert a great influence on the affective domain of the learners. However, we assumed that it was the responsibility of the instructional developer to stimulate the learner to such a degree that higher levels of involvement were reached. We think that the powerful affective attribute of video needs to be explored further.

Acknowledgements

This research is partially funded by FCT (Fundação para a Ciência e a Tecnologia).

References

Anderson, R. H. (1983). *Selecting and Developing Media for Instruction*, New York: Van Nostrand Reinhold Company.

Azarmsa, R. (1996). *Multimedia: Interactive Video Production*, New York: Wadsworth

Bidarra, J., Guimarães, N. (1999). *A Case for Learning Sites with Video Bytes: The Hyperscapes Experience*. Proceedings Online Educa '99 – Berlin, 24-26 November, 1999.

Boyle, Tom (1997). *Design for Multimedia Learning*. Prentice Hall Europe.

Chambel, T., Correia, N. and Guimarães, N. (1999a) *Towards Hypervideo on the Web*, IMSA'99, Third IASTED International Conference on Internet and Multimedia Systems and Applications, Nassau, Grand Bahamas, October 1999.

Chambel, T., Guimarães, N. (1999b). *The Role of Hypervideo in Learning Environments (poster)*, WebNet' 99 - World Conference on the WWW, Internet, & Intranet, AACE Conferences, Association for the Advancement of Computing in Education, Honolulu, Hawaii, USA, October 1999.

Davenport, Glorianna (1997). *Encounters in DreamWorld: A Work in Progress*. Retrieved from the WWW: http://ic.www.media.mit.edu/CR/CR.html

Hoogeveen, Martijn (1997). Towards a Theory of the Effectiveness of Multimedia. In: *International Journal of Human Computer Interaction*, 9(2), 151-168.

Kozma, R.B. (1986). *Implications of Instructional Psychology for the Design of Educational Television*, Education Communication and Technology Journal, 34, (1), 11-19.

Norman, Donald (1993). *Things that Make Us Smart*. Addison Wesley.

Spiro, R.J., Jehng, J. (1990). Cognitive Flexibility and Hypertext: Theory and Technology for the Non-linear and Multidimensional Traversal of Complex Subject Matter. D. Nix & R. Spiro (eds.), *Cognition, Education and Multimedia*. Erlbaum, Hillsdale, NJ.

Winograd, T., Flores, F (1986). *Understanding Computers and Cognition: A New Foundation for Design*. Addison-Wesley.

When frames collide: adapting cognitive frame analysis to a child's comprehension of narrative video

Janet Blatter
McGill University
3700 McTavish Street
Montreal, Quebec, H3A 1Y2
jblatt@po-box.mcgill.ca

Abstract: This proposal outlines research on the comprehension of narrative dynamic multimedia such as video. I describe an approach to investigating comprehension based on a synthesis of methods and models developed in classical cognitive studies (Kintsch, 1998; Frederiksen, Donin, and Bracewell, 1987; Bracewell and Breuleux, 1994) with theoretical work in cognitive film analysis (Bordwell, 1989) and film semiotics (Metz, 1968). This approach provides a principled argument for constructing a filmic text-base (Kintsch, 1998) that serves as the basis for studying the situation and frame models used by viewers to understand narrative content in dynamic multimedia. The paper applies this approach in a child's recall task. Discrepancies between the child's protocol and a text derived from a shot script of the viewed video are discussed in light of the situation knowledge needed to adequately construct a "problem/plot frame". This work has implication for assessing instructional design modules that include video.

Introduction

Video, whether stand alone or embedded in interactive multimedia has become a powerful resource in many classroom settings. There is considerable research assessing the learning occurring with video delivered course content, such as Vanderbilt's Jasper series. However, research on how students comprehend dynamic multimedia narratives needs more attention. Movies and video are such a pervasive part of K-12 culture that their comprehension seems almost a naturally acquired skill. The mimetic, iconic illusions in most films and videos children view lead to a perspective of movie viewing as being a simple mapping from world reality to screen diegeis. But, on closer look, understanding a "moving narrative" is a cognitively demanding task.

The purpose of this paper is 2-fold: to gain insight into the cognitive processes of film comprehension in recall; to provide a principled basis for applying discourse and propositional analysis to the inherently non-natural language of dynamic multimedia. My research is based on a recall task in which a 10 year- old is asked to "tell me what the movie was about". The movie was a 20- minute stop-action animation, "Wallace and Gromit: a Grand Day Out". Based on theories of comprehension and film semiotics, I show how a text base of film may be constructed and accommodate the kind of scrutiny for comprehension strategies successfully undertaken in classical cognitive accounts in text and discourse. Using propositional and frame analysis, I show how the child's construction of meaning may be represented as structured around narrative and plot frames. Two text bases are provided: the child's recall and a shot script derived from repeated viewing of the video. I compare the propositions and plot frames derived from an episode in the two text bases and discuss the results in light of summarizing strategies and situation knowledge.

Narrative film comprehension is generally under researched. Chafe's (1980) discourse analysis of film recall production in children and adults yielded interesting insights into comprehension. However, his research failed to account for the filmic units of analysis; his work failed to articulate on what basis imagery and time were conflated into declarative knowledge. In the field of cognitive film studies, Bordwell (1989) has used script-based knowledge representation to develop his own model of film interpretation. Bordwell theorizes that critics adopt particular scripts or schemas and apply them to understand the connotations in film. As Bordwell states, however, there may be different mechanisms involved in the expert critic's interpretation of a film than in the casual viewer's more immediate comprehension process.

This study is based on Kintsch's model (1998) of the comprehension process as constructed in a loosely structured, bottom up process which only gradually integrates knowledge into a more stable set or mental representation. Kintsch differentiates comprehension knowledge into a text base and situation model with the text base representing the knowledge constructed from the text itself and the situation model representing the frames, scripts, or models derived from the readers/listener knowledge of similar texts, situations, and world knowledge. Kintsch has applied his model to many comprehension tasks yet admits that most of his work in narrative discourse focused on single situation problems. Frederiksen, based on a similar comprehension model, has explicitly probed texts and discourse for multiple situations or, in his model, multiple frame construction. Frederiksen's model focuses on the representation of comprehension in both text (1987) and discourse (1998), as well as being applied to text production situations (Bracewell, and Breuleux, 1994). The model identifies three types of representational units: natural language units (e.g. clauses, words); units of propositional meaning (e.g., events, states, processes); units of conceptual meaning (related structures in which concepts are associated to form conceptual knowledge as in frames and situation models. The basic unit in these studies has been the proposition.

Current cognitive inquiry into comprehension is based on a fundamental, if not entirely uncontroversial assumption that comprehension knowledge may be represented at the semantic level as propositions. Kintsch points out the alternative views that point to the non-linguistic representation of mental imagery (Kosslyn, 1994). But even Kosslyn used spatial predicates to represent the deep knowledge level of surface pictorial forms. Without attempting to finalize the debate between linguistic, spatial, or symbolic representation of visual media such as movies, I proceed cautiously with Kintsch's basic assumption. In order to find an analogous representational structure to language, I looked to film semiotics, specifically as developed by Metz (1968).

Metz is adamant that while film has expressive and communicative features, it cannot be considered as having a syntactical system. As in art, there is a tight coupling between sign and signified. Film comprehension proceeds from "blocks of reality" which are actualized with their total meaning in discourse or in the filmic presentation. According to Metz, these blocks are shots, either individual ("autonomous") or in sequence, which semantically relate to one another. Metz's ambitious "Grand Syntegma" constructs a hierarchical film structure organized around shots and sequences.

Agreeing with Kintch that propositions may adequately represent comprehension knowledge even in non-linguistic phenomenon, the syntegcmatic framework suggests that comprehension may proceed from the autonomous or simple sequence. A main idea or event is presented in these syntegemes, and associated with subsequent syntegemes into a hierarchical structure of sequences and episodes. In essence, the shot or simple sequence may function as a clause in comprehension. Individual syntegemes cohere similarly to Kintch's microrules, whereas macrorules relate events to sequences to episodes. With this assumption, a propositional representation may be derived from a filmic 'text'.

Method

This study is based on the recall protocol of a 10 year- old girl who was asked to "tell me what the movie was about". The purpose of the research was to see what summarizing strategies she used, and to compare her understanding to a text-base derived from a shot script constructed from the researcher's viewing of the film.

The movie was a 20- minute, stop animation video by Nick Park, "Wallace and Gromit, A Grand Day Out". The child had seen the film previously as well as his other animations in the series. She was therefore exposed to his filmic style, the characters, and the narrative genre. The researcher's protocol was derived from constructing a "shooting script" while viewing and reviewing the movie. Both texts were segmented into clauses analyzed using propositional analysis as similarly developed and applied in Frederiksen, Donin-Frederiksen, and Bracewell (1987). A narrative frame and plot frame is mapped on to the respective propositions to reveal the conceptual structures present in the child's and researcher's knowledge. The study focuses on a particular episode in the final act of the movie, in which the main characters are discovered by a robot on the moon and rush to return home.

Findings

The frames were compared for frame completeness and accuracy, particularly on the marking of events, themes, temporal ordering, and causal and conditional links. The child correctly and completely recalled the plot structure but had difficulty in identifying and ordering the plot themes and events.

Discussion

Deviations between the child's and researcher's comprehension as compared in their respective construction of the narrative and plot frames are discussed in light of summarizing strategies and situation knowledge. According to Kintsch, summarizing is a form of recall which, like other types of comprehension, is governed by macrorules. These rules stipulate the selection of key events or objects, the generalization to a more abstract version, and the construction of a new 'text' (vanDijk and Kintsch, 1983). Thus, while the child had little problem in identifying this sub-plot as being significant to the main characters - and correctly selecting this in her recall - and subsequently generalizing to a global problem-goal-plan-action-reponse structure, her accounting of the events reveal gaps which would have required more knowledge of the technology depicted in the film. As an example of multi-situation comprehension, this study suggests that developers and users of narrative dynamic multimedia must identify frame knowledge needed to comprehend the content and relate it to the knowledge of their viewers.

Conclusion

Understanding how students comprehend narrative dynamic visual media was the direct objective of this paper. Providing a rationale for inferring a 'text' from dynamic visual media became necessary in order to apply comprehension theories and methods successfully used in text and verbal discourse. A synthesis between comprehension models and methods and film semiotics furnished a basis in which to approach the topic. This appraoch may be useful in assessing and developing multimedia projects for children.

References

Bordwell, D. (1989). *Making meaning: inference and rhetoric in the interpretation of cinema*. Cambridge, MA: Harvard University Press

Bracewell, R.J., Breuleux, A. (1994). Substance and romance in the analysis of think-aloud protocols. In P. Smagorinsky (Ed), *Speaking about writing: reflections on research methodology*. (pp. 55-88). Newbury Park, CA: Sage

Chafe, W. (Ed). (1980). *The Pear stories: cognitive, cultural, and linguistic aspects of narrative production*. Norwood, NJ: Ablex

Frederiksen, C. and Donin, J. (in press) *Conceptual Processing in text comprehension and learning through situated discourse*

Frederiksen, C. Donin-Frederiksen, J. and Bracewell, R. (1987). Discourse analysis of children's text production. In Matsuhashi, A. (Ed.) *Writing in real time: modeling production processes*. (pp.254-290). Norwood, NJ: Ablex

Kintsch, W. (1998). *Comprehension: a paradigm for cognition*. NY: Cambridge University Press

Kosslyn, S. (1994). *Image and brain : the resolution of the imagery debate*. Cambridge, MA: MIT Press

Metz, C. (1968) Film language: some points in the semiotics of the cinema. In Braudy, L. and Cohen, M. (Eds.). 1999. *Film theory and criticism: introductory readings* (Fifth edition). NY: Oxford University Press

vanDijk, T. and Kintsch, W. (1983). *Strategies of discourse comprehension*. NY: Academic Press

Integrating ARCS Motivational Strategies into CALL Courseware for Holistic Practice: A Study

Isabel Borrás
San Diego State University
United States
borras@mail.sdsu.edu

Maria Coronel
San Diego State University
United States
mcoronel@mail.sdsu.edu

Abstract: This study investigated the effects on writing performance of three levels of integration (basic, medium, full) of ARCS motivational conditions (Attention, Relevance, Confidence, and Satisfaction) into a CALL (Computer-Assisted Language Learning) program for holistic foreign language practice. It also addressed the effects of two degrees of relevance (low, high of the learning tasks. Forty-eight undergraduate students, randomly assigned to six treatments, accomplished two writing activities using one of the six versions of the program. The ARCS full integration groups performed significantly better than did the medium and basic groups. The degree of task relevance did not affect significantly performance. Students felt that the program gave them, in this order, confidence, attention, relevance, and satisfaction. Motivational strategy and task relevance impacted significantly the intensity and persistence of students' learning effort, as revealed by five sets of data traced by the program's tracking tools: Intro Time, Activity Time, Help Time, Help Frequency, and Overall Frequency of Access. Writing draft analysis uncovered the effects of three writing-fostering features of the program on subjects' use of "practice," "resourcing" and "output structuring" strategies.

Introduction

Motivational factors arc an important mediator of performance and are considered instrumental in the expenditure of cognitive effort (Bandura, 1977, Salomon, 1983). An instructional design model that addresses motivation is the ARCS model (Keller, 1987). The model, which has been applied to courseware design (Keller and Suzuki, 1987), includes subcategories of motivational characteristics and examples of strategies that stimulate or sustain each motivational condition "Attention," "Relevance," "Confidence" and "Satisfaction."

Instructional technology (IT) research has addressed, with mixed results, the ways different ARCS strategies embedded in instructional materials affect learner's motivation and performance. Some studies have found that confidence-enhanced materials augment learner's assuredness (Naime-Diefenbanch, 1991) or that relevance-enhancing strategies result in enhanced motivation and performance (Means, Jonassen, and Dwyer, 1997). Other studies, however, have indicated no effects of confidence-enhanced materials on learners' achievement or confidence (Moller, 1993). Means et al. (1997) contend that this imparity of effects is due to the fact that the ARCS conditions are interdependent and that it is not clear how motivational enhancement affect cognitive activity.

Motivation is also an issue in Second Language Acquisition (SLA). Ushioda (1993) sustains that motivational outcomes such as learner's participation, attentiveness, and enthusiasm should be viewed as significant by themselves, apart from their particular relevance to second language development. Spolsky (1989), in his theory of second language learning, asserts that language knowledge and skills in the future are the result of a number of factors including knowledge in the present, abilities, motivation/affect, and opportunity. Spolsky sustains that learner's acquisition depends on the various strengths of these conditions and that the greater the amount of each, the greater the learning. Research is needed to understand how to build up and combine the Spolsky's factors that allow intervention, motivation and opportunity, within language learning environments and, particularly, within those supported by technology.

On the other hand, IT and SLA have been equally interested in the learning and attitudinal effects of tasks that are inherently relevant to the learner. Research from both fields suggest that perceptions of learning task meaningfulness influence learner's "cognitive capacity usage" (Salomon, 1993; Pokay & Blumenfeld, 1990), and that perceptions of enjoyableness of language learning tasks correlate with learning effectiveness (Green, 1993). However, intentional cognition is not always based on the task's interest. Means, et al.'s (1997) assertion that "many learners in undergraduate courses are not intrinsically motivated to learn course content" (p. 15) is all the more true for learners in foreign language courses since cultural context and background may affect their perceived relevance of second language tasks (Green, 1993). Thus, research is also needed on how to design Computer-Assisted Language Learning (CALL) programs whose manipulated motivational strengths affect performance and attitude beyond, or regardless of, the inherent motivational value of the programs' instructional tasks.

Purpose of the Study

Within the above framework, this study investigated if the comprehensive integration of ARCS motivational strategies in CALL courseware for holistic practice (Wyatt, 1987), affected the writing performance in a foreign language of undergraduate college students.

The study equally explored the effects on writing performance of language tasks relevant to students' interest, the potential interactions between motivational strategy integration and task relevance, the effects of motivational strategy integration on attitudes, and the correlation between attitudes and performance.

Additionally, in accordance with "contextualized" research tenets (Salomon, 1991), the study investigated a number of issues with a potential impact on the main outcomes. These included the impact of courseware motivational strategy integration and task relevance on learner's intensity and persistency of effort (Keller, 1987) and the effects of courseware writing-fostering features on subjects' use of "practice," "resourcing" and "output structuring" cognitive strategies.

Method

Subjects

Forty-eight lower-division undergraduate students, 28 women and 20 men, enrolled in the various sections of an intermediate Spanish course during the spring semester at San Diego State University constituted the experimental sample. Students were randomly assigned to the six experimental treatments of the study, which involved completing two writing tasks in Spanish using a CALL program. The subjects had quite heterogeneous academic backgrounds and their academic skills were mostly limited to word-processing.

Variables

The main independent variables of this study were motivational strategy integration and task relevance. The motivational strategy variable consisted of the levels of integration, basic, medium and full, of the ARCS motivational strategies found in the six versions of an original courseware package*Writing in Spanish: Two Practice Sessions* (WS) developed for the study (Borrás, 1999).

---

[1] From the "leader of activity" viewpoint, CALL software is routinely classified as tutorial, holistic practice, and games. Basically, the holistic practice variety provides "higher-level, contextualized, practice activities," "idea processor" and "on-line thesaurus" (Wyatt, 1987: 87).

The WS versions featured different number of screens. To the five screens of the basic versions (Title, Menu, Introduction, Activity, and Credits), the medium versions added one (Help), and the full versions two (Help and Archives). Common to all versions, the Activity screen included a four-page notepad for writing the drafting and final renditions of the tasks, a toggling writing prompt, on-demand access to contextualized multimedia resources, and users' input locking capabilities. Tracking tools available in all versions allowed the self-saving of user's writing input and navigational paths data on to an automatically created folder located on the hard disks of the computers used in the study.

As shown in Figure 1, the *basic* level of strategy integration consisted of the message found in the Introduction screens of the six versions of WS. Elements of the message included a statement of the program's goal, three comments on the task's nature, benefits and resources, and a warming up expression. The elements, which fell into the motivational strategies categories, "Experience," "Present Worth," "Learning Requirements," and "Positive Outcomes" (Keller's, 1987), were aimed at reaching three ARCS' motivational conditions, relevance, confidence, and satisfaction.

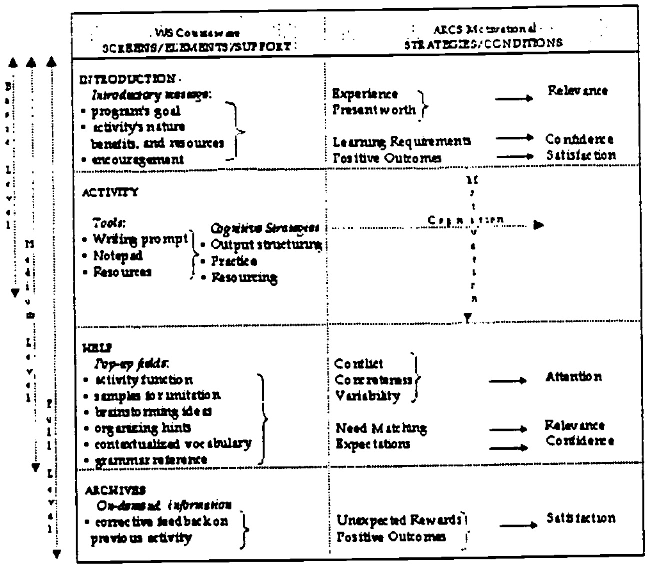


Figure 1. WS "Basic," "Medium," and "Full" Integration Levels of ARCS Motivational Strategies

The *medium* level of strategy integration included the introductory component and the contents of a Help screen common to four versions of WS. The screen included information on the function of the assigned task, and a number of macro-aides (samples for imitating, brainstorming, and/or organizing the task) and micro-aides (audio-visual monolingual vocabulary lists, and grammar reference). These contents embodied such motivational strategies as "Conflict," "Concreteness," "Variability," "Need Matching," and "Expectations" and targeted the motivational conditions attention, relevance, and confidence.

The *high* level of strategy integration comprised the introductory and help components together with the Archives screen common to two versions of WS. The screen, which provided access, through a metaphorical button, to the instructor's corrective feedback on the writing activities subjects accomplished during the first experimental session, addressed motivational strategies like "Unexpected Rewards" and "Positive Outcomes" in order to attain the motivational condition satisfaction.

The second independent variable, task relevance degree (high, little), was based on the subjects' higher or lower interest in the writing tasks of the WS program. Taking into account Crookes and Schmidt's (1991) assertion that "a program which appears to meet the students' own expressed needs ... will be more motivating, more efficient, and thus more successful." (p. 492), the selection of the tasks drew on the results of a survey conducted one month before the experiment with 119 students of Intermediate Spanish. Surveyees were asked to rank from 1 (least liked) to 10 (most liked) the ten authentic writing activities of a Task Relevance questionnaire. Based on the results of the survey, four activities, two of them "highly relevant" and two others "little relevant," were selected to support subjects' writing practice with WS during two experimental sessions.

The primary dependent variable of the study, writing communicative performance, was defined as achievement in conveying information in writing (narration, description, persuasion, and argumentation). The second dependent variable, attitudes, was aimed at measuring the reactions of subjects toward the computerized writing experience, and to find out which were the features of the WS package that according to subjects' perceptions contributed the most to the activation of the ARCS' motivational conditions.

Other variables including learner's intensity and persistency of effort, and learner's use of particular strategies during writing practice were also considered to better understand where and how WS was strong or weak in producing the desired motivational and cognitive outcomes.

Treatments

Using a two-way 3 x 2 factorial design, subjects were randomly assigned to one of the six treatments resulting from the combination of the levels of motivational strategy integration (basic *vs* medium *vs* full) with the degree of relevance of the writing task (little *vs* high). The treatments included T1 (basic motivational strategy/little relevant task); T2 (basic motivational strategy/highly relevant task); T3 (medium motivational strategy/little relevant task); T4 (medium motivational strategy/highly relevant task); T5 (full motivational strategy/little relevant task); and T6 (full motivational strategy/highly relevant task). Depending on their assignment to a given treatment, subjects used one of the six versions of the *Writing in Spanish* package.

BEST COPY AVAILABLE

Instruments

The main dependent variable, writing performance, was computed by applying Gaudiani's Composition Analytical Scales (1981) to the writing samples produced by the subjects using theWS package. The Scales allow the separate scoring of four composition features including grammar/vocabulary, style, organization, and content.

To measure the secondary dependant variable, attitudes, three slightly modified versions of Keller's (1993) Instructional Materials Motivational Survey (IMMS) were used to collect attitudinal data from the subjects working with WS under the basic (T1-T2), medium (T3-T4) or full (T5-T6) treatments. The IMMS (Cronbach's alpha reliability coefficient = .96) asks the survey-takers to assess the degree of truthfulness of its 36 statements using a 5-point Likert scale (1= not true; 5 = very true). In the IMMS adaptations, A1, A2, and A3, statements 27 and 28 were replaced by two others targeting subjects' attitudes toward the motivational strategies embedded in the Introduction, Help, and Archives screens ofWS. Also, statement 29 was removed because of its tangential pertinence.

Procedure

The WS program was aimed at providing, in varying degrees, Spolsky's (1989) "motivation" and "opportunity" conditions for language learning by exposing learners to a diversity of tasks and sources that promoted their use of receptive and productive language skills (Krashen & Terrell, 1983). Thus, using the six versions of WS, subjects in the different treatments performed the variety of tasks involved in the writing activities they completed during the two experimental sessions (thereafter, S1 and S2).

In S1, subjects working with the basic versions of WS accomplished a number of tasks including reading the message of the Introduction screen, reading the writing prompt and exploring the multimedia resources of the Activity screen, and writing the draft and final versions of the experimental activity. Furthermore, subjects in the medium and full motivational strategy integration treatments explored the macro-aides and micro-aides of the Help screen available in the WS versions they were using.

In S2, subjects accomplished a number of activities similar to the ones they did in the first session. In addition, subjects in the basic strategy integration treatments could revisit the Activity screen of the first session to explore its resources and what they had written in its notepad. Subjects in the medium strategy integration treatments could access both the Activity and the Help screens of the WS version they worked with in the first session. And subjects in the full strategy integration treatments were able to access not only the Activity and the Help screens of the version used in the previous session but also the Archives screen with the instructor's feedback on their first writing sample. At the end of S2, subjects filled in one of the three adaptations of the IMMS (A1, A2, or A3), depending on the treatment basic, medium, or full to which they were assigned.

Subjects were encouraged to accomplish the activities as well as possible. In order to keep performance's standards equally high in both sessions, it was not until that the experiment was concluded that students were told that the first of the sessions had just a training purpose. Implementation of the experiment extended over fourteen days and took about one hundred and forty hours.

Throughout the sessions, seven sets of data were unobtrusively traced by the WS' tracking tools for weighing the intensity and persistency of students' effort using the package. These included the overall time subjects spent on the entire program, the time they spent on the program's Intro, Activity, and Help sections, and the frequency with which they accessed the entire program and the Help and Intro sections.

Results

Performance Outcomes

The effects and interactions of the independent variables motivational strategy integration and task relevance were analyzed for the composite writing performance scores using analysis of variance (ANOVA). The means and standard deviations for performance scores for each treatment group in S2 showed that the highest mean score across treatments was obtained by the T5 subjects (3.19) --the maximum possible score being 4.00.

Statistically significant effects were found for the independent variable of primary interest, motivational strategy integration ($F(2, 42) = 3.844$, $p < .05$). Results of Tukey-Honestly Significant Difference (HSD) post-hoc tests demonstrated that in S2 the highly motivational strategy integration/highly and little relevant task combinations were statistically different from both the medium motivational strategy integration/highly and little relevant task conditions ($HSD\ (3, 42) = 4.53$, $p < .05$) and the low motivational strategy integration/highly and little relevant task conditions ($HSD\ (3, 42) = 4.90$, $p < .05$).

The full motivational strategy integration treatments seemed to be the most beneficial across time as indicated by the significant effects yielded by the ANOVA performed on the combined writing performance scores of S1 and S2 ($F(2, 42) = 3.327$, $p < .05$).

No significant effects were found for task relevance independent variable on the ANOVA performed on the writing scores of S2. The T5 group, which accomplished the little relevant tasks, obtained the highest mean score. Finally, analysis of S2 data also revealed that a variable interaction (motivational strategy integration x task relevance) occurred in the basic and medium strategy integration treatments. No interaction was detected for the full strategy integration treatment.

Attitudinal Outcomes

The one-way ANOVA performed on the data yielded by the three IMMS versions (A1, A2, and A3) indicated that the motivational strategy integration variable did not have a significant effect on attitudes. The three strategy integration groups, however, demonstrated a quite positive attitude toward the writing practice with the courseware.

The most motivated subjects appeared to be those in the basic strategy integration treatments (T1, T2) (mean = 3.63 out of a possible 1-5 range) followed by those in the full (T5, T6) (mean = 3.43) and medium features treatments (T3, T4) (mean = 3.29).

Pearson r of overall attitude ratings (A1, A2, A3) with overall writing performance mean scores (S1 and S2) indicated a correlation of .1704 (the P_{cv} for two-tailed test $\alpha = .05$ and 46 df r's for the basic (T1-T2), medium (T3-T4) and full (T5-T6) strategy groups respectively showed correlations of .1778, .4631, and -.2778 (the P_{cv} for two-tailed test $\alpha = .05$ and df performance for the basic and full integration treatments, and low positive correlation, but almost significant, for the medium features treatments.

Additional Findings

Subject's Perception of WS' Motivational Value. Responses to the attitudinal surveys' statements grouped by the motivational condition they addressed indicated that subjects across the "high", medium and "low" strategy integration treatments found that the highest motivational value conveyed by WS was Confidence (mean = 3.56) followed by Attention (mean = 3.49), Relevance (mean = 3.22), and Satisfaction (mean = 3.12).

Four WS' attributes including appropriate level of difficulty of the activities, spare number of screen components, suitability of the audiovisual resources, and comments encouraging previous writing efforts, were viewed by the subjects as the main motivating components of the program.

The effect on student's confidence of the appropriateness of tasks in the WS package ratifies tenets of expectancy-value theory (Lewin, 1938) which assume that people are motivated to engage in an activity if they have a positive expectation for success. The impact on subjects' attention of the frugal use of media attributes by WS proves the validity of the interface design principles that were applied to the package to achieve visual clarity (Mayhew, 1992) or avoid cognitive overload (Miller, 1953). The effects of WS praising comments about previous writing efforts on subjects' satisfaction supports research findings which indicate that feedback on past successes can be a powerful mediator in improving self-efficacy (Schunk, 1989).

Subject's Intensity and Persistency of Working Effort with WS. The MANOVA performed on four sets of data gathered by the WS tracking tools in S2, Intro Time, Activity Time, Help Time, and Overall Working Time revealed that task relevance affected significantly the time subjects in the T3-T6 treatments spent on the Help screen (F (1, 28) = 8.961, $p < .05$), and the time subjects in the different treatments invested on the Activity screen (F (1, 42) = 4.098, $p < .05$).

On the other hand, the MANOVA performed on three other sets of data, Intro Frequency, Help Frequency, and Overall Frequency of Access on S2, showed that task relevance impacted significantly (F (1, 28) = 6.153, $p < .05$) the frequency with which subjects in the T3-T6 treatments accessed the Help screen. Both motivational strategy integration (F (2, 42) = 7.482, $p < .05$) and task relevance (F (2, 42): 4.250, $p < .05$) affected significantly the overall frequency of subjects' access to the program.

These findings indicate that the strategy integration and, particularly, the task relevance variables affected significantly the persistency and intensity of the effort subjects invested on the WS program. The finding are consistent with those of previous SLA (Crookes & Schmidt, 1991) and IT (Ames & Ames, 1989) research showing that personal relevance of instructional content is a good determinant of selective learner attention and results in increased time-on task.

Subject's Use of WS Writing Strategy-Fostering Features. A descriptive source of data was used to explore the impact of the WS motivational enhancements on subjects' cognitive activity. Forty-eight draft versions of the writing activities, twenty-four per session and four per treatment, were analyzed according to four sets of criteria including length (number of words), nature (outline, vocabulary, or rough work), language (native or target), and quality (inclusiveness of activity's requested ideas). Drafts' analyses indicated the ways three WS writing-fostering features including dedicated drafting space, comprehensive yet discretely available help, and systematic activity directions, affected subjects' use of strategies such as "practice," "resourcing" and "output structuring," which are relevant to language learning in general (Oxford, 1990) and CALL (Liou, 1997) in particular.

Conclusion and Implication

This study investigated the effects of ARCS motivational strategies integration into the WS courseware package on the writing performance and attitudes of college students of Intermediate Spanish. Results indicated that subjects who worked with the full strategy integration versions of WS, which provided the highest number and recurrence of ARCS strategies, significantly outperformed subjects who worked with the basic and medium integration modalities. Strategy integration level resulted in greater performance gains than did the inherent interest of the learning task.

The study provides a working model on how to manipulate in combination two language learning conditions, motivation and opportunity, through the comprehensive application of ARCS motivational strategies to a CALL courseware holistic paradigm. More research is needed to consistently validate the effectiveness of such model.

Results of the study imply that with high levels of motivational strategy integration it is possible to boost the performance of learners of a foreign language not necessarily interested in the activities of a CALL package for holistic practice. Future tests of CALL packages of similar nature featuring longer treatment periods and greater number of participants may provide wider evidence of this possibility.

References

Ames, R. & Ames, C. (1989). *Research on motivation in education: Goals and cognitions.* New York Academic Press.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84* (2), 1991-215.

Borrás, I. (1999). Multimedia environments for research on instructional technology (MERIT): Development of a model (submitted).

Crookes, G., & Schmidt, R. W. (1991). Motivation: reopening the research agenda. *Language Learning, 41*(4), 469-512.

Gaudiani, C. (1981). *Teaching composition in the foreign language curriculum.* Language in Education: Theory and Practice Series, 43. Washington, DC: Center for Applied Linguistics.

Green, J. M. (1993). Student attitudes toward communicative and non-communicative activities: Do enjoyment and effectiveness go together? *Modern Language Journal, 77I* (1), 1-10.

Keller, J. M., & Suzuki, K. (1988). Application of the ARCS model to courseware design. In D.H. Jonassen (Ed.), *Instructional design theories and models: An overview of their current status* (pp. 401-434). Hillsdale, NJ: Lawrence Erlbaum Associates.

Keller, J. M. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development, 10* (3), 2-10.

Keller, J. M. (1993). Instructional Materials Motivation Survey (IMMS). Tallahassee: FL. Florida State University.

Krashen, S. & Terrell, T. (1983). *The natural approach: Language acquisition in the classroom.* Hayward, CA: The Alemany Press.

Lewin, K. (1938). *The conceptual representation and measurement of psychological forces.* Durham, NC: Duke University Press.

Liou, H. C. (1997). Research of on-line help as learner strategies for multimedia CALL evaluation. *CALICO Journal, 14* (2-4), 81-96.

Mayhew, D. J. (1992). *Principles and guidelines in software user interface design.* Englewood Cliffs, NJ: Prentice-Hall.

Means, T. B., Jonassen, D. H., & Dwyer, F. M. (1997). Enhancing Relevance: Embedded ARCS Strategies vs. Purpose. *Educational Technology Research & Development, 45* (1), 5-17.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review, 63*, 81-97.

Moller, L. (1993). *Increasing learner motivation and achievement through confidence building strategies.* Doctoral Dissertation, Purdue University.

Naime-Diefenbanch, B. (1991). *Validation of attention and confidence as independent components of the ARCS motivational model.* Doctoral dissertation, Florida State University.

Oxford, R. L. (1990). *Language learning strategies: What every teacher should know.* New York: Newbury House Publishers.

Pokay, P. & Blumenfeld, P. C. (1990). Predicting achievement early and late in the semester: The role of motivation and use of learning strategies. *Journal of Educational Psychology, 82* (1), 41-50.

Salomon, G. (1983). The different investment in mental effort in learning from different sources. *Educational Psychologist 18,* 42-51.

Salomon, G. (1991). Transcending the qualitative-quantitative debate: The analytic and systemic approaches to educational research. *Educational Researcher, 20*(6),10-18.

Schunk, D. H. (1989). Self-efficacy and cognitive skill learning. In Ames, C. and Ames, R. (eds.) *Research on Motivation in Education*, Vol. 3. *Goals and Cognition*. Academic Press: CA.

Spolsky, B. (1989). *Conditions for second language learning.* Oxford: Oxford University Press.

Ushioda, E. (1993). Redefining motivation from the L2 learner's point of view. *Teanga 13*, 1-12.

Wyatt, D. H. (1987). Applying pedagogical principles to CALL. In W. F. Smith (Ed.), *Modern media in foreign language* *education: Theory and Implementation* (pp. 85-98). Lincolnwood, IL: National Textbook Company.

Using Multimedia to Support Reflection on Past Events for Young Children

C. Bouras
Computer Technology Institute, 61 Riga Feraiou, Patras, Greece
bouras@cti.gr

V. Kapoulas
Computer Technology Institute, 61 Riga Feraiou, Patras, Greece
kapoulas@cti.gr

A. Konidaris
Computer Technology Institute, 61 Riga Feraiou, Patras, Greece
konidari@cti.gr

M. Ramahlo
Starlab N.V., Bd. St Michel 47, Brussels, Belgium
maria@starlab.net

A. Sevasti
Computer Technology Institute, 61 Riga Feraiou, Patras, Greece
sevastia@cti.gr

W. Van de Velde
Starlab N.V., Bd. St Michel 47, Brussels, Belgium
wvdv@starlab.net

Abstract: The work presented in this paper focuses on software tools that act as video explorers and annotation platforms and more specifically as diary composers for younger children. Through such tools, children can have as their raw material video recordings from everyday life and they are given the opportunity to review this material, reflect upon it and annotate it, thus creating the stories of everyday life from their own perspective. The specific tool proposed, focuses on multi-perspective capture of events by one or more children and their cooperation during the annotation procedure.

Introduction

Current educational software rarely offers either the child or the adult facilitator options for 'deeper interaction'. By 'deeper interaction' we refer to a procedure where the child takes active control over the material presented to it, reflects upon this material, annotates it alone or in teams and creates his own version of reality. This work focuses on developing both at interface levels of interaction and within the software, features that could explore a number of dimensions of learning (Umaschi 1997). The software paradigm being proposed will aim at supporting stages of reflection, levels of abstraction and opportunities for cooperation in grounded context that are accessible to young children. The ultimate aim is to enhance children's development both at cognitive, physical and social communication level (Baecker & Posner 1998), (Umaschi 1996).

More specifically, interaction with the video material recorded previously is performed through a video explorer. This video explorer is essentially a platform for the first stages of reflection. These will include the software and interface's functionalities of location, navigation and individual or collaborative viewing/annotation. The video explorer must therefore provide tools for both navigating inside videos and annotating them, thus consisting a diary composer. Navigating features are suggested to be inherent to the diary composer through a control panel, while annotation features are organized in distinguished toolbox palettes accompanying the composer. Functionality of the

palettes could include traditional editing functions such as cut, paste, drag, drop, coupled with other levels of annotation such as sequence by time, event, emotion, people, object, movement.
The research and implementation leading to the tool proposed here, have taken place within the framework of project "Today's Stories", part of the Long Term Research Task 4.4, (i3 –ESE, Project Nr. 29312, URL: http://stories.starlab.org/). The Today's Stories project is evolving a wearable technology facilitated approach to learning for young children (4 to 8 years old) that is aimed at supporting the development of social, communicative and emotional skills of children in the context of the everyday activities. In this paper, a thorough reference is being made to those requirements that must be met by an innovative diary composing tool, such as the one already outlined (see Druin 1998), (see Norman 1990). Consecutively, a list of the functional specifications of the proposed implementation is given. Based on the above, the diary composer prototype environment is described, escorted by implementation and usage details.

Related Work

Within the framework of the work presented in this paper, a thorough evaluation of the respectful number of current commercial and research activities in the field of multimedia editing and storyboarding for younger children has been performed (see Buckleitner et al. 1999). Among the commercial products taken under consideration, the most outstanding ones were:

- Kid Pix Studio Deluxe from Brøderbund Software, California
- Magic Theatre from Instinct Corporation, Silicon Valley
- Stanley's Sticker Stories from Edmark Corporation, an IBM company
- The Multimedia Workshop from Davidson
- Kid Works(TM) Deluxe from Davidson
- ClarisWorks for Kids from Apple Computer, Inc

These products were evaluated with respect to the proposed tool and a summary of their features is given in (Tab. 1).

Feature	Kid Pix Studio Deluxe	Magic Theatre	Stanley's Sticker Stories	The Multimedia Workshop	Kid Works Deluxe	ClarisWorks for Kids
Authoring platform	x	x	x	x	x	x
Playback platform	x	x	x	x	x	
Age range	3-12	pre-readers	3-7	8 and up	4-9	5-11
Create video	x	x	x	x	x	x
Insert video	x			x		x
Create sound	x	x	x	x	x	
Insert sound		x	x	x	x	x
Text-to-speech	x			x	x	x
Verbal help		x	x		x	x
Icon-based UI	x	x	x		x	x
Automatic saving and naming of files		x				
Spelling			x		x	x
Wizard					x	

Table 1: A collection of features from commercial diary composing tools for younger children

An interesting research activity in the field of storyboarding consists 'The Fabula project: Interactive children's storybooks to promote bilingual literacy' ('Fabula' Project 1998). Fabula was a two-year project in which partners in Ireland, Spain, the Netherlands and the United Kingdom worked together to develop an easy to use multimedia software kit for schools. An authoring tool was developed, to enable teachers to create illustrated bilingual multimedia story books to help primary school children learn a second language (and gain a deeper understanding of their first) through the written word, supported by pictures, sound, animation and interactive graphics. As children read the 'pages' of those storybooks, using the specially developed Fabula viewer software, they were able to exploit the unique opportunities provided by a multimedia environment.

Requirements

In this section a more detailed set of requirements for stimulating reflection through the confrontation of viewpoints and perspectives is proposed. The design approach of the video explorer tool, given in the following sections, is entirely based on this set of requirements. The diary composer environment should be essentially shared (as opposed to single user). Although it must be possible for children to reflect on their own material alone, we expect the most productive sessions to be based on collaborative confrontation of children's interpretations. The diary composer should be as much as possible language neutral. We do not assume literacy so we do not propose the use of text. We also envisage that the spoken word is a powerful means of annotation, allowing the children for example to narrate, in their own language and words, an interpretation of an episode.

The tool should be open to include arbitrary libraries of annotations, including those that have been created by children (symbols from scanned drawings for instance). It should allow making explicit interpretations. The core of interpretation is by annotation with symbols that children can select from a given repository. The collaborative aspect is essential here. The design choice followed is to use a single repository of annotations, also when different video frames are rolling. This does not mean that there is only one consistent interpretation of the events but will foster mutual understanding of them. The tool should finally act as a self-organizing memory support, avoiding file naming and saving operations. The different recorded episodes will be organized on a time line reflecting the times of their occurrence e.g. throughout the day.

Functional specifications

Storing and Indexing

The structure of the database of video recordings is proposed to be based on a time line indexing, with a time span of e.g. one day. Functions to be performed on this database are:

- Adding a new recording
- Erasing a recording: Children should be allowed to delete recordings and preserve for editing and annotation only those considered to be more interesting

Annotating

Functions to be provided here include:

- Interaction with the video player: Either by using pause, forward, backward buttons or by a mechanism that translates movement of the mouse over the video screen
- Preview of the meaning of an annotation icon by clicking on it
- Insertion of new annotations, either verbal or graphical ones
- Implementation of a wizard acting as a guide throughout the annotation procedure

Archiving

This set of functions aims at maintaining a database of the annotated versions in addition or as a replacement of the original video recordings. The two alternatives are either to delete the previous annotated version of a recording if re-editing is desirable or to perform re-editing over an existent annotated version by removing old and adding new annotations. In both cases saving an annotated video is done automatically. In cases where the original video needs to be destroyed for privacy reasons, the better approach is to automatically delete a video after an expiry date.

Worthwhile Features

Based on our research in the field of commercial diary composing environments, we have ended up with a set of features that such a tool as the one proposed should try to inherit. Some of the most important features are:

- Possibility to send a "story" (annotated video) to a friend, parent, etc.
- Easy-to-use icon based User Interface.

- Option to insert sounds (e.g. verbal annotation).
- Option to insert pictures and sounds either by the children or imported from an external source.
- Providing both an authoring and a playback platform combined in a transparent way to the child.
- Providing help on the meaning of annotation buttons by visual animation which could be accompanied or not of sounds suggestive of its action.

A general description of the diary composer prototype environment

The prototype environment proposed for development consists of two modules: the 'Timeline' display and the 'Annotation' display. In (Fig. 1), those two displays are presented simultaneously. However, this is not obligatory. It is proposed that the 'Timeline' display is permanent on screen, while the 'Annotation' display appears only when it is required: during the procedure of video annotation.

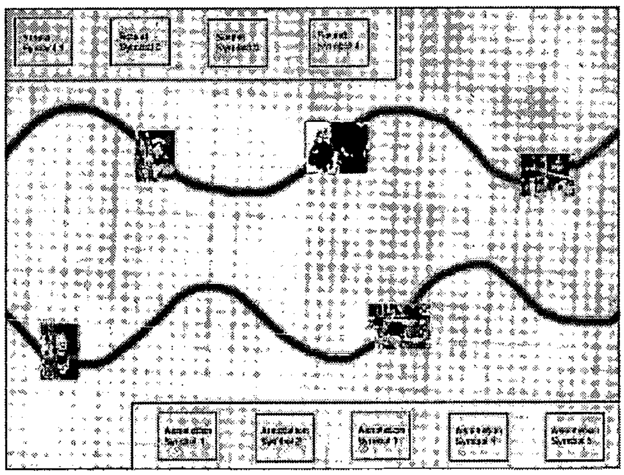


Figure 1: The 'Timeline' and 'Annotation' displays

The 'Timeline' display expands to the whole screen displaying one curved line for each child using the diary composer. Each one of the curved lines in (Fig. 1) represents a day for one child. One thumbnail for each video recording is placed on a child's timeline. In (Fig. 1), three such thumbnails are created in the first timeline and two thumbnails are placed on the second timeline. Thumbnails are placed on the timelines in such a way that the time of recording is reflected, thus the distance of two thumbnails on a certain timeline is proportional to the real time interval between the two recordings. The 'Annotation' display consists of two groups of annotation icons, one group of icons symbolizing sounds and another group of icons symbolizing emotions and any other kind of annotation. Each group consists a tool bar placed at the screen edges (the placement of the 'Sounds' icon bar on the top left part of the screen and the 'Annotations' icon bar on the bottom right of the screen in (Fig. 1) is indicative).

The 'Annotation' display provides children with the tools for annotating the videos. The icons representing sounds can be either buttons, which when pressed allow for the playback of the correspondent sound, or drag and drop items, which the children will be able to drop on a video frame in order to annotate the instance displayed with the correspondent sound. The icons for the rest of the annotations (showing expressions, feelings etc.) can only be drag and drop icons, dragged by the children on certain video frames, during the annotation procedure.

Both the icon bars of the 'Annotation' display will be global in the diary composer environment. In other words, the annotation tool bars will always be visible during the annotation procedure of different videos, instead of appearing each time an annotation procedure is initiated and being imminently related to the current video under annotation. This will allow children to treat the diary composer as a homogeneous tool that provides the same layout and options regardless of the current thumbnails and video processing procedures.

The annotation procedure

When one or more children decide to annotate a video of an incident they have already recorded, they have to simply 'click' on this video's thumbnail, for the annotation procedure to begin. Immediately, the thumbnail is transformed to an enlarged video display, extending to a large part of the screen (see Fig. 2). The dimensions of the video display will be customizable but it is definite that they will not extend to the whole of the screen. Space on the screen must be preserved for the 'Annotation' display and the timeline(s) will remain at the background for the children to return to them and select another thumbnail, if needed.

Navigation in a video recording for the purposes of annotation will be made either by the buttons appearing on the bottom of the video (right arrow for 'Forward', left arrow for 'Backward' and the hand icon for 'Stop' or 'Slow Motion' playback) or by imminently clicking on the video itself. The latest feature will allow children to move forwards in the video by placing their mouse at the right hand-side of the video display, move backwards in the video by placing their mouse at the left hand-side of the video display and pausing/resuming playback of the video by clicking on the video display.

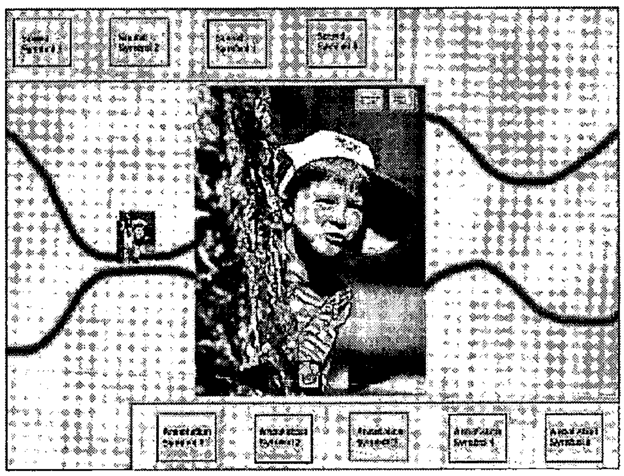


Figure 2: Annotations are added to the video

Once the child has successfully acquired the navigation techniques, it can then playback the video and pause/stop playback at any moment in order to annotate it. In the case where both sound and expression/emotion annotations are of a drag and drop nature, the diary composer screen will look like that of (Fig. 2). Two annotations, one sound and one expression/emotion annotation are added to the particular video frame and can appear as small icons, dropped on the top right corner of it. Of course, the placement of annotations will not be restricted.

During the annotation procedure, any annotations and changes on the current video will be automatically saved. However, when a child wishes to make a modification, it will be able to locate the annotated video frame it wishes to edit and remove or add annotations with the drag and drop fashion. Removing an annotation from a video frame will be achieved by dragging and dropping it out of the space where the video is displayed. Removing all annotations added to a video recording and restart annotating the pure video will be achieved by clicking on the thumbnail of the video recording, which remains on the timeline in the background. Clicking on the 'Timeline' display, which during the annotation procedure comprises the diary composer's background, will terminate an annotation procedure, saving automatically all annotations in the current video.

Specific features of the Diary Composer

An interesting feature that is proposed for the 'Timeline' display is that of dynamic behavior. Although the diary composer will allow a child to reflect only on his own material, by watching only his own timeline and thumbnails on the 'Timeline' display, it will also allow collaborative confrontation of children's interpretations. This feature will be supported by the dynamic the timelines. It is proposed that in cases where two children have recorded the same incident (from different points of view) and wish to annotate their recordings cooperatively, the two different thumbnails of this same incident will be associated. This association will be visualized by the two children's timelines 'approaching', as shown for the first thumbnails of the two timelines in (Fig. 3). This metaphor will initiate the procedure on collaborative annotation of the videos.

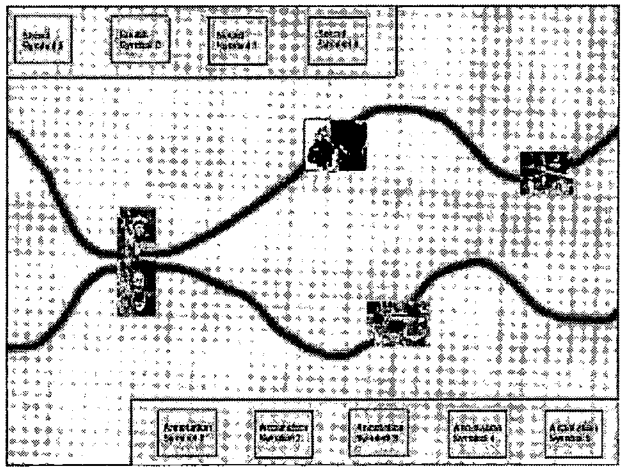


Figure 3: The dynamic behavior of timelines

Conclusions and Future Work

It is evident by the nature and design of the tool proposed here that a lot of its implementation choices consist open issues with regard to their pedagogical value. The tool seems to succeed in acquiring collaboration of its young users, by presenting simultaneously video recordings on the same event and provoking small groups of children to comment upon them and annotate them. It, therefore, distinguishes itself among relevant existent tools.
The issue is here, how to stimulate the children's involvement in the editing and annotating procedure as much as possible. On this goal, should future work on the diary composer focus. The issues to be dealt with are the improvement of the controls for loading, editing and annotating the videos as well as the library of annotations, so that they will approach as much as possible the children's perception.

References

Baecker, R., & Posner, I. (1998). Children Creating Movies Using a Novel Multimedia Authoring Tool. *ECOO '98 Making IT Happen*. Toronto, Ontario, Canada.

Buckleitner, W. W. (Editor), Orr, A.C., & Wolock E.L. (1999). *Complete Sourcebook on Children's Software, Vol. 8*. Active Learning Associates

Druin, A. (Editor) (1998). *The Design of Children's Technology*. Morgan Kaufman Publishers, Inc. San Francisco, CA USA.

'Fabula' Project (1998). *D1.1: 'Fabula: A report to the Educational Multimedia Taskforce of the EU'*. Project number: MM1039. Conrad Taylor Dept. of Typography & Graphic Communication, University of Reading, UK

Norman, D.A. (1990). *The Design of Everyday Things*. Doubleday Books.

Umaschi, M. (1996). SAGE Storytellers: Learning about Identity, Language and Technology. *ICLS '96 Second International Conference of the Learning Sciences, 1996*, Evanston, IL USA.

Umaschi, M. (1997). Soft Toys with Computer Hearts: Building Personal Storytelling Environments. *CHI '97*, Atlanta, GA USA.

The Baker's Dozen: Design Principles for Collaborative Telelearning

Jacqueline Bourdeau, Department of Education
Université du Québec à Chicoutimi, Chicoutimi, Québec, CANADA G7H 2B1
jbourdea@uqac.uquebec.ca
Laura Winer, Faculty of Education, Université de Montréal
C.P. 6128 Succ. Centre-ville, Montréal, Québec, CANADA H3C 3J7
winerl@scedu.umontreal.ca
Martine Chomienne, Centre collegial de formation a distance
7100, rue Jean-Talon Est, Montreal, Québec, CANADA H1M 3S3
mchom@ccfd.crosemont.qc.ca
Jesus Vazquez-Abad, Faculty of Education, Université de Montréal
C.P. 6128 Succ. Centre-ville, Montréal, Québec, CANADA H3C 3J7
vazquez@scedu.umontreal.ca
Barbara Wasson, Department of Information Science, University of Bergen
N-5020, Bergen, Norway
barbara.wasson@ifi.uib.no

Abstract: Design Principles for Collaborative Telelearning have been extracted from design experiments and validated by instructional designers. The design approach integrates individual learning, teamwork and group/class instruction, and links on-site and on-line learning situations in a coherent instructional continuum. The challenge was to build scenarios that integrate a three-level set of learning activities: individual, team and group activities and to support collaboration in action.

Introduction

Telelearning represents a new educational opportunity that offers many of the same features as distance learning, but is different in some ways as well. Telelearning provides opportunities not available in traditional distance learning, such as highly interactive and media-enhanced peer collaboration. The potential for mediated social interactions raises a number of issues. Our research focuses on two of these issues: 1) What is the nature of collaboration in collaborative telelearning?; 2) What principles guide the design of collaborative telelearning scenarios and software environments?

Our definition of telelearning is as follows: "The term *telelearning* is used to designate new forms of distance or of computer mediated learning, where the distance is not only distance in terms of space or time as in traditional distance learning, but the mediation in learning activities served by media, such as multimedia-based shared workspaces, multimedia communication, or multimedia servers" (Bourdeau & Wasson, 1997). The definition of collaborative learning by Salomon (1991) contains three major components: sharing, interdependencies and involvement. Ohlson & Ohlson (1993) see collaboration in the context of computer-supported collaborative work as a combination of communication and coordination. Coordination science defines coordination as managing interdependencies, which can apply to interdependencies between actors (Bourdeau & Wasson, 1997). In order to develop design principles for collaborative telelearning, existing learning situations needed to be analyzed and new ones created. The purpose was to extract and elicit principles, then determine whether these principles could be implemented in the scenario or whether some roles could be played by a software agent. The general type of learning situation selected is called a distributed simulation lab, which consists of a scenario plus a software environment.

Starting from general instructional design principles for distance learning, (Bourdeau & Bates, 1996), the challenge was to extend or specify existing principles, add new ones, and validate the new set. The starting set of principles was as follows: 1) Select media based on access for students; 2) Develop fully readable, understandable and feasible material and guidance; 3) Plan both synchronous and asynchronous two-way communication; 4) Design a variety of learning activities; 5) Design a structured interactive student support system; 6) Plan opportunities for peer collaboration; 7) Provide appropriate feedback to students; 8) Anticipate errors by students, both in terms of content and process; 9) Set clear evaluation standards for learning outcomes to compensate for the high distribution of students and tutors and to ensure equity; 10) Plan for the evaluation of instructional materials and student support.

Project 6.2.3 of the Telelearning Network of Centres of Excellence (www.telelearn.ca) focused on the development of Instructional Design principles for collaborative telelearning. The design approach is far more inclusive than existing ones in that it integrates individual learning (self-directed learning and self-tutoring), teamwork and group/class instruction. It also links on-site and on-line learning situations in a coherent instructional continuum. The challenge was to build scenarios that integrate a three-level set of learning activities: individual, team and group activities based on the belief that learning is maximized when the three situations are used appropriately (in alternation or combined). An additional challenge arose from the desire to support collaboration in action, not just in discourse, in the context of multimodal scenarios that integrate synchronous multimedia interactions with textual asynchronous communication.

Method

Design principles are the prescriptive knowledge produced in the field of instructional technology, based on instructional and learning theory (Gagné, 1992; Merrill, 1994; Reigeluth, 1983, 1997, 1998; Lebow, 1995) that serve a community of practice (Tessmer & Wedman, 1995). Their use and validity are strongly related to the field of practice. The methodological approach adopted here respected requirements of rigor and validity, while working within the constraints of technological innovation. The following principles will be revised as technological environments and our understanding of how people learn within them evolve.

A series of different methods was employed to develop and validate principles : a) *Field testing* to extract knowledge about collaborative telelearning in a distributed simulation lab for management students; b) *Design experimentation* to test a new design for a distributed simulation lab in physics; c) *Modelling* to analyze interdependencies and the potential roles of a coordination agent; d) *Focus group* to validate principles.

The *field test* for extracting knowledge about collaborative telelearning in a distributed simulation lab in the strategic management field consisted in a series of structured observations in various on-campus learning sessions. The central element of the learning environment is a business simulation (www.cetai.ca/netstrat) that is run as a game. Several teams can participate at a distance within a predetermined timeframe set by the gamemaster (Bourdeau & Winer, 1997). Participants were students in various business administration programs at the *École des HEC* (School of Commerce) in Montreal.

The scenarios involved students in a mix of face-to-face, distributed group, as well as inter- and intra-team activities. Researchers observed and analyzed interaction within and among the teams, between the students and the professor, and between the students and the computer simulation environment. Observations covered the briefing, action rounds, report writing and debriefing. Particular attention was paid to the following questions: a) What means of communication did the students use and to what end? (Communication); b) Which activities or methods encouraged the creation of interdependencies? (Interdependencies); c) Did all team members participate in the decision-making process? (Involvement); d) Which coordination strategies did the various teams develop? (Coordination)

Data sources included a structured journal and semi-structured comments from each participant, structured observations during group sessions, as well as copies of messages, decisions and reports. Results from the analysis of the field test showed that the processes involved in working and learning in a collaborative way need to be improved. The processes of information-sharing, fostering relationships among participants, participating in the decision-making process, and building specific coordination strategies among team members all need to be supported by implicit and explicit tools.

A *design experiment* was conducted to test a new distributed science lab in physics (Winer, Chomienne & Vázquez-Abad, 1999). The scenario consisted of three experiments: Experiment 1 was a qualitative exploration of the behaviour of simple electric circuits. It involved handling common electrical materials, such as bulbs, batteries, connecting wires, etc... Experimentation and data measurements were conducted using real instruments. The data analysis was carried out on an individual basis. Results were interpreted and conclusions were drawn as a team. Experiment 2 was on Ohm's Law. The experiment consisted of working with a computer simulation. Measurements were automated, data analysis was carried out on an individual basis, and interpretations/conclusions were drawn as a team. Experiment 3 was on Kirchhoff's Law on the distribution of current in a circuit. The experiment was again conducted with a simulator and measurements were automated. Data analysis, interpretations and conclusions were carried out as a team.

A software environment was developed and implemented at a distance learning college to test the learning scenario under distance learning conditions (i.e., students in different locations interacting in a software environment with their peers). See (http://crosemont.qc.ca/ccfd/soci/contenu/203-FPF-03/Section2/laboratoires/lab3/electrik html).

Data sources included observations, student productions, and team interviews. Results enabled researchers to establish the following guidelines: a) Provide a workspace for the individual, not just a shared space for the team; b) Conduct a group-based formative evaluation of learning materials with different learners to ensure that the instructions and vocabulary are not only internally consistent, but also subject to the same interpretation; c) Offer a variety of learning activities; d) Error analysis must distinguish between productive and non-productive errors so as to permit the former and block the latter; e) The technology should enhance the learning experience; f) Each learner's contribution must be necessary but not sufficient for both the individual and the group to succeed in the learning activity.

The *modelling* conducted to analyze interdependencies and the potential roles of a coordination agent was based on both Salomon's framework for CL (Salomon, 1991) and the Crowston & Malone framework for coordination (Crowston & Malone, 1994) using a modelling tool called MOT (www.licef.teluq.uquebec.ca). Several learning scenarios in the strategic management course were modelled and analyzed to identify interdependencies, and extract coordination principles (Bourdeau & Wasson, 1997; Wasson, 1998a). The following observations were made: "Actors in a collaborative telelearning situation must or need to: 1) share goals to complete activities; 2) share activities to achieve goals; 3) share resources to complete activities; 4) share activities to produce resources (Bourdeau & Wasson, 1997). Interdependencies can be either collaborative or competitive. They differ in the coordination processes required to manage them. Coordination software agents can be designed to manage interdependencies. Preliminary work on identifying roles to be played by agents indicates that agents can either serve as coordination managers or coordination facilitators. Other roles they could play include: team-building agent, group decision-making assistant, scheduling manager, synchronization manager, competition manager, and competition monitor (Wasson, 1999).

The *Focus group* was conducted to validate principles. Preliminary principles derived from the steps above were developed as follows:

1. Select media based on their ability to support collaboration in learning activities (i.e., by being multidirectional, interactive and sharing).
2. Ensure shared understanding of learning materials--text, graphics, audio, video--by conducting formative evaluations in a team setting.
3. Create meaningful and balanced opportunities for synchronous--face-to-face or mediated--and asynchronous interactions among students, between distributed teams and the system, as well as between distributed teams and the instructor.
4. Provide specific support tools and structures for the team-building phase of the activity, whether teams are formed by participants or course leaders.
5. Introduce collaboration gradually. Ensure that students are familiar with the learning environment before requiring intensive collaboration.
6. Implement coordination mechanisms when designing each learning activity.
7. Design a student support system capable of supporting distributed teamwork.
8. Create authentic and feasible collaborative learning activities with built-in interdependencies.
9. Provide multidirectional feedback channels from student to student, team to team, and system to team.

10. Anticipate possible technical and conceptual errors. Eliminate non-productive errors by stronger guidance and/or interface design. Use productive errors as input for team discussions, to provoke cognitive conflict among team members, and to stimulate individual reflection.
11. Design an assessment method for both individual and team achievements by tracking individual contributions, and by asking individuals to reflect on teamwork processes and/or performance.
12. Plan for obsolescence. Foresee frequent updates of collaboration mechanisms.
13. Provide strong guidance for learning how to use the tools, as well as support for teamwork and a design for active learning to develop skills.

A group of eight (8) instructional designers were selected based on their professional experience and interest in new ideas. Participants were asked to attend a one-day seminar with a course design of their own. Each participant completed a profile to answer the following questions: How many years' experience do you have in instructional design? Have you received formal training in instructional design? Have you designed or participated in the design or evaluation of "traditional" distance education or training involving computer-based learning? How often do you refer to ID references when designing instructional methods? If and when you consult references, what are you looking for?

Each principle was presented to the group with illustrative examples. The group was then divided into teams and asked the following questions: Are the principles easy to understand? Is there any terminology that is confusing? Do the principles apply to your design situation? Were the principles useful in the design process? Do you have instructional design questions specific to Web-based learning that were not addressed by the principles? Is there an order of presentation that would be useful? Are the principles independent, or does it make sense to look at them in a specific order? Do you have any other comments or questions?

After the teams had answered the questions, a group session was organized to discuss teamwork results, summarize the most important comments and suggestions, both on the wording and order of the principles.

Results

The preliminary principles were revised and reordered by design phase (analysis, 1-5; design/development, 6-11; evaluation, 12; delivery and management, 13) as presented below:

1. Identify opportunities for authentic and feasible collaborative learning activities.
2. Select media, channels and tools based on their ability to support collaboration in learning activities (i.e., by being multidirectional, interactive and sharing).
3. Provide feedback channels from student to student, team to team, and student support system to team.
4. Anticipate possible technical and conceptual learner errors. Use productive errors as input for team discussions, to provoke cognitive conflict among team members, and stimulate individual reflection. Eliminate non-productive errors by providing stronger guidance and/or interface design.
5. Use a structured learning approach for learning how to use tools and an active learning approach for developing skills.
6. Design meaningful and balanced opportunities for synchronous--face-to-face or mediated--and asynchronous interactions among team members, between distributed teams and the system, as well as between distributed teams and the instructor.
7. Design an assessment method for both individual and team achievements by tracking individual contributions, and by asking individuals to reflect on teamwork processes and/or performance.
8. Provide specific support tools and structures for the life span of the team. For example, during the team-building phase of the activity, whether teams are formed by participants or course leaders.
9. Introduce collaboration gradually. Ensure that students are familiar with the learning environment before requiring intensive collaboration.
10. Implement coordination mechanisms when designing each learning activity.
11. Design a student and tutor support system capable of supporting distributed teamwork.
12. Conduct formative evaluations in a team setting to ensure shared understanding of learning materials--text, graphics, audio, video—and coordination mechanisms.
13. Plan for upgrades. Foresee frequent updates of collaboration tools and mechanisms.

As a by-product of the Telelearning project (6.2.3), a learning product and the profile for a software coordination agent were also developed. The design experiment in Step 2 was used to build and implement a learning scenario and environment. The product is called a distributed collaborative science learning lab: DCSLL (Winer et al., 1999). The modelling exercise in Step 3 served to complete the analysis of the roles of a coordination agent (Wasson, 1998b).

Conclusions and Outlook for the Future

The results of this project provide an in-depth understanding of collaborative telelearning scenarios distributed over both time and space. The groundwork has been laid to coordinate actors in collaborative telelearning scenarios. As a result, the design of pedagogical agents for collaborative telelearning has been further advanced.

The foundations for collaborative science telelearning laboratories have also been established and tested. More specifically, a scenario in a Web-based environment for a physics lab has been developed, implemented and tested. Collaborative telelearning scenarios were modelled using the MOT knowledge editor in order to extract instructional design principles.

Instructional designers and consultants have validated preliminary principles. Design principles, based both on theoretical foundations and training practices, should ideally provide instructional designers with the knowledge they need for innovative teletraining, while maintaining high-quality standards.

Until now, work has been carried out using "bridges" to develop and test training solutions: Management training was tested in a higher education environment at the *École des Hautes Études Commerciales* (HEC), and technical training was tested at the collegiate continuing education level – *Centre Collégial de Formation à Distance* (CCFD). This made it possible to test preliminary solutions in situations that were realistic enough for a formative cvaluation of scenarios and technological environments.

Future work in the Telelearning Network of Centres of Excellence should include: 1) Creation of a Workplace Training portfolio, consisting of a collection of basic learning scenarios, as well as a methodology for adapting scenarios to specific learning situations or needs (DelaTeja et al., submitted to EDMEDIA'2000); 2) Design of a coordination agent able to play the roles identified above (Wasson,1998b); 3) Implementation of the coordination agent in a virtual campus environment, such as LICEF's Explora (Paquette et al., submitted to EDMEDIA'2000).

References

Bourdeau J. & Bates A. (1997). Instructional Design for Distance Learning, in Dijsktra, S., Seel, N., Schott, F., & Tennyson R., ed., *Instructional Design: International Perspectives: Solving Instructional Design Problems.* Mahwah, NJ: Lawrence Earlbaum Ass., 369-397.

Bourdeau, J. & Wasson, B. (1997). Orchestrating collaboration in collaborative telelearning. In B. du Boulay & R. Mizoguchi (Eds.) *Proceedings of the 8th World Conference on Artificial Intelligence in Education*, 565-567. Amsterdam: IOS Press.

Bourdeau, J., Chomienne, M., Vazquez-Abad, J. Wasson, B. & Winer, L. (1997). Developing instructional design principles for collaborative telelearning. In T. Muldner & T.C. Reeves (Eds.) *Proceedings of EdMedia & EdTelecom'97, Vol II*, 1141-1142. Charlottesville, VA: Association for the Advancement of Computing in Education.

Bourdeau, J. & Winer, L. (1997). Learning strategic management with NetStrat, a distributed business simulation. In T. Muldner & T.C. Reeves (Eds.) *Proceedings of EdMedia & EdTelecom'97, Vol II*, . Charlottesville, VA: Association for the Advancement of Computing in Education.

Gagné, R., Briggs, L., and Wager, W. (1992). Principles of Instructional Design, 4th ed.. Fort Worth, TX: Harcourt Brace Jovanovich College Publ.

Lebow, D. (1995). Constructivist values for instructional systems design: Five principles toward a new mindset. In Seels, B. Instructional Design Fundamentals: A Reconsideration. Mahwah, NJ: Ed. Tech. Publ., 175-187.

Malone, T. and Crowston, K. (1993). The Interdisciplinary study of Coordination, Center for Coordination Science, 52pp. Cambridge, MA: MIT

Olson, J., Card, S., Landauer, T., Olson, G., Malone, T. and Leggett, J. (1993). Computer-supported cooperative work: research issues for the 90s. Behaviour and Information Technology, 12,2:115-129.

Paquette, G., Ricciardi-Rigault, C., Bourdeau, J., Paquin, C. and Liegeois, S. (1995). Modelling the Virtual Campus Environment for Interactive Distance Learning, In Educational Multimedia and Hypermedia 1995. pp 523-528. Charlotteville, VA: Association for the Advancement of Computing in Education.

Reigeluth, C. (1997). Instructional Design Theory, practitioner needs and new directions: Some Reflections. Educational Technology, 37 (1), 34-41.

Salomon, G. (1991). What Does the Design of Effective CSCL Require and How Do We Study Its Effects? SIGCUE Outlook, Special Issue on CSCL. 21,3: 62-68.

Salomon, G. (1993), ed. Distributed Cognitions: Psychological and Educational Considerations. New York, NY: Cambridge University Press.

Tessmer, M. & Wedman, J. (1995). Context-sensitive instructional design models: A response to design research, studies and criticism. Performance Improvment Quaterly, 8(3), 38-54.

Wasson, B. (1998a). Developing an (Inter)dependence Model for Collaborative Telelearning, LICEF report 98R152.

Wasson, B. & Bourdeau, J. (1998). Actor Interdependence in Collaborative Telelearning. In & (Eds.) *Proceedings of Ed-Media & Ed-Telecom '98,* 1458-1463. Charlottesville, VA : Association for the Advancement of Computing in Education.

Wasson, B. (1998b). Identifying roles for a coordination agent, International Journal of Artificial Intelligence and Education. http://cbl.leeds.ac.uk/ijaied/

Winer, L.R., Chomienne, M. & Vázquez-Abad, J. (1999) "The Electrical Circuit Simulator" Towards a Collaborative and Distributed Science Learning Laboratory, LICEF Report, Montreal.

Credits

This project received funding from the TeleLearning NCE of the Canadian Government. Support was also received from the *Centre Collégial de Formation à Distance*, the LICEF Research Centre of the *Télé-université*, the University of Montreal, the *Université du Québec à Chicoutimi*, and the University of Bergen, Norway.

Patterns for Learning, and Metadesign: Key Challenge for Learning Environment Designers

Tom Boyle
School of Informatics and Multimedia Technology
University of North London
166-220 Holloway Road
London, N7 8DB
England.
Email: t.boyle@unl.ac.uk

Abstract: The discipline of learning environment design has expanded greatly in the past decade. The need for effective methods to capture, represent and communicate design knowledge remains pressing. High level principles, such as those provided by constructivism, are not sufficient in themselves. This paper provides an exposition of the concept of PALs (Patterns for Learning). These are re-usable design patterns that can be applied in the development of computer supported learning environments. The paper discusses how PALs may be extracted to capture and represent design knowledge. It is argued that these re-usable design patterns provide a productive currency for metadesign, the theoretical discourse about design.

Introduction

There has been a rapid expansion of learning technology in the past decade. This expansion has involved not just an increase in the size of the community but also a burgeoning of design innovations. Many of these innovations are linked with the increasing influence of constructivist conceptions of the learning process (Cunningham et al. 1993, Jonassen et al. 1993). There remains, however, a considerable fragmentation in the representation of design knowledge, and often a considerable gap between exhortation and implementation. There is a need to develop a systematic conceptual representation of design knowledge.

There are different ways of capturing and representing design knowledge. Constructivism has presented design guidance at two main levels: principles and tactics. Constructivist principles include an emphasis on authentic learning tasks which evoke a high degree of interaction and collaboration to engage the learner in the knowledge construction process. These principles, emphasizing authentic tasks, interaction, engagement, collaboration and ownership of the learning process, have a high heuristic value for the designer. However, there is considerable freedom of interpretation in how they should be implemented. These principles may be realized through various methods. These methods range from constructionisn with a very strong emphasis on learner freedom in constructing artifacts (Papert 1993) through to structured guided-discovery methods such as CORE (Boyle et al 1994). These methods may include refinement and expansion of constructivist principles and/or some degree of structured method for doing design.

These representations of design knowledge are both valuable. However, there remain a number of problems. This becomes particularly manifest when teaching learning environment design. There is often, for example, a marked gap between exhortation and implementation. For novice designers the principles are quite abstract. How do they relate these principles to the specific problem situation? In software engineering the re-use and tailorability of software components has been a very important issue in design. However, support for tailorability and re-use in learning environment design is weak. Constructivism provides reusable principles but at a very high level. The designer may struggle to extract re-usable components from examples of constructivist systems. Constructivist oriented methods for learning environment design, such as Cognitive Apprenticeship, does not fully solve this problem. Some features still remain at a high level of representation. How do modeling and scaffolding apply at the level of detail, for example, of developing a learning environment for program design? How do you apply the concepts when dealing with issues such as the complexity and abstraction of the material to be learned? The concepts provide good starting principles. But how you progress from these starting principles to develop successful systems is often not clear.

There is thus often a marked gap between principles and design practice. A central issue is: how do you capture design insights in a form that provides re-usable techniques that can be applied to create a bridge from principles into practice?

Design patterns

There is considerable research work that indicates that much expert knowledge is represented at the level of 'patterns'. These are abstract representations relating problem space characteristics to solution frames that can be applied to a range of concrete problem situations. Patterns have been identified as a key presentation of expert knowledge in domains such as chess, programming (Hohmann et al. 1992, Clancy and Linn 1999) and hypermedia design (Lyardet, Rossi and Swabe 1998). In modern object oriented design 'design patterns' has become recognized as a key way of capturing and disseminating high level design expertise (Gamma et al. 1995). These patterns capture expert knowledge. They are the 'chunks' that enable experts to deal at a much higher level of representation in solving problems. They fit in with the classical psychological theory of how people overcome the limitations of working memory - 7 pus or minus 2 bits of information (Miller 1956). Experts deal with chunks or patterns of information (sometimes at a very high level) not isolated elements. The development of expertise involves building up these patterns of information together with the skills to apply them effectively.

Work has started in the area of object oriented design on the concept of pedagogical patterns as a way of capturing and representing expert knowledge (see especially http://www-lifia.info.unlp.edu.ar/ppp/index.html). The work in this area has begun to tackle some important issues, such as developing formats for the representation of pedagogical patterns (see http://www-lifia.info.unlp.edu.ar/ppp/format.htm). However, this work has tended to be focused mainly on the domain of object-oriented programming and design. The importance of the concept of re-usable design patterns as a way of capturing re-usable 'domain free' pedagogical techniques has made little impact on the wider learning environment community. The concept of design patterns should provide a powerful tool for analysis and synthesis. It should provide a tool to analyze existing approaches, extract re-usable design patterns and support the use of these design patterns in new creative systems or learning architectures. These are the objectives of the approach advocated in this paper.

PALs for designers

The aim is to develop an approach that will help extract, represent and apply the high level knowledge that is possessed by expert designers of computer based learning environments. The term used in the paper for these re-usable deign patterns is PALs (Patterns for Learning). This explicated knowledge, in turn, should provide a currency for productive dialogue among designers. It should facilitate a real debate, a dialectic of development in furthering the explication and adaptation of design knowledge.

There are two main sources for extracting re-usable design patterns:

* Abstraction from examples of good practice

* Analysis of existing methods

This discussion will focus on the second source. This provides a very direct and productive way of extracting re-usable design patterns. It supports the creation of a level of design knowledge at a level of granularity below that of methods or tactical frameworks. It complements and extends traditional ways of representing design knowledge.

Analysis of existing methods

There have been a number of methods proposed for the design and development of learning environments, such as Cognitive Apprenticeship (Collins et al. 1989), CORE (Boyle et al. 1994) and CaBLE (Feifer and Allender 1994). However, there is a limit to the theoretical utility of having a number of design methods presented as alternative choices. There ought to be common techniques for the analysis of these methods into smaller, re-usable design components that can be adaptively used by creative instructional designers. Where can we find PALs in these methods that can be used as design entities independently of the 'macro' methods in which they were originally embedded? Applying this approach should free up knowledge embedded in these larger methods and provide a more flexible currency for the exchange and re-use of creative design insights.

The extraction of PALs from these larger methods may be illustrated using the CORE Approach. This is a constructivist method for designing learning environments for complex skills or highly structured knowledge. It was first applied to the domain of programming (Boyle and Margetts 1992, Boyle and Davies 1996). It has subsequently been applied to a range of domains ranging from the formal recording of animal behaviour (Boyle et al 1996) to nuclear medicine (Hogg et al. 1999). The CORE method involves structuring learning blocks based on a sequence of Context, Objects, Refinement and Expression. Each learning block commences by setting the context. This presents the new skill embedded in a larger working environment. This is followed by the provision of examples of the learning target disembedded from the working context. A refinement section follows. This is based on a series of carefully chosen questions with feedback. This dialogue of questions and answers enables the learners to construct their knowledge of the target domain rather than this knowledge being transmitted didactically. Each learning block terminates in an 'expression' phase where the student applies the new skill acquired. At the curriculum level, each of these learning blocks is organized around a target competence, with later learning blocks building on the accomplishments of earlier blocks.

A designer might wish to use certain features of this approach combined with features of other methods such as Cognitive Apprenticeship. How can this selective use of specific pedagogical features be achieved? Here we use the CORE approach as an example. A similar analysis could be applied to other methods such as CaBLE or Cognitive Apprenticeship to yield re-usable PALs. The 'Refinement' aspect of CORE, for example, provides pedagogical techniques that might be extracted and used independently of the full CORE approach. An examination of the 'Refinement' reveals that it has a link and chain structure phase. Two main design patterns can be extracted - the link PAL, and the chain level PAL which provides a higher level organization of the link components. In this discussion we may focus on the 'link' pattern.

The CORE 'link' pattern is based on a microproblem-response-feedback structure. In its simplest realization this is a structured variation on a 'question-answer-feedback' exchange. CORE uses example-based learning. Each link involves the presentation of an example. This example is an instantiation of some underlying structure, e.g. a construct in a programming language. The learner has to form a hypothesis or guess about the underlying pattern based on this example. This underlying hypothesis, or guess, informs the learner's response. When students answer the questions they receive feedback. This feedback provides the mature user's response with a short explication of this response. For example, if the learner is presented with a yes/no question the feedback will always give the reason for the expert's yes/no answer. This is the most important part of the feedback. It allows the learner to compare their response with the experts and use the feedback to elaborate or 'refine' their hypothesis, or idea, about the underlying structure. It is important to note that the feedback provided by the software does not require any AI type parsing. The information is provided as a knowledgeable response. The method encourages the learner to compare their response with the expert's response and actively refine their understanding as a result. The feedback also adds new formative knowledge that the user may apply to solve the next example-based question. In this way a didactic exposition of knowledge can be replaced by a highly constructivist 'example-infer-feedback' chain. The structure of the CORE link PAL is set out in Figure 1.

The 'link pattern in CORE may be extracted as a PAL entity in its own right. In the CORE method these links are organized in a dialogue 'chain' that has its own structural properties. However, systematically applying the full method is very time consuming. Pure example-based learning, as in CORE, is very demanding to develop. A learning environment designer might wish to employ smaller sets of 'CORE links' combined with direct exposition - as in 'modeling' espoused by Cognitive Apprenticeship. The separation of the 'CORE link' PAL supports this creative and adaptive re-use. The designer may wish to break down a complex area into episodes of exposition followed by short sets of CORE links (e.g. three to five links). In this way the designer may wish to attain a balance between economy in development time with the use of example-based constructive learning. The analysis of CORE and Cognitive Apprenticeship into re-usable PALs would actively supports this creative 're-purposing' by the designer.

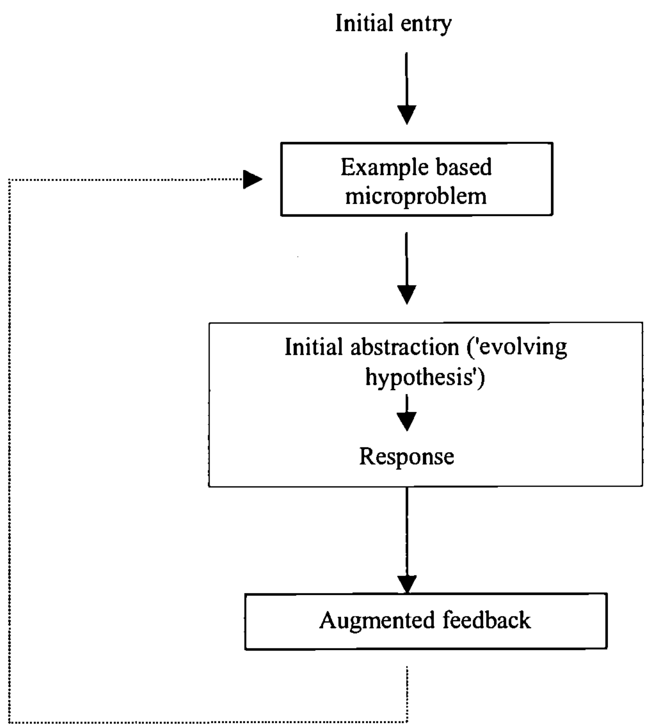


Figure 1: Diagrammatic representation of CORE link PAL

Towards metadesign - discourse about design

One of the learning objectives of constructivist theory is to encourage metacognition - thinking about thinking. Learners should not only learn about the domain and skills in problem solving, they should also be able to reflect on how they solve problems and how they think about the domain. This is a high level skill. If this is a skill that should encouraged in learners it is certainly a target that we as designers should doubly strive for. It is not enough to do good design - we need to reflect, analyze, explicate and communicate about design expertise. We need a disciple of 'metadesign' - a way of representing and communicating about the process of design. This is not 'doing' design; it is reflecting, explicating and developing dialogues about the doing of design. A dialogue about design requires a currency in which communication and exchange can be expressed. The idea of PALs and design patterns should make a significant contribution to this currency of exchange. It can provide a significant contribution to the language in which we can communicate, think and solve problems in the domain of learning environment design.

Conclusion

As a community we need to pay greater attention to the nature and development of design knowledge. The idea of PALs or re-usable design patterns provides a productive contribution to this debate. The concept of re-usable PALs points to a number of key activities for the design community. These activities include:

* the analysis of existing 'macro' methods into flexible, re-usable design patterns;

* the synthesis of new knowledge based on the combination and adaptation of existing PALs;

* developing a knowledge base to capture and provide access to these design patterns

More broadly we need to expand our theoretical discourse about design. The concept of PALs and re-usable design patterns provides a useful 'currency' for the exchange of ideas about design in a form that is directly related to the needs of designers. It is non-prescriptive. Design patterns from different and even ideologically opposed methods can be extracted and re-used. The assessment of a PAL is its utility in solving problems in the design of pedagogically sound learning environments.

References

Boyle T. and Margetts S. (1992) The CORE guided discovery approach to acquiring programming skills, *Computers and Education*, 18, 127-133.

Boyle T., Gray J., Wendl B. and Davies M. (1994) Taking the plunge with CLEM: the design and evaluation of a large scale CAL system, *Computers and Education*, 22,19-26.

Boyle T. and Davies M. (1996) Hypermedia environments for learning to program. In P. Brusilovsky, P. Kommers and N. Streitz (eds.) *Multimedia, hypermedia and virtual reality. LNCS 1077.* Springer.

Boyle T., Stevens-Wood B., Zhu F. and Tikka A. (1996) Structured learning in virtual environments, *Computers and Education*, 26, 1/3, 41-49.

Clancy M. J. and Linn M. C. (1999) Patterns and pedagogy. *Procs. of SIGCSE '99.* ACM Press.

Collins A., Brown J. S. and Newman S. E. (1989) Cognitive apprenticeship: teaching the crafts of reading, writing and mathematics. In L. B. Resnick (ed.) *Cognition and instruction: issues and agendas.* Lawrence Erlbaum Associates.

Cunningham D. J., Duffy T. M. and Knuth R. (1993) The textbook of the future. In C. McKnight, A. Dillon and J. Richardson (eds.) *Hypertext: a psychological perspective.* Ellis Horwood.

Feifer R. G. and Allender L. T. (1994) It's not how multi the media, it's how the media is used. In T. Ottmann and I. Tomek (eds.) (1994) *Educational Multimedia and Hypermedia 1994, Proceedings of Ed-Media '94 - World Conference on Educational Multimedia and Hypermedia, Vancouver, June 1994.* AACE.

Gamma E., Helm R., Johnson R. and Vlissides J. (1995) *Design patterns: elements of reusable object- oriented software.* Addison -Wesley.

Hogg P., Boyle T. and Lawson R., (1999) Comparative evaluation of a CORE based learning environment for nuclear medicine, *Journal of Educational Multimedia and Hypermedia*, 8, No. 4, 457-473.

Hohmann L., Guzdial M. and Soloway E. (199 (1992) SODA: a computer-aided design environment for the doing and learning of software design, computer assisted learning. *Proceedings of the fourth international Conference on Computers and Learning.* Springer-Verlag Lecture Notes in computer Science 602.

Jonassen D. Mayes T. and McAleese R. (1993) A manifesto for a constructivist approach to uses of technology in higher education. In T. M. Duffy, J. Lowyck, D. H. Jonassen and T. M. Welsh (eds.) *Designing environments for constructive learning*. Springer-Verlag.

Lyardet F., Ross G. and Schwabe (1998) Using design patterns in educational multimedia applications. In T. Ottmann and I. Tomek (eds.) *Ed Media and Ed Telecom '98*. AACE.

Miller G. A. (1956) The magic number seven plus or minus two: some limits on our capacity for processing information. *Psychological Review*, 63, 81-97.

Papert S. (1993) *The children's machine: rethinking school in the age of the computer*. Harvester Wheatsheaf.

The Forgotten Partner: the Role of Visual, Graphic and Design Principles in Educational Multi-media Course Instruction.

Ian Brown
Faculty of Education
University of Wollongong
Australia
ian_brown@uow.edu.au

Abstract

As educational media becomes more interactive, there has been a proliferation of, and renewed interest in, courses relating to multi-media construction. On-line course and web page construction now occupy countless development hours within educational institutions. But in the 'real' world of media and software development, computer programmers and graphic designers now work in partnership to produce the final product. The question is posed: when educating and training teachers to develop new media for the classroom are we providing them with the visual, graphic and design skills necessary to produce quality products?

This paper will argue the case for greater inclusion of the basic visual, graphic and design principles to be included in educational multi-media courses. A number of core skills and principles will be outlined which should be developed and included for successful course implementation.

Design shouldn't be mere decoration **– Roger Black, 1997.**

Advocacy. This paper unashamedly advocates a greater role for visual, graphic and design principles to be included in all educational multi-media courses. In 1996 the Australian Good Universities Guide listed three specialisations in information technology (IT). By 1999 there were over fourteen specialisations with dozens of connected courses. This is just one example of the dramatic increase or mini explosion of course development in the area of information technology and multi-media in Australia. The presumption that learning can be enhanced through technology, including on-line courses has been debated and supported through recent studies.new technologies, such as Web based delivery, promises superior classroom instruction in relation to traditional instructional delivery. (Turoff, 1995). As more and more courses go on-line and instruction moves from the traditional method educators are expected to develop skills to cope with this paradigm shift. Universities have been charged with the responsibility to play a major role in this shift.

Questions arise to what is appropriate for inclusion in a multi-media course instruction. What content is needed? What skills should educators develop? What course components should be categorised mandatory or elective? The problem of content selection could be (and should be) as problematic as the delivery of the course.

This paper has been motivated by 'apologies'. The researcher has observed a number of educational multi-media conference presentations where authors have prefaced their talks by apologising for the 'look' of their products, be they packages, on-line courses or web page design. It was obvious, through their own admission, that considerable time and effort had been given to such areas as research, problem design, navigation, design solutions, metaphor choice, prototype construction, usabiltiy testing, choosing the appropriate cognitive processing tools but little effort had been given to the 'look' of their product.

Informal investigations eluded to the possibility that multi-media course instruction minimises the importance of visual design in their instructional courses. This paper proposes two notions:

- Visual design is an integral mandatory component of all educational multi-media courses
- Connections between learning cognitive theory and visualisation should be made more explicit

Visual Design is an Integral Mandatory Component of all Educational Multi-media Courses

According to Lynch (1994), highly interactive multimedia electronic documents pose unique graphic design problems. Visual design skills affect virtually every aspect of software interface design. Students need to develop skills in the following areas: spatial relations or layout, perceptual or aesthetic principles (such as, proximity, similarity, continuity, closure etc), designing for computer screens, graphic interface design, visual design conventions (such as, typography, or colour), animation, sound. There are many principles relating to interface design that should also be developed and included in course content but this paper is mainly dealing with visual design skills.

Traditional graphic design principles must be adapted to work successfully with new technologies. There needs to be a paradigm shift for working specifically with digital media. According to Heller and Drennan (1997), that although a high level of traditional design expertise is imperative students must develop a new way of 'reading' and 'seeing'.

Students need to be aware of the role of visual communication and the impact on the learner. A successful on-line course, web page or educational multi-media package needs to bring together all the elements of successful interface including the visual design component.

Connections Between Learning Cognitive Theory and Visualisation Should be Made More Explicit

The recent move to constructivist theory allows educators to reinforce the ways in which the learner's derive meaning and review the learning process. Traditional theories, such as Gestalt, combine with recent work by Herle (1996), concluding that the brain works by making patterns, making connections and deriving meaning. Metacognition has allowed educators to see how individuals can problem solve and reflect on their own thinking processes. Within multi-media, visualisation allows the user to participate in the learning process. In reality, the majority of educational multi-media produced today is highly relevant on visual design to help the learner make important connections for meaning. Tools such as visual mapping tools are contributing to teaching and learning in a constructivist-cognitive paradigm.

The role of multi-media education is to encourage interconnectedness of knowledge while allowing accessibility to visually supported information (Hyerle, 1996). Educators using new technologies are now confronted with a new set of problems. How will problems be represented? How do students control and access information? And for developers of educational mult-media specifically: how do you visually present and design the information?

The structure, choice and visual design is imperative for learning. (Tufte, 1990). According to Tufte (1990), effective and efficient visual displays are borne of the necessity to escape the endless flatlands of the bland tabulated mass of predigested data. Designers of educational multi-media need skill in visual design and an understanding of how visuals can provide meaning and context for the learner.

Often educational institutions spend energy and resources trying to improve interface and navigation for multi-media packages, on-line subjects, web page construction, while neglecting the visual impact of the product. Visually they look uninviting, inappropriate and often gives the user the impression that visual quality has little importance. Although products are often well organised, clear and easy to navigate, they can at times, be visually unappealing.

Course designers are charged with the task of developing a course for students which tries to pull all the elements together: content, organisation, navigation, interaction and visual design. On examination of many educational multi-media courses, the final component is either minimally represented or totally lacking. If this is the case, it raises a number of questions. What design principles should be included in a multi-media instructional course to allow students to develop a design aesthetic? What design rules and techniques need to be employed? What skills should be developed by students for greater success? How much time should be devoted to the components of visual, graphic and design principles within a course?

What is important is that visual design should not be just an added component, but instead an integrative, integral part of the total design process. Designers have acknowledged cognitive recognition is central to the process of interface design... then an added basic understanding of visual elements and their employment in the design projects would only enhance the process. For successful interface designers must have a well rounded understanding of perceptual elements and the affect on the user. Often we find that design fundamental rhetoric outlined for effective interface, focuses merely on the functional characteristics of the design. (Hobart 1997, Mullet 1994, Mountford 1990, Laurel 1990, Apple 1988). That is, visual structures are identified, such as, buttons, icons, metaphors, text fields, windows without recognising the importance of visual elements in the design (colour, shape, size, direction, texture). (Salomon 1990, Black 1997)

Visual design skills affect virtually every aspect of the multi-media construction. According to Lynch, visual design skills affect every component from simple generic objects like windows to the animated illustration of interactive three-dimensional structures within electronic documents. (Lynch 1994; Marcus 1992; Schneiderman 1992; Tognazzini 1992,).

Students enrolled in educational multi-media construction courses do not need to be qualified graphic designers or artists, but they do need fundamental skills and exposure to principles of graphical user interface, including visual design principles.

The following principles, skills or knowledge, (in relation to the visual, graphic and design area), should be included in all multi-media construction courses. This is not an exhaustive list but instead provides a basis for initial scholarly debate and a review of existing course content.

Students need to
- be exposed to visual design conventions;
- be able to develop a consistent visual structure;
- understand and employ visual design elements;
- understand and apply robust graphics;
- employ discretion concerning typography;
- understand the need for clear graphic layout;
- be able to identify and apply visual layering;
- be aware of spatial relationships;
- see the relationship between visual and functional goals;
- be aware of the positive use of the visual elements.

As Lynch (1994) contends, elements within the design must appear in a stable, intuitive and predictable relationship. This paper argues the notion that this will not occur by chance... it must be developed, nurtured and taught. The author challenges course designers to review course content, re-evaluate time allocation and include a visual, graphic and design component in your courses.

References

Apple Computer Inc. (1988). *Apple human interface guidelines*. Addison-Wesley.
Black, R. (1997). *Web sites that work*. Adobe Press: San Jose.
DiNucci, D. (1998). *Elements of web design*. Peachpit Press: Berkeley.
Good Universities Guide, 1995-99.
Hobart, J. (1997). Principles of good GUI design. http://axp16.iie.org.mx/Monitor/v01n03/ar_ihc2.htm
Hyerle, D. (1996). *Visual tools for constructing knowledge*. Association for Supervision and Curriculum Development.: Virginia.
Laurel, B. (1990). *The art of human-computer interface design*. Addison-Wesley Publishing Co: Reading.
Lynch, P.J. (1994). Visual design for the user interface. *Journal of Biocommunications*, Vol. 21, No. 1. Pp. 22-30.
Marcus, A. (1992). *Graphic design for electronic documents and user interfaces*. Addison-Wesley: New York.
Mountford, S. J. (1990). Introduction, in *The art of human-computer interface design*. Addison-Wesley Publishing Co: Reading.

Mullet, K. (1994). *Designing visual interfaces: communication oriented techniques.* Prentice-Hall.
Salomon, G. (1990). New uses of color, in *The art of human-computer interface design.* Addison-Wesley Publishing Co: Reading.
Schneiderman, B. (1992). *Designing the user interface.* Addison-Wesley: Reading.
Siegel, D. (1997). *Creating killer web sites: the art of third-generation site design.* HaydenBooks: Indianapolis.
Tognazzini, B. (1992). *Tog on interface.* Addison-Wesley: Reading.

Interaction: The Key to Successful Distance Learning

Albert S. Byers
Virginia Tech
2812 Wellsley Court
Blacksburg, VA 24060
Abyers@vt.edu

Abstract: The purpose of this paper is to discuss the impediments to distance education (DE) programs and the critical value of interaction and dialog in DE learning environments. Many specific types of interaction like student-student and student-content will be presented. Examples showcasing distance delivered k-12 support curriculum projects from the National Aeronautics and Space Administration (NASA) will then be discussed with respect to their interaction and collaboration. The NASA examples provided will be tied back to the pedagogy surrounding distance education interaction.

Impediments to Distance Education

Distance education (DE) has usually been defined as the separation between instructor and student, whether temporally or by spatial distance. While this physical and temporal distance is a fact, it erroneously limits the factors affecting learning at a distance. Transactional distance more aptly describes the relational separation between learner and instructor and is based on the interplay between the environment, patterns of behavior or dialog between the learner and teacher and the autonomy of the learner (Moore, 1996).

With the physical separation of the leaner and instructor there are psychological and sociological implications that limit communication (Wolcott, 1996). In effect the psychological distance may generate a feeling of isolation for the student and hinder the development of rapport between the learner and teacher. Wolcott (1996) states that it is this rapport that allows the learning discourse between teacher-student and student-student relationships to occur. Social presence or acceptance as perceived by the distance learner is a significant factor for consideration (McIsaac & Blocher, 1998) and should be included in the design process.

Distance education programs malfunction due to their lack of consideration for the human dimension (Spitzer, 1998). While tremendous strides have been made in telecommunication hardware, Spitzer (1998) states that it is the social interaction level between humans that will determine if a DE program fails or succeeds.

Necessity of Interaction

Moore (1997) describes the necessity of a purposeful instructional dialog, which facilitates and increases the interaction between student-student and teacher-student communication. In a purposeful dialog environment all learners are active participants, listening and building upon the contributions of other individuals. Moore continues on that dialog is also influenced by teacher and learner personality and content. Thus, intentionally designed collaborative opportunities should be incorporated into the instruction for distance learning environments to be most effective. As dialog and learner control increase transactional distance decreases (Saba & shearer, 1994). For learning is not an objective search for prescribed knowledge, but one that is experienced and formulated based on how we interact with our environment and others (Duffy & Jonassen, 1991).

Equally effecting the exchange of dialog or interaction between participants is the way a distance learning program is structured. Selecting the right instructional strategy, such as that of interaction facilitates learning of the higher levels of cognition such as: analysis, synthesis, and evaluation (Weston & Cranton, 1986). Programs that are extremely rigid and that do not allow flexibility for student contributions, interactions or discussions are detrimental to the learning outcomes desired (Moore, 1996).

Several forms of interaction are possible in a DE environment, all of which should be considered during the instructional design phase of a course. Interaction occurs between the following categories: learner-instructor, learner-learner, and learner-content (Wagner, 1997). A fourth dimension of interaction was added in 1994, that between the learner and the interface(Hillman, Willis, & Gunawardena, 1994). When designing instruction one should first should look at the intended instructional outcomes desired for a learning experience, analyzing the type of learning that is desired (verbal or intellectual skills, psychomotor skills or attitude changes), then select the appropriate type of interaction that will facilitate this type of learning (Wagner, 1997). A brief list of the types of interaction possible will finish this section.

Types of Interaction:

Interaction of the following types should be considered when designing a DE program (Wagner, 1997):

1. Interaction to increase Learning
2. Interaction to increase participation
3. Interaction to develop communication
4. Interaction to receive feedback
5. Interaction to enhance elaboration and retention
6. Interaction to support learner control/self-regulation
7. Interaction to increase motivation
8. Interaction for negotiation and understanding
9. Interaction for team building
10. Interaction for discovery
11. Interaction for exploration
12. Interaction for clarification of understanding
13. Interaction for closure

With the impediments to distance education and the necessity of interaction in DE environments discussed, a look at several instructional examples from NASA's k-12 education program will next be presented. The first NASA program discussed below takes advantage of the interaction between teacher-student and student-student to increase learning, participation, team building, motivation, negotiation and understanding.

NASA Online Interactive Projects: NASA Quest/Sharing NASA (http://quest.arc.nasa.gov)

Senator Al Gore originally funded this project in 1991 as part of the NASA High Performance Computing and Communications (HPCC) program. Capitalizing on the motivational aspects of collaborating/communicating with NASA individuals, teachers have expressed the value of the "Sharing NASA" supplementary support curricula aligned with the National Science Education Standards (NSES). Sharing NASA provides "real-world" authentic contexts and situated learning opportunities that connect the science content and process skills currently taught in the classroom, transcending the physical and temporal classroom limitations.

At the link above you'll find a listing of online collaborative NASA projects where one may participate in a variety of conferencing opportunities with NASA scientists, engineers, researchers and support personnel via email, synchronous chats, asynchronous threaded discussions, and streaming video. In addition to the interaction opportunities, online activities, project background information, mission updates, and biographies are available.

A combination of software solutions and "Smartfilter" designates (volunteer teachers, paid employees) manage the enormous influx of inquiries, aggregating common questions and facilitating the asynchronous interaction between the limited time of the NASA employee participants and the classrooms across the nation.

Past examples of "Sharing NASA" projects are archived and available online. One example will now be discussed.

Live From Mars: July 1996-December 1997 (http://quest.arc.nasa.gov/lfm/index.html)

Created in conjunction with the "Passport to Knowledge-Live From" series, the "Live From Mars" Sharing NASA project had a host support curriculum with the following programmatic categories: featured events, live video, photo galleries, questions, chat, kids corner, teacher's lounge, background, Mars team (biographies, images), and what's new.

One featured event Weather Worlds challenged student classrooms from around the country to debate what key weather measurements and instruments they thought were most important to gather here on Earth (similar to decisions the NASA Mars Pathfinder scientists had to decide for the surface of Mars). Classroom submitted their proposals online with justifications for debate. For example, if a classroom felt temperature was a worthy measurement, they then had to figure out protocols and procedures on how, when and within what range and frequency they should collect temperature data.

Electronic individual class results were collected by the "Sharing NASA" personnel, placed in a spreadsheet, and responses aggregated and debated online. From these collective results, final instruments and protocols were tallied and presented.

Ironically, this type of interaction doesn't necessitate high bandwidth connectivity or a computer lab. The learning is done in the classroom facilitated by the teacher, then submitted via email for presentation and debate. Current "Sharing NASA" projects include:

1. Space Scientists Online
2. Aero Design Team Online
3. Women of NASA

The next NASA educational curriculum support area that will be discussed focuses on the interaction between the learner and the content, and learner-interface while also integrating teacher-student and student-student interactions to facilitate learning, exploration, feedback, and elaboration and retention.

NASA's Learning Technologies Project: (http://learn.ivv.nasa.gov)

Here you'll find the entry page to approximately 50 NASA funded Internet projects focusing on interaction between the learner and content. NASA is supporting the development of projects in disciplines like Agriculture, Aeronautics, Aquatics, Earth Science, Tourism, and Space Science. At this site one may search for projects by discipline or state. One project from NASA's LTP will be referenced below.

NASA Glen Research Center:
FoilSim (Basic Aerodynamics Software)
http://www.lerc.nasa.gov/WWW/K-12/aerosim/index.html

FoilSim is simulation software that allows students to interact and control the parameters of airflow around a wing or baseball by varying the airspeed, altitude, thickness, camber, and area. Students also have learner control over the placement of the probe gathering aerodynamic data, and receive immediate feedback via a Plotter View Panel that depicts graphical changes in surface pressure, speed at surface and lift. The student can also visually see how far a curve ball would "break" across homeplate for various elevations (Cleveland, Denver, Mt. Everest). This Java applet (Mac or PC) when used in conjunction with guided questions and the necessary content background facilitates the learning of the factors that influence lift.

The final NASA educational project that will be discussed concerns the interactions between learner-interface, learner content, and learner-learner while enhancing learning, communication, feedback, team building, exploration and discovery.

EarthKAM (http://www.earthkam.ucsd.edu/)

EarthKAM is an opportunity for students to investigate Earth from the unique perspective of space via digital photographs they request during live space flights and from previous mission image archives. Piloted on 4 previous space shuttle missions, EarthKAM will be the first operational payload on the International Space Station.

In essence, students plan investigations that can in part be answered from examination and manipulation of remotely sensed images. For example EarthKAM can be used to answer questions involving real world problems like deforestation, beach erosion, urban crawl, etc.

Uniquely designed web interfaces allow students to search from images either visually by geographic location, by image index number, by mission, by school, or by geographic name (China, Nile River, etc.). Once a particular image is selected, students can then examine the image by zooming in/out or panning left, right, up, and down. To place the image in the "big picture" a student can overlay the digital photograph onto a composite map showing the elevations and contours of the surrounding areas or a Jet Navigation Map (JNM) displaying the location and names of major geographic reference points (rivers, cities, etc.).

Also available is the ability to view the map against the animated cloud cover that was present (within 3 hours) on the day the image was taken using weather satellite remote sensing image overlays. Finally, with the use of a VRML browser plug-in, the student can take a composite map (image overlaid against surrounding colored contour map or JNM) and visualize the image in a 3-D environment. This environment allows the student to fly by, fly over, fly under, or fly around the image with the elevations literally portrayed with vertical depth as well as 2-D color. Finally, using free image editing software (NIH image), student can label their photographs and make measurements like scale distances, area, and perimeter.

This environment provides complete learner control and higher learner-interface, learner-content interaction. It should be said that while this program is extremely technologically savvy, without proper instruction and ancillary reference documents to facilitate worthy investigative questions, image manipulation alone merely becomes a novelty toy.

Summation:

For distance education to be effective design efforts must consider the impediments that hinder effective learning such as: transactional, psychological and sociological distance (Moore, 1996; Wolcott, 1996). Intentionally designed programs that foster interaction and dialog between the student-teacher and student-student enhance learning and emphasize specific learning skills if properly facilitated (Wagner, 1997). Several NASA education support curriculum projects seem to emphasize interaction and were described herein.

References

Duffy, T. M., & Jonassen, D. H. (1991). Constructivism: new implications for instructional technology. Educational Technology, 31(5), 7-11.

Hillman, D., Willis, D., & Gunawardena, C. (1994). Learner-interface interaction in distance education: an extension of contemporary models and strategies for practitioners. The American Journal of Distance Education, 8(2), 30-41.

McIsaac, M. S., & Blocher, J. M. (1998). How research in distance education can affect practice. Educational Media International, 35(1), 43-47.

Moore, M. G. (1996). Theory of transactional distance. In D. Keegan (Ed.), Principles of Distance Education (pp. 22-38). New York: Routledge.

Saba, F., & shearer, R. (1994). Verifying key theoretical concepts in a dynamic model of distance education. The American Journal of Distance Education, 8(1), 36-59.

Spitzer, D. R. (1998). Rediscovering the social context of distance learning. Educational technology, 38(2), 52-56.

Wagner, E. (1997). Interactivity: From agents to outcomes. In T. Cyrs (Ed.), New Directions for Teaching and Learning (Vol. 71, pp. 19-25). New York: Jossey-Bass.

Weston, C., & Cranton, P. A. (1986). Selecting instructional strategies. Journal of Higher Education, 57(3), 259-288.

Wolcott, L. L. (1996). Distant, but not distanced: a learner-centered approach to distance education. TechTrends, 41(5), 23-27.

Gender and Facilitator Talk in CMC

Katy Campbell, Ph.D.
Academic Technologies for Learning
University of Alberta, Canada
katy.campbell@ualberta.ca

John A. Boeglin, Ph.D.
Faculte Saint-Jean
University of Alberta, Canada
john.boeglin@ualberta.ca

Abstract

The building of collaborative online communities raises questions about the nature of discourse in these environments: Underlying these questions are fundamental notions about the social construction of knowledge. CMC has the potential to even out social/technology-related gender issues. However, a body of literature has emerged from various domains that describes the presence of gendered discourse patterns in online communities. Would these gendered patterns extend to the discourse patterns among conference *facilitators* and conference *participants*? What effect would these patterns have on the conversation, especially for women participants? This exploratory study analyzes the CMC transcripts of two junior undergraduate courses employing a conference forum as part of the learning design. A framework integrating several theories of online discourse contextualizes findings.

The 1980's saw a large-scale post-secondary technology infrastructure project supporting the use of productivity tools such as word processors and spreadsheets in numerous computer labs across campus. The IT field focused on the creation of *optimal blueprint* models of computer-based instruction in which learners worked alone, often on tasks that were procedural and criterion-based, with little interaction among themselves, with their instructors, or even with the authentic content of the domain (Ewing, Dowling, & Coutts, 1998). The nature of the technology itself maintained a hierarchical relationship between instructors and students in which the instructor was regarded as the Intellectual Authority; the source of all knowledge in the classroom.

However, with increasing access to other sources of knowledge, and new constructivist approaches, learning designs now focus on social interaction among communities of learners. The building and maintenance of online communities as forums in which to construct and share knowledge naturally raises questions about the nature of discourse in these communities: What counts as knowledge? Whose knowledge counts? And how is it valued in computer-mediated conversation (CMC)? Underlying these questions are fundamental notions about the social construction of knowledge through language, and especially through computer-mediated language in virtual, asynchronous, online communities in which the traditional and taken-for-granted cues of social discourse are mostly absent. Sherry Turkle describes a *new* social construction of computers, in which a "new set of intellectual and emotional values more like those applied to harpsichords than hammers" prevails (p.280, in Kirkup, 1992). Here, groups that have been traditionally excluded by an epistemological value set, such as women, will find a learning environment that *distributes* "authority to bring everyone into an educational process extending beyond time and physical space and sociopolitical boundaries" (Slatin, 1992, p 50). CMC goes beyond a technological tool to provide a pedagogical framework that can encourage active learning in a context of "constant collaborative conversation" (Hollingsworth, in Elliot & Woloshyn, 1997).

Much has been written about the potential of CMC to even out the gender inequities described in educational technology studies over the past 30 years. Equally, however, a body of literature has emerged from sociolinguistics, discourse analysis, feminist theory, and educational computing research that describes the presence of gendered discourse patterns in online communities. We were curious to know whether that gendered pattern extended to the discourse patterns of online *facilitators*. As a first step towards understanding the problem, we have analyzed two junior undergraduate courses in which a conference forum was an integral part of the learning design. One facilitator was male; the other female. In the first phase, reported here, we intended to develop a rubric from which to examine and describe any gender-related differences. The next step will explore their effects on the conversation of the learning community.

Theoretical Framework

This study is embedded in four intersecting research strands. Taken together from a feminist perspective, they form an epistemological framework for investigating the design and implementation of technology-based learning environments in the post-secondary setting. These strands are: the exploration of technology as a social construct; the seminal, yet controversial, work characterized by the phrase *women's ways of knowing* (WWK); and the emerging research base in gender characteristics of online discourse. The promise of CMC for constructivist learning is the fourth strand that weaves them all together.

Technology as Social Construct

Women's relationships with technology have been aptly summed up by the admonishment, 'Don't touch it, you'll get a shock' (Turkle in Spender, 1995, p. 173). Computer culture may reproduce and reinforce sexist gender ideologies (deCastell in Luba, 1997, p.23) represented by technological innovations such as individualized computer-based learning software, used in contexts (such as computer labs) that are isolated and unappealing to women. An established body of work in the social sciences has emphasized that innovations reflect social constructs (Cockburn & Ormond, 1993, p. 7). Therefore, technology is a *culture* out of which artifacts are created.

If men have been the creators and designers of technological artifacts (the thinking goes), men's social domination of the technological culture is extended. Technology relations, then, ultimately become gender relations (Cockburn & Ormond, 1993, p. 155). On the political face of it, technological solutions to power over women and the contexts in which they live, work, and learn are global issues of knowledge creation and representation, language use, and access, and could be condemned. However, if culture is socially negotiated rather than imposed, CMC can be used as a critical pedagogy; an agent of change in the real world.

Beardon and Worden (1995) describe a *collaboratively* constructed learning environment in which we see, "the value of a broad experience of possible applications; (and) the advantages of students setting their own agendas "(p. 65). Implementing electronic communications in the classroom is a decision to build an active community for learning that is grounded in conversation.

In its role in sustaining relationships with others, Bruffee (1993) characterizes conversation as connected knowing and the site for constructing knowledge. This aspect of conversation reflects its centrality in the constructivist environment, because dialogue is a cognitive process in which students work together to decenter, moving beyond personally held views to construct new and expanded representations (Fosnot, 1996), and transforming classroom relationships (Slatin, 1992, p.30). However, teachers may have trouble re-conceptualizing their roles in these active, participatory, and democratic environments (Ewing, Dowling & Coutts, 1998, p 6). We wondered if the difficulty in this process is inherently gender-related.

In the virtual classroom CMC provides both a pedagogical framework and a strategy for collaborative knowing. Pedagogically, CMC emphasizes extensive and sustained interaction that is more student-centered, than teacher-controlled (Kearsley, Lynch, & Wizer, 1994). Strategically, the asynchronous nature of CMC expands user control because learners can control the timing, amount, and pace of their contributions since opportunities to speak are not limited or constrained by time or turn-taking concerns, or to social position and language ability.

Women's ways of knowing

Women may be socialized to process information in concrete, relational, and associative ways (Elliot & Woloshyn, 1997), as opposed to the abstract, systematic ways required by androcentric designs (c.f. Shade, 1993; Winkelman, 1997). This view has informed feminist criticism of traditional learning design for two decades. Articulated by Carol Gilligan in 1982, and elaborated in the work of Belenky, Clinchy, Goldberger, and Tarule (1986, 1996), *women's ways of knowing* (WWK) describes an alternate view of cognitive development in which the *received knowing* of Western intellectualism is contrasted with the relational position of *connected knowing.* The criticism of *malestream* technology design is exemplified by Margaret Wylie's (1995) observation that "the Internet is male territory. Considering its roots are sunk deep in academia and the military-industrial complex, that's hardly surprising" (p. 3). The WWK framework suggests that knowledge can be socially constructed in ways that include intuition, emotion, and experience; and shared through relationship and conversation. Therefore, much of the work of WWK continues to have a critical, activist stance.

The adult learning literature suggests different learning styles that are somewhat gender-related. Theorists in this field suggest two developmental paths (Table 1): the autonomous, separate, or independent path, typifying most men (and some women); and the relational, connected, or interdependent path, typifying most women (and some men). Virtual learning designs based on relational concepts may accommodate learners who are autonomous or separate as well as connected learners, but not vice versa (MacKeracher, 1996).

Separate Knowers	Connected Knowers
• are concerned with controlling their environment	• are concerned about remaining connected to others
• adopt a highly critical and adversarial stance when disagreeing with another	• adopt a narrative or descriptive stance when disagreeing
• force a choice if there appear to be opposing views	• search for a way to incorporate the ideas of all
• are independent	• are interdependent
• are wary of collaborative learning	• prefer collaborative learning
• use analytical thinking styles	• use holistic thinking styles
• look for logic and consistency as signposts of truth	• test for truth by using believability measures
• prefer to keep their thoughts and feelings separate	• are better able to integrate thoughts and feelings

Table 1: Paths of Knowing

Gender and online discourse

Much has been written, and expected of, the virtual community of CMC as social barriers of sex, age, race, physical appearance, and facility in face-to-face, real-time discourse are apparently eliminated (or at least mediated). CMC provides an opportunity to solve the problem of inequitable distribution of dialogue space, reflected in gender inequalities in language use (Spender, 1995). However, Kirkup (1995) suggests that the style of talk that CMC participants are required to engage in is very dialogue-oriented, which privileges the expository style of men. These communicative styles, or cultures, are described by Deborah Tannen (1990), a sociolinguist, whose work has been extended to include data from a study of men and women communicating in the workplace (1994a) and online (1994b). Herring (1996), for example, described women's tendency to attenuate (Tannen's *rapport talk*) online, whereas men tended to adopt an aggressive and adversarial stance, challenging the ideas of others (Tannen's *report talk*). Tarule (1996) points out a gendered discourse style that emphasizes a game and privileges a separate knowing approach to understanding and analyzing dialogues (p. 279). Dialogue as debate defeats a constructivist learning design, and does not reflect women's ways of knowing. Do we see this gendered style in *facilitator talk*? Table 2 identifies several gender-related styles of discourse noted in online forums (Herring, 1996; Hiltz & Turoff, 1993; Taylor and others, 1993):

Women	Men
• Attenuated assertions, consensual	• Strong, forceful assertions
• Apologies, approbation	• Self-promotion
• Explicit justifications	• Presuppositions
• Concrete examples (often from experience)	• Rhetorical questions, abstract examples
• Questions seeking answers	• Authoritative orientation, ownership of ideas
• Personableness	• Challenges others, competitive, adversarial
• Supports others, cooperative	• Humour/sarcasm/mild profanity/sexual innuendo
• May employ some features of male language in order to be taken seriously	• Directness, task-orientation
	• Control of cross-gender conversations

Table 2: Styles of Discourse

Accepting the view that knowledge is a product of social interchange, the nature of that exchange through electronic conversation is pivotal in the experience of meaning-making (Bohan, 1993). And, if the nature of conversation in these environments is gendered, the social construction of knowledge is more likely to reflect a gendered worldview. Learners (especially younger and/or novice learners) may expect an online experience resembling traditional classroom discourse in which the instructor is the Intellectual Authority, knowledge is received, and peer perspectives are not welcomed or valued (Magolda, 1992). The expectations of both learners and instructors are quite likely gendered in this regard. We believe it evident that *facilitator talk*, which represents and supports a particular view of knowledge representation, is pivotal in developing learning environments that reflect either received or connected knowing.

The Study

To help make sense of the many relevant theories and models related to the four strands elucidated above, we constructed a research rubric that attempts to weave the main ideas together along three (of many possible) dimensions of the facilitator's online discourse patterns, and their potential underlying epistemologies, shown in Table 3, below.

Issue	Hypothesis		Examples of associated literature
	Sex	Tendency	
Dimension 1: Task Role			
Focus of facilitation	F	Socio-emotional group process	Berge, 1995; Kirkup, 1992; McConnell, 1994; Savicki, 1995
	M	Task maintenance, procedural	
Personal orientation	F	Learner-centered	Kearsley et.al., 1994
	M	Teacher-centered	
CMC as pedagogical strategy	F	Activist, collaborative, relational	Mason, 1990; Rogers, 1996: Winkelman, 1997
	M	Task maintenance, intellectual	
Dimension 2: Discourse Style			
Initiating a new thread	F	Shared responsibility	Slatin, 1992
	M	Self	
Answering technical or management questions	F	Will re-direct to group	Berge, 1995; Mason 1990;
	M	Answers himself; management focus	
Ratio of facilitator talk to participant talk	F	Gives online wait time, encourages participants to talk to each other	Kirkup, 1992; Shade, 1993; Spender, 1995; Taylor et.al, 1993; Wylie, 1995
	M	Will dominate	
Length of message	F	Shorter	Blanchette, 1999, Herring (1996)
	M	Longer	
Nature of facilitator talk	F	Exploratory, *believing game*	Herring, 1996; Tannen, 1990; Winkelman, 1997; Tarule, 1996
	M	Expository, *doubting game*, rhetorical	
Purpose of language use	F	Attenuating, collaborative	Kirkup, 1992; Tannen, 1990; Tarule, 1996
	M	Assertive, argumentative	
Dimension 3: Source of Authority			
Direction of interaction	F	Each other as sources of knowledge	WWK; Mackeracher, 1996; Magolda, 1992
	M	To content, to self	
Messages referenced most often as evidence	F	Student messages, or experts	Slatin, 1992
	M	Own messages as expert, other experts	
Knowledge representation	F	Others, intuition, self, narrative, Truth	Beardon & Worden, 1995; Magolda, 1995; Tarule, 1996
	M	Truth, self	

Table 3: Research Rubric

Preliminary Results: Table 4

Both first-year undergraduate courses, from two different Faculties, each had a face-to-face (F2F) component supported by an online conference. The male facilitator's (MF) class size was 1/3 that of the female facilitator's (6 to 18, respectively); he also had a student participating by videoconference. The MF's students were less active which may be reflected in his level of direct participation. The FF replaced some F2F sessions with CMC, while the MF did not. The MF teaches in a bilingual Faculty, i.e. he is a language teacher as well as a content expert. The FF teaches in the Humanities; the MF in a science-based domain. These contexts are important as *facilitator talk* is embedded in social constructs related to academic disciplines as well as gender.

Dimension	MF	FF
Task Role	• Interactions emphasize task maintenance; management and/or procedurally oriented	• Initially suggests ways to build a community. • Reminds students to keep talking to each other
	• Informative, very active	• Withdraws as tutorials progress
	• Elaborates on student responses • Stresses evidence-based answers	• Directs attention to class resources • Experience/beliefs acceptable evidence
Discourse Style	• Always initiates new thread or topic, based on module topics	• Sets tutorial boundaries but students initiate threads, sometimes based on student interests
	• Very helpful personally	• Invites help on technical questions
	• 42% of total postings • Usually responds to individual student postings	• Averages 11% of total postings • Waits average of 14 s. postings before responding
	• Length often 50% of students' posts	• Varies from 10-50% of students' posts
	• Thanks students for contribution; evaluates responses • Compliments students by name • Often refers to literature and research	• Thanks students by name for contribution; rarely offers evaluative opinion • Sometimes synthesizes and weaves comments into course content, notes literature
	• Provides evaluative feedback	• Attenuates: "It seems to me… If I can…"
Source of Authority	• Does not usually redirect conversation	• Student messages contain evidence; ideas
	• Expert, evidence-based	• Importance of how others interpret learning
	• Science key, vs. emotion or personal beliefs	• Asks, "whose account counts?"

Table 4: Preliminary Results

References

Beardon, C. & Worden, S. (1997). The virtual curator: Multimedia technologies and the roles of museums. In E. Barrett and M. Redmond (Eds.), *Contextual media: Multimedia and interpretation.* MA: MIT. Press.

Belenky, M.F, Clinchy, B.M., Goldberger, N.R., & Tarule, J.M. (1986). *Women's ways of knowing: The development of self, voice, and mind.* NY: Basic Books.

Berge, Z. L. (1995). Facilitating computer conferencing: recommendations from the field. *Educational Technology*, 35, 22-30.

Blanchette, J. (1999). Register choice: Linguistic variation in an on-line classroom. *International Journal of Educational Telecommunications, 5*(2), 127-142

Bohan, J.S. (1993). Regarding gender: Essentialism, constructionism, and feminist psychology. *Psychology of Women Quarterly,* 5-21.

Bruffee, K. A. (1984). Social construction, language and the authority of knowledge. *College English, 48*(8), 773-790.

Cockburn, C, & Ormrod, S. (1993). *Gender and technology in the making.* London: Sage Publications.

Elliott, A.E., & Woloshyn, V.E. (1997). Some female professors' experiences of collaboration: Mapping the collaborative process through rough terrain. *The Alberta Journal of Educational Research, 43*(1), 23-36.

Ewing, J.M., Dowling, J.D., & Coutts, N. (1998). Learning using the World Wide Web: A collaborative learning event. *Journal of Educational Multimedia and Hypermedia 8*(1), 3-22.

Fosnot, C.W. (1996). Constructivism: A psychological theory of learning. In C.W. Fosnot (Ed.), *Constructivism: Theory, perspectives and practice.* NY: Teachers College Press.

Gilligan, C. (1982). *In a different voice.* Cambridge, MA: Harvard University Press.

Goldberger, N, Tarule, J., Clinchy, B., & Belenky, M. (Eds.), (1996). *Knowledge, differences and power. Essays inspired by 'Women's ways of knowing'.* NY: Basic Books.

Herring, Susan C. (1996). Gender and democracy in computer-mediated communication. In Rob Kling (ed.), *Computerization and controversy: Value conflicts and social choices* (2nd ed.), 476-489. San Diego, CA: Academic Press.

Hiltz, S. R. & Turoff, M. (1993). *The network nation : human communication via computer.* Cambridge, MA : MIT Press.

Kearsley, G., Lynch, W., & Wizer, D. (1994). The effectiveness and impact of online learning in graduate education. *Educational Technology, 35*(1), 37-42.

Kirkup, G. (1992). The social construction of computers: Hammers or harpsichords? In G. Kirkup and L. Smith Keller (Eds.) *Inventing women: Science, technology and gender.* (pp. 267-282). Cambridge, MA: Basil Blackwell.

Luba, F. (March 25, 1997). *Girls left behind in access to technology.* Occupational Health and Safety, p 2.

MacKeracher, D. (1996). *Making sense of adult learning.* Toronto: Culture Concepts, Inc.

Magolda, M. Baxter (1992). *Knowledge and reasoning in college: Gender-related patterns in students' intellectual development.* San Francisco: Jossey-Bass Publishers.

Mason, R. (1990). Computer conferencing in distance education. In W.A. Bates, (Ed.) *Media and Technology in European Distance Education* (pp. 221-226). Milton Keynes: Open University.

McConnell, D. (1994). Learning in groups: Some experiences of on-line work. In M. Verdejo & S. Cerri (Eds.). *Collaborative dialogue technologies in distance learning*, (pp. 46-59). New York: Springer-Verlag.

Rogers, E. (1986). *Communication technology: The new media in society.* New York: The Free Press.

Savicki, V., Lingenfelter, D., & Kelley, M. *Gender language style and group composition in Internet discussion groups.* Online at http://www.usc.edu/dept/annenberg/vol2/issue3/savicki.html#rherring94

Shade, L.R. (1993, August). *Gender issues in computer networking.* Paper presented at Community Networking: the International Free-Net Conference, Carleton University, Ottawa.

Slatin, John M. (1992). Is there a class in this text? Creating knowledge in the electronic classroom. In E. Barrett, (Ed.). *Sociomedia: Multimedia, hypermedia, and the social construction of knowledge.* (pp. 27-51). Cambridge, MA: MIT Press.

Spender, D. (1995). *Nattering on the Net: Women, power, and cyberspace.* Australia: Spnifex Press. 278 pages.

Tannen, D. (1991). T). *You just don't understand : Women and men in conversation.* NY: Ballantine Books.

Tannen, D. (1994). *Gender gap in cyberspace.* Newsweek, May 16, 54.

Tannen, D. (1995: *Talking from 9 to 5: Women and men in the workplace.* NY: Avon Books.

Tarule, J.M. (1996). Voices in dialogue: Collaborative ways of knowing. In N. Goldberger, J. Tarule, B.M. Clinchy, & M. Belenky (Eds.) *Knowledge, difference, and power: Essays inspired by Women's Ways of Knowing.* (pp. 274-304). NY: Basic Books

Taylor, H., Kramarae, C., & Ebben, M. (1993). *Women, information technology and scholarship.* University of Illinois.

Winkelman, Carol l. (1997). Women in the integrated circuit: Morphing the academic/community divide. *Frontiers: A Journal of Women Studies, 18*(1), 19-42.

Wylie, M. (1995). No place for women. *Digital media, 4*(8), p.3.

The Hypermedia Conversation: Reflecting Upon, Building And Communicating Ill-Defined Arguments

Milton N. Campos
Département de communication
Université de Montréal
Montréal, QC, Canada
Milton.Campos@umontreal.ca

Abstract: This paper shows how reasoning upon questions and hypotheses built collaboratively can lead to knowledge-building and conceptual change in hypermedia conferencing systems. It is a qualitative study of the conditional reasoning process carried on in a biology mixed-mode undergraduate course on mammals delivered in the fall semester of 1998. The professor applied Socratic maieutic by posing online questions to the students, and then reasoning upon the answers and raising new questions in face-to-face encounters. We applied the meaning implication analysis to study the role of production systems in the conditional reasoning activity, taken in their logical (procedural) and referential (declarative) dimensions altogether. Results show qualitative circumscribed evidence of high order reasoning and conceptual change, and indication that high order learning had been achieved through collaborative knowledge building. The study discusses implications for course and conferencing systems design, and gives directions for new forms of representation in asynchronous conferencing systems.

Introduction

This paper shows how reasoning upon questions and hypotheses built collaboratively can lead to knowledge building and conceptual change in hypermedia conferencing systems. We studied one sub-conference of a biology mixed-mode undergraduate course on mammals delivered in the fall semester of 1998 in a French speaking Canadian university. The professor applied Socratic maieutic by posing online questions to the students, and then reasoning upon the answers and raising new questions in face-to-face encounters.

Results show the knowledge building process that led some of the participating students to achieve high order reasoning and conceptual change in the part of the conference chosen for study. We understand high order reasoning as the ability to logically operate the modules of content, and conceptual change as the ability to rebuild a conceptual (logical) based on the assumption that the previous construction had premises that were inconsistent with the conclusion of the argument. Conceptual change suggests that high order learning was achieved, i. e., that the content was retrieved and stored in the memory. The circumscribed collaborative knowledge building found in the students' learning processes, reified by the transcripts as objects of knowledge (Popper, 1994; Bereiter, 1994; Scardamalia, & Bereiter, 1996), was assessed by transcript analysis. The meaning implication transcript analysis technique was applied to identify the chains of interconnected meaning implications, and how collaborative conditional reasoning and hypotheses formulation evolved in the hypermedia conversation (Campos, 1998).

Theory and Method

Learning is the process of acquiring expertise (Bereiter, & Scardamalia, 1993; Bruer, 1994) by storing mental objects as memory traces (Changeux, 1997). Assessing expertise acquisition in conceptual specific domains is usually done by applying the traditional comparison of the way novices and experts solve problems, like in physics (Larkin, 1981; Larkin, McDermott, Simon, & Simon, 1980), and how the schemas of the procedures are accommodated (Piaget, 1976a). Methods of assessing how novices and experts solve well-defined problems in conceptual domains, in which axiomatization allows necessity and sufficiency (Grize, 1990), cannot be simply transposed to ill-defined domains, in which the degree of the subjective referencing of natural language impeaches the occurrence of logical necessity and sufficiency (Grize, 1990). Indeed, the natural, social and human sciences, in different degrees, all suffer the lack of relative and provisional certainty provided by the hard sciences.

To allow assessing reasoning in ill-defined domains, in which classic problem solving is not possible due to the constraints of the referential function of natural language, we developed a method in which both the logical and referential dimensions were taken into account (Campos, 1998). This method looks at the way we reason through natural language and the conditional operations subjacent to the inferences we make. The inferential capacity, expressed by conscious or unconscious conditional reasoning, is at the core of the cognitive process and can be considered its gist (Piaget, 1976c).

To apply our method to hypermedia learning environments we developed a technique of analyzing transcripts of online conversation. The analysis allows the study of production systems in the conditional reasoning activity, taken in their logical (procedural) and referential (declarative) dimensions altogether. This technique allows the identification of implications among meanings in online discourse (Campos, 1998).

The classical definition of meaning implication is that it is the source of necessary relations (Piaget, 1976b, 1977), and that if part of a meaning C is embedded in B and a part of a meaning B is embedded in A, then A implies C in terms of meaning (Piaget, 1991): a backtracking process, though. This definition applies strictly to the level of actions and the abstract logical concepts (mainly procedural, logical propositions, knowledge construction) and loosely to that of statements (mainly declarative, referred enunciates, knowledge building). Statements are referred notions whose referencing depends on the subjective social-cultural-psychological symbolic universe of the individual (Campos, 1998; Ramozzi-Chiarottino, 1998). The notion of meaning implication, a late development in genetic epistemology, allows the inclusion of pragmatics in Piaget's syntactic-semantic model of knowledge. It enhances the classic Piagetian theory to the domain of psychosocial linguistic processes allowing the establishment of consistent links with Vygotsky's pragmatic psychological model (Z. Ramozzi-Chiarottino, personal communication, August 1999) and the classic model of cognitive architecture.

Applied to statements, meaning implications are notional conditional enunciates in which subjacent If-Then operations do not have the logical consistency of propositional argumentation. They are encountered in ill-defined knowledge domains in which the validity of the notions is given by the act of signifying through natural language. These symbolic operations are analogous and complementary to those found in action implication. Action implications are If-Then operations encountered in physical actions independently of the use of natural language to express them (Ex: if I run then I am able to cross the field before that mad cow reaches me, given that I really run to cross the field before that mad cow reaches me).

Meaning implications are as varied as the possibilities of natural language. Generally, they are tautological because from the psychological point of view of the individual who writes or talks, the argumentation is always correct. Nonetheless, in a hypermedia conversation, the participants can check the tautological character given by individuals through refutation, making knowledge building possible. When the content coincides with logical rules, inductive validity results from the agreement between logic and reality (Ex: if I step on a banana it is likely that I will fall), although necessity and sufficiency might not be achieved. When the content does not coincide with logical rules, inductive validity results from strict psychological subjectivity (Ex: if all mammals develop two breasts as human beings then they will all also look sexy). There is, though, a scale: the closer the content comes to the agreement between logic and objective reality, the more plausible is the reasoning and the further it is from subjective judgment. This scale is also applicable to the sciences: from the closest to pure form (propositional logic, mathematics) to the closest to pure content (history, the social sciences) (Granger, 1994, 1992).

The Study

Our goal was to show circumscribed qualitative evidence of collaborative learning in a hypermedia asynchronous conversation triggered by the process of interrogation and reasoning about scientific dilemmas as a teaching method.

The following instruments were used in the research: Transcript analysis, in-depth interview with the professor and the teaching assistant, and the analysis of the comments written and the marks given to the messages published by the students in the online learning environment (comments and marks were provided by the professor).

We studied a biology mixed-mode undergraduate course on mammals delivered in the fall semester of 1998 in a French speaking Canadian university. Seventy-three persons took part of the course, including students, the professor and the teaching assistant. A root conference was opened from which eight sub-conferences were created. The root conference aimed to provide all needed information, including hypermedia navigation manuals to help the students, and also hyperlinks to a number of mammalogy web sites. Each sub-conference had a different topic: Introduction (in which general notions applied to the field were discussed), Characters, Constructive criticism (in which students could discuss the use of hypermedia conferencing for learning mammalogy), Origins and evolution, Reproduction, Domestication, Dentition, and Locomotion.

The online teaching strategy applied by the professor was that of triggering discussion through questions related to unsolved scientific dilemmas in mammalogy. Different hypotheses explaining those dilemmas formulated by biology theorists were presented to the students by the professor through traditional face-to-face lecturing. The students were then encouraged to propose alternative solutions for the dilemmas in the hypermedia conferences by applying the knowledge about mammals and biology they had already acquired. No readings or literature research were required for the course, although the students were encouraged to do so. To guide their reasoning, the students had primarily access to black and white drawings and graphics provided by the professor, in addition to the notes they were able to take during the lectures.

The instructor is a full professor who teaches this course without significant changes for more than 20 years. The professor was not knowledgeable about technology, did not want to get involved in learning how to use computers, and did not participate directly in the hypermedia part of the course. According to the professor, the hypermedia component was chosen as a tool that would, eventually, enhance the learning process and allow discussions that would never take place in the classroom due to the way the course is taught.

A graduate student, expert in educational technology, worked as an exclusive online teaching assistant, responsible for posting the questions and providing instructions to the students on how to participate. No facilitator or moderator was assigned to mediate the conferences. The students were left free to take charge of the discussions. Participation was not mandatory.

After each of the sequential hypermedia conferences was over, the professor marked the messages according to the level of plausibility of the hypotheses formulated and the quality of argumentation. Together with the marks, there were sometimes, written comments. The marks did not count for evaluation purposes. Marks given were:

- Zero – no meaningful contribution,
- ¼ - minor contribution,
- ½ - reasonable contribution, and
- 1 – outstanding contribution (plausible hypothesis and argumentation).

Later, the comments (marks were not made available to the students) and the messages were discussed in class. The professor commented on the most plausible solutions presented, raised further questions, and discussed the state of the dilemmas.

We hypothesized that if implications among meanings were found in arguments present in different messages, then the quality of the arguments marked "1" could be explained by the conditional contribution given by others. In addition, it would indicate that high order learning (attributed by the professor through the marks) in the knowledge building process was achieved through collaboration. Furthermore, such predicted result would provide qualitative evidence that the process of interrogation and reasoning about scientific dilemmas would be a consistent method for teaching evolutionary biology.

Results

After reading the texts of all conferences and identifying meaning implications sustaining the arguments, we have chosen the conference on characters of mammals because it was the most interactive both in terms of implications among meanings and in terms of a reasonable (although poor) use of the threading feature of the conferencing system used (Virtual-U). This feature allows users to sort messages by threads, as shown in Figure 1.

Five questions were posed to the students in the sub-conference about characters. We chose the chain of thought of question 2 for this study by following the meaning implications built. The reason for the choice of question 2 was that two messages related to this question were marked "1" by the professor (outstanding contributions). In three of the four remaining questions only one single message was marked "1" by the professor.

To study the meaning implication chain of question 2, we focused on backtracking the meaning implications between the arguments and hypotheses marked "1" in order to understand how were they built (identify knowledge building), and to examine whether they had been gestated in other arguments written by other students in previous messages (identify collaboration). Messages that were published after the last contribution marked "1", all isolated from threads, were ignored. We studied six messages in which we identified 12 meaning implications. Four students participated in this part of the discussion.

It is remarkable that only one of the six messages was a reply, although all meaning implications found were linked to each other, be in a message or among different messages. Meaning linking was not related to the built-in threads.

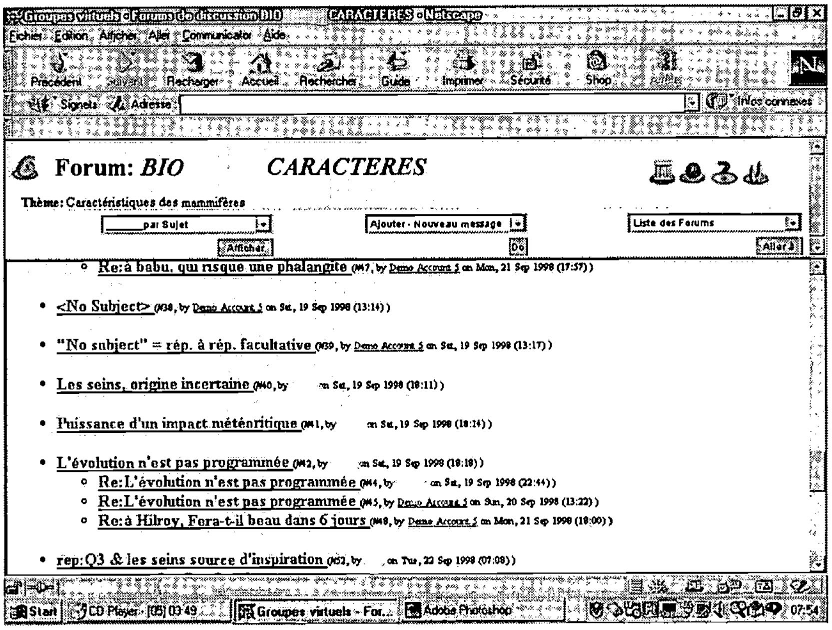


Figure 1 – In the studied hypermedia conference, knowledge was built through collaboration but meaning linking was not necessarily related to the built-in threads.

In addition, qualitative analysis shows that in both messages marked "1", hypotheses were built upon non-plausible hypotheses formulated in previous messages. Two different students wrote these messages. The plausibility of the formulated hypotheses, assessed by the professor's expert marking, indicates that high order learning was achieved. In addition, one of the students whose message was marked 1 passed through a process of conceptual change when he/she realized that his/her previous analysis was a misinterpretation of the evidence (highlighted by the professor in a comment) and decided to re-build his/her own argument. This student, thus, accommodated his/her own learning and changed the previous conceptualization of the problem, adjusting it to the evidence. In addition, the analysis indicates that all participating students built knowledge through collaboration. In other words, built their arguments by discussing the premises formulated by the colleagues.

Implications

For course design

The study suggests that the teaching strategy might be strongly related to the results. The Socratic maieutic was applied by posing questions to the students, reflecting upon the answers provided, building and communicating arguments both in the hypermedia environment and in face-to-face encounters. Questions were challenging, and they are still to be answered by evolutionary biology. This aspect seems to be specifically attractive for the students because, as novices, they were given the opportunity to exercise their own sense of how to apply background knowledge to scientific dilemmas, given the chance to solve ill-defined problems that scientists had still not done, and had the opportunity to provide meaningful contribution to the discipline. The importance of questioning in educational processes is common sense. In Socrates, it is a teaching method (Mondolfo, 1972) through which problems about the empirical world could be responded inductively (Jaeger, 1987). Questioning seems to be an appropriate teaching method for exploring scientific dilemmas in online written conferencing. The depth of argumentation triggered by questioning would be difficult to achieve in a face-to-face conversation because writing demands deeper reflection and allows thought refining.

For conferencing systems design

Data indicate that the agreement of threads and meanings in hypermedia conversation does not emerge by itself. The analysis of the way the students linked their chain of thoughts shows that the threading feature is neither necessary nor sufficient for knowledge building through collaboration. Most messages were not threaded although they were linked by meaning. This finding is consistent with that of a previous study and is a strong indicator that hypermedia conferencing systems still need further development and increased flexibility. Their underlying formal structure should adapt to the way we use natural language, mold our symbol systems to assimilate what the others have to say, and accommodate knowledge. Advance of conferencing systems depends on representations closer to the functioning of our neural systems. A reply-to-many feature would be a first step to allow more interaction (Campos, 1998). A pop up help tool to guide conference participants in the use of threads would be another important feature to be added.

Conclusion

We discussed in this paper how we assessed qualitative circumscribed evidence of high order reasoning and conceptual change, achieved through collaborative knowledge building. The meaning implication transcript analysis allowed us to assess this circumscribed evidence in the studied online written conversation. The analysis shows how conditional reasoning governed the inferences students made upon the contribution of their colleagues. In addition, it presents hypothesis formulation and argument building as a likely result of memory retrieval of both information presented in face-to-face lecturing and the study of drawings provided by the professor (Changeux, 1997), of acquisition of scientific reasoning expertise (Bruer, 1994; Bereiter, & Scardamalia, 1993) and of in-depth reflection upon contributions provided by others (Scardamalia, & Bereiter, 1994).

The analysis of the way the students built their chain of thoughts shows that the threading feature, as it is today, is neither necessary nor sufficient for meaning linking. This finding is consistent with a previous study (Campos, 1998) and is a strong indicator that hypermedia conferencing systems still need further development to make their underlying formal structure more flexible in order to be adapted to the way we use natural language, to the way we converse and mold our symbol systems to assimilate what the others have to say, and to accommodate this knowledge into our mental semiotic configurations. Furthermore, the study suggests that the Socratic maieutic, as a teaching strategy, might be strongly related to the results.

These reasons, altogether, might explain why such a level of collaborative knowledge building was achieved in a situation in which the students were left free to take charge of their own learning processes without any of the award systems found in pedagogical behaviorism. The fact that the professor did not participate at all is additional indication of the inner learning possibilities of hypermedia conferencing. Another fact, not unimportant, is that the studied course was mixed-mode. The use of this teaching hypermedia modality suggests that mixing face-to-face encounters with the use of the conferencing component provided specific opportunities that enriched experiences leading to social interaction and learning (Laferrière, Breuleux, & Campos, 1999). The teaching and the learning processes of this mixed-mode course seem to show that when proper teaching strategies are present, knowledge building and collaboration are achieved (Campos, & Harasim, 1999).

References

Bereiter, C. (1994). Constructivism, socioculturalism, and Popper's world 3. Educational Researcher, 23 (7), 21-23.

Bereiter, C., & Scardamalia, M. (1993). Surpassing ourselves. An inquiry into the nature and implications of expertise. Chicago: Open Court.

Bruer, J. T. (1994). Schools for thought: A science of learning in the classroom. Cambridge, MA: MIT Press.

Campos, M. N. (1998). Conditional reasoning: A key to assessing computer-based knowledge building communication processes. Journal of Universal Computer Science [online serial], *4* (4), 404-428. Available: http://www.iicm.edu/jucs_4_4/conditional_reasoning_a_key/paper.html (October 21, 1999)

Campos, M. N., & Harasim, L. (1999). Virtual-U: results and challenges of unique field trials. The Technology Source [online serial], *6*. Available: http://horizon.unc.edu/TS/vu/1999-07.asp (October 21, 1999)

Changeux, J.-P. (1997). Neuronal man. The biology of mind (L. Garey, Trans.). Princeton, NJ: Princeton University Press. (Original work published 1983)

Granger, G.-G. (1992). La vérification [The verification]. Paris: Éditions Odile Jacob.

Granger, G.-G. (1994). Formes, opérations, objets [Forms, operations, objects]. Paris: Librairie Philosophique J. Vrin.

Grize, J.-B. (1990). Logique et langage [Logic and language]. Paris: Ophrys.

Jaeger, W. (1987). Paideia: Los ideales de la cultura griega [Paidea: The ideals of Greek culture]. Mexico: Fondo de Cultura Economica. (Original work published 1953)

Laferrière, T., Breuleux, A., & Campos, M. (1999). L'évolution des métiers et des formations dans les nouvelles méthodes de production des connaissances. L'apprentissage en réseau, une réalité pédagogique à définir [The evolution of professions and professional formation in the new methods of knowledge production. Networked learning: a pedagogical reality to be defined] .Paper presented at the colloquium Initi@tives99, Universités Virtuelles: Vers un Enseignement Égalitaire [Initiatives, Virtual Universities: Towards an Egalitarian Teaching], Edmunston, NB. [Online]. Available: http://www.aupelf-uref.org/initiatives/colloque/ (October 21, 1999)

Larkin, J. H. (1981). Enriching formal knowledge: A model for learning to solve textbook physics problems. In J. R. Anderson (Ed.) Cognitive skills and their acquisition (pp. 311-334). Hillsdale, NJ: Lawrence Erlbaum Associates.

Larkin, J. K., McDermott, J., Simon, D. P., & Simon, H.. A. (1980). Expert and novice performance in solving physics problems. Science, 208, 1335-1342.

Mondolfo, R. (1972). Socrates. São Paulo: Mestre Jou. (Original work published 1959)

Piaget, J. (1976a). La formation du symbole chez l'enfant. Imitation, jeu et rêve, image et représentation [Plays, dreams and imitation in childhood]. Neuchâtel-Paris: Delachaux et Niestlé. (Original work published 1945)

Piaget, J. (1976b). Le possible, l'impossible et le nécessaire [The possible, the impossible and the necessary]. Archives de Psychologie, 44, 172, 281-299.

Piaget, J. (1976c). Ensaio de lógica operatória [Essay on operatory logic]. São Paulo: Globo/EDUSP. (Original work published 1949)

Piaget, J. (1977). Essai sur la nécessité [Essay on necessity]. Archives de Psychologie, 45, 175, 235-261.

Piaget, J. (1991). Introduction. In Piaget, J., & Garcia, R. (Eds.) Toward a logic of meanings (P. M. Davidson & J. Easley, Trans.). Hillsdale: Lawrence Erlbaum Associates. (Original work published 1987)

Popper, K. (1994). Knowledge and the body-mind problem. In defense of interaction. London: Routledge.

Ramozzi-Chiarottino, Z. (1998). Piaget selon l'ordre des raisons [Piaget according to the order of reasons]. Bulletin de Psychologie, 51 (3), 435, 333-343.

Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge building communities. The Journal of the Learning Sciences, 3 (3), 265-283.

Acknowledgements

The Université de Montréal and the Canadian TeleLearning – Network of Centres of Excellence funded the present study. I would like to thank Dr. Linda Harasim for making it possible. I would also like to thank the students and the professor who provided the materials and their informed consent, Sandrine Turcotte (Université Laval, Canada), Dr. Thérèse Laferrière (Université Laval, Canada), Dr. Alain Breuleux (McGill University), Jean Gunderson (Douglas College, Canada) and Sylvia Currie (Simon Fraser University, Canada). I would also like to heartily thank the theoretical guidance, support and encouragement of the Honorable Professor Jean-Blaise Grize (Université de Neuchâtel, Switzerland).

Traveling Culture: Digitizing Special Collections Materials at the University of Iowa Libraries

Carol Ann Hughes
Information and Research Services
The University of Iowa Libraries
United States
Carol-Hughes@uiowa.edu

Abstract: In 1998 The University of Iowa Libraries was the recipient of a grant from the Library of Congress/Ameritech National Digital Library Competition in support of a project to digitize a portion of its unique and extensive Redpath Chautauqua Collection. Although the staff of the Information Arcade at the University of Iowa Libraries has extensive experience in instructional technology, this was the first opportunity for them to engage in the digitization of a large text collection of rare materials. This article describes the processes undertaken in the project as well as the challenges when the theory of how to approach a digitization project of significant scope clashed with the realities faced by the project team.

Introduction

In 1998 The University of Iowa Libraries was the recipient of a grant from the Library of Congress/Ameritech National Digital Library Competition in support of a project to digitize a portion of its unique Redpath Chautauqua Collection. The competition, which was funded for three years by a $2-million partnership between the Library of Congress and the Ameritech Corporation, has made awards to a total of 29 institutions with the aim of supporting the digitization of a range of materials of significance to the social and cultural history of the United States.

One of the goals of the competition was to encourage U.S. libraries, archives, museums, and historical societies to assist in the development of the American Memory electronic collections of the Library of Congress. But in making the awards, the LC/Ameritech program also offered many institutions that would not otherwise have had sufficient institutional resources to learn by "getting their hands dirty" about the sometimes confounding issues involved in planning and carrying out a complex digitization project. Although the staff of the Information Arcade at The University of Iowa Libraries has extensive experience in instructional technology, this was the first opportunity for them to engage in the digitization of a large text collection. This article will describe the processes undertaken in the project as well as the challenges faced by the project team when the theory of how to approach a digitization project of significant scope clashed with the realities faced by the project team.

The Redpath Chautauqua Collection

The University Libraries collection chosen for the award is a series of talent flyers in its distinguished Redpath Chautauqua Collection and the project was named: "Traveling Culture: Circuit Chautauqua in the Twentieth Century." The circuit Chautauqua Movement represents an early embodiment of the American drive for self-realization and self-improvement. Its importance as a manifestation of the "American spirit" and as a dominant influence on American culture has been well documented in both scholarly and general works. By the mid-1920s there were twenty-one circuits of traveling performers providing seven-day programs in more than 10,000 rural communities in 45 states to an estimated 40 million people. Programs included discussions on political, literary, scientific, and moral topics, music (from accordionists to yodelers), and entertainment for all ages of both high and popular culture.

Comprising some 648 linear feet of materials dating between 1890 and 1940, the Redpath collection is considered to be the most extensive holding of circuit Chautauqua materials in existence. Its particular strength lies in the breadth of coverage and length of time over which the Redpath Bureau conducted business as the premier booking agency in the U.S.A.

The talent portion is the largest series in the collection consisting of nearly 8,000 flyers promoting the talents of nearly 4,600 performers. At the beginning of the project the flyers were housed in folders arranged alphabetically by performer's name in 279 manuscript containers in which flyers, correspondence, and contracts were intermingled. The series comprised 139 linear feet of primary research materials especially rich in contemporary information by and about notable people of the period. Selection of this collection for digitization was not the difficult part of this project. The talent flyers were a natural resource to select for presentation to the widest possible audience via the web.

The spirited language and vivid art work used in the promotional flyers reflect the emotions and ideals of the Chautauqua movement. Presenting the flyers in digital form makes the possibly dry topic of U.S. history come alive to the casual and serious researcher alike. For instance, young students are able to discover that the public's fascination with pet tricks did not begin with David Letterman. Rather, they would be able to see that *Pamahasika's 50 Highly Educated Pets* were an amazing and popular source of entertainment in the early part of the century. Secondary school students could learn that outrageous expenditure of federal funds is not a new concern. Judson King's lecture on how a "certain state government recently paid $10 each wholesale for some jack-knives which were worth $2.50 each retail" would point out that government reformers have long had their work cut out for them. The general public of today would be just as curious as their great-grandparents about tales of hardship and misfortune, such as the experiences of Mrs. Florence E. Maybrick. Unjustly convicted of poisoning her husband, she was sentenced by a judge who went insane shortly thereafter. Yet she served 14 1/2 years of her punishment and then went on the circuit to lecture on prison life and the need for judicial and prison reform.

Initial Plan for Workflow

Both the text and the graphic layout of the flyers are highly valuable for the study of American popular culture so the digitization strategy had to include adequate access to both the textual information on the flyers and the graphic representation of the flyers. As with most advertising material, there was no standard presentation or design to any of the flyers, although it was very rare that a flyer would be more than four pages in length. Moreover the physical state of the flyers and correspondence was such that a preservation effort simultaneous to the digitization effort was essential. Therefore the project had four distinct workflows that had to be managed separately within a timeframe of 18 months (a stipulation of the award) with an eye toward re-assembling all the pieces in both physical and digital form in the final phase. The workflows include: preservation, keying/encoding the textual information on the flyers for full text searching, providing intellectual access to the individual flyers, and imaging of the flyers.

Because the flyers are rare, no consideration was given to outsourcing the imaging of the flyers. Iowa City is not near enough to a major urban area to allow a vendor to come on-site to perform outsourced tasks. Therefore the budget and workflow plan had to accommodate student staff for the imaging workflow. The planning team estimated that full-time staff would be needed to train, supervise, and provide quality control for the student workers doing the imaging. There would be no possibility of including in the grant budget additional full-time staff for the training, supervision, and quality control for students who might be doing OCR/re-keying and SGML encoding - especially considering the timeframe in which the project was to be completed. Therefore the task of keying and "light" SGML encoding (based on a TEI-Lite DTD) was outsourced to a vendor through a bid-process managed by the University of Iowa's Purchasing Department.

Over the years flyers have been used by researchers and staff who were not uniformly attentive to replacing materials in strict order. It was anticipated that some reorganization would be needed to ensure that all flyers were in the correct folders. The number of flyers in the collection and the number of unique performers was estimated by a random sampling one folder in each of the 256 boxes. This process indicated that there were 9,600 flyers representing 7,600 performers and those figures were the basis for estimating the number of page images to be scanned for purposes of writing the grant proposal. However early in the project it was discovered that there were fewer performers (about 4,600) represented by about 8,400 flyers. Lesson: Know the dimensions of the project you are undertaking and then add in sufficient time to accommodate the unexpected - especially if one is working in a special collection of substantial size and variety.

Preservation

Although the flyers were in satisfactory condition to withstand the rigors of digitization, the accompanying materials had badly deteriorated. Those materials are letters and news clippings on acidic paper, or even onionskin, or carbon copies of original documents in other files.

To ensure that the folders containing the flyers and correspondence would be handled only once, a plan was developed comprised of the following steps: a folder is removed from its container, the brochures and correspondence are separated, a preservation photocopy of the correspondence is made on archival bond paper, and returned to the collection. These preservation activities are not funded as part of the LC/Ameritech grant so the tracking of staff time and the costs involved in handling the preservation of these materials has to be accounted for separately.

A photocopy surrogate of the entire flyer is made for use by the vendor in keying/encoding the text and a second photocopy of the flyer's first page is made for use by the catalogers. At this juncture a unique identifier, which is the directory/file structure for the electronic file, is written on both copies of the first page. This identifier is the common bond that links the cataloging record to the digitized image. After the flyer is cataloged, the title page photocopy and the original flyer in a new acid-free folder are sent to the in-house imaging process. After imaging is completed, talent flyers are re-united with the correspondence related to that performer, each in separate acid-free folders, and replaced in alphabetical order in archival boxes.

Keying/Encoding

As mentioned above, the initial estimate of the number of flyers and the number of performers involved was lower than expected based on initial samples. Unfortunately, this was not the case with the keying/SGML encoding estimates.

The Library of Congress encourages SGML encoding of textual materials in the American Memory project in support of full-text searching and to serve as the basis for more sophisticated search and discovery strategies that might be available in the future. Although the talent flyers are highly graphical and the nature of a promotional flyer might not seem to warrant full text searching, the quality of the text and the richness it provides as context to the images led the project team to concur with a plan for encoded full text. However the team also decided that deep encoding was not necessary and only nineteen elements were identified for the vendor's tagging work. The elements selected were primarily structural, like <figure> and <cell>. Other elements focused on the types of text that might be likely to provide special insight into contemporary culture and style, like citations, quotes from verse, and quotations. It was reasoned that if use of the collection warranted more encoding it could be inserted at a later date when more money was available for such activities.

Initial estimates of a character count of 28 million characters for purposes of the grant proposal were based on counting the number of characters (including spaces) in a relatively small sample of flyers during the grant-writing process. Unfortunately the sample proved to be skewed and the number of characters required for keying and encoding was underestimated by about 100%, even considering the fact that there were fewer flyers than was first assumed. Part of the under-estimation was due to inexperience in estimating the number of keystrokes that would be involved in the insertion of the SGML tagging. This miscalculation was compounded with the discovery that there were quite a few flyers that had unexpectedly substantial textual material. Taken together the team severely underestimated of the number of characters to be keyed which led in turn to an underestimation in the budget required to support this dimension of the project. Lesson: Take the time to do a substantial sample of the textual materials to ensure that one has a solid sense of the amount of text to be keyed - and then add at least 25% for tagging character strokes.

Fortunately, the commitment of the University Libraries administration to this project is strong and the commitment of the vendor to the project was equally deep. Together a negotiation of the fee to finish the keying was achieved which resulted in both sides accommodating some of the extra cost. Lesson: Find a vendor who considers the venture to be a partnership and with whom you can communicate frequently. Also, be very diligent about reviewing initial encoding samples for quality

One other unanticipated wrinkle in the workflow occurred during the keying process. The quality of the photocopies to be used by the vendor in the keying and encoding process was often difficult to decipher. The flyers make great use of shading for background effect and the text is artistically displayed in a variety of fonts around and across multiple images. (This was one reason that OCR was not considered for the keying process - another reason is the poor quality of affordable OCR software which requires a great deal of proofreading and correction.) Photocopies of text printed in black font on a gray or colored background were in many instances illegible to the keying staff. It is especially important to have absolutely legible photocopies for keying staff who may not be proficient enough in the language of the text to decipher poor reproductions. Lesson: The quality control procedures employed to ensure adequate photocopying were sufficient for the preservation photocopying, but we did not employ the same procedures for photocopies to be used by the vendor. Now the team needs to devise a method for filling in the <gap> and <illegible> tags from the source originals.

Intellectual Access

Intellectual access to "Traveling Culture" is provided through a number of avenues. The finding aid for the collection, which has been encoded in both HTML and SGML according to the EAD DTD, provides a box list of performer names. Part of the agreement for the grant was the development of a scholarly historical essay. Charlotte Canning, University of Texas at Austin Department of Theatre and Dance, a frequent user of the collection, has agreed to provide the historical essay for "Traveling Culture."

Each flyer is individually cataloged according to USMARC compatible standards. Strict adherence to USMARC standards was not feasible in determining the title of many of the brochures. In those instances, the decision was arbitrarily based on such factors as font size, placement on the page, or other dominant characteristics. Bibliographic data are included in the TEI Header and will also reside in a Library of Congress USMARC database. The homepage for "Traveling Culture" will provide both full text searching and access to flyers through a browse list of subject terms based on *Library of Congress Subject Headings*, *Thesaurus for Graphic Materials I : Topical Terms for Subject Access (LCTGM 1), and Thesaurus for Graphic Materials II: Genre and Physical Terms (LCTGM 2)*. Subject analysis has been applied for the context of the piece as well as to its content. Uncontrolled subject terms have also been applied when appropriate. For example, we have yet to find a controlled vocabulary term for bird imitators or cymbolomists.

The Redpath Collection has been cataloged at the collection level for quite a while, but cataloging at the flyer level was a requirement of the grant. Workstation based packages for simple MARC cataloging did not suit our needs. We wanted to catalog the item once and then automatically export a MARC file for both the Library of Congress and our local online catalog, as well as a TEI header with the bibliographic data inserted in the correct elements. Finally our project team developed a FileMaker Pro database that could manage both the MARC and TEI header export. The FileMaker Pro database has been easy for our student catalogers to use and flexible to adapt. We have added special fields that contain the file names (see below) and the identifying numbers for the archival CDs that contain the images for that flyer so the database record contains all the information necessary to provide full access to any given flyer. Moreover it now provides a fully functional database in support of interim subject access to the "Traveling Culture" collection until such time as full-text SGML searching is available.

After cataloging each flyer staff have an additional task that provides the lynch-pin for the entire process--assigning the file naming structure to be used as the unique identifier for linking together the TEI headers with the text files and the page images of the flyers. The basic directories are based first upon file type, i.e. "sgm" for the text, "gif" for the thumbnail image, "jpg" for the JPEG images, etc. The second level of the directory indicates the series, performer, sequential number of unique flyer in the collection by that performer, and the individual page image. An example: sdrc/traveling-culture/chau1/img/stagg/3/5.gif indicates the Traveling Culture collection, talent flyer series, the performer named Alonso Stagg, the third unique talent flyer in the box, and the gif image of page 5 of that flyer.

Requiring that the file naming structure reflect the flyers of a particular performer has both advantages and drawbacks. One advantage is that it reflects the traditional structure of the collection, which has always been based upon performer name. The naming procedure makes sense to human beings which assists in the construction of the unique identifier for the files and may assist humans in quality control when linking the page image, text and header files together. However, as more flyers by the same performer are found or as more flyers by performers with similar name stems are discovered, the system begins to be subject to transcription errors. No change in the file structure naming process is planned, but these considerations will inform our choices in the next project. Lesson: Plan for as much extensibility in file structures as possible, even when dealing with collections that are no longer growing in size. It may be the case that machine-assigned/random components to file names provide the most flexibility in the long run for large text collections that are intended to grow and expand in coverage.

Imaging

The imaging for the project has been accomplished in-house by student staff with equipment provided by the Office of the Vice-President for Research. Special attention to simplifying and automating procedures as much as possible has been a goal of the project team to minimize training time and error rate.

The general procedure is as follows: the original flyers arrive from the catalogers with the photocopied title page indicating the unique identifier/file name for the flyer. Students scan the flyer pages creating 600dpi 32-bit color TIFF images (a much slower process than had been originally estimated) that are saved to Jaz disks. The Jaz disks are used to burn archival CDs so no more than 650 megabytes of data are saved to each disk. Each CD is labeled sequentially with a note indicating which performer's flyers/pages are included. The color TIFF files are so large that each CD averages only 6 images.

An automated program creates a 300dpi 32-bit color file on the workstation desktop from the 600dpi TIFF image after it is saved to the Jaz disk. The 300dpi file is again downsampled into one 300dpi 1-bit black/white PDF file, one 150dpi 32-bit color JPEG, one 72dpi 8-bit color GIF image and one 6dpi 8-bit color GIF image. All images for a flyer are saved in one folder on the server. The color 300dpi file is then discarded. We originally tried to use Debabelizer for the downsampling, but that software could not rename the files as they were downsampled according to our file naming scheme. So we use a semi-automated procedure based on Photoscripter. . There is an as-yet-unidentified "waffle-effect" that sometimes appears with GIF images, but not in the JPEGs. Quality control on the imaging will be the primary focus of post-production image processing. The results of the review of image quality will inform our production workflow for the next project.

GIF images at 6dpi are used as thumbnail navigational aids in the search interface; GIFs at 72dpi are the default display images. The JPEG image is an option that may be selected by the user who wishes to view or download a higher quality image than the GIF image provides. PDF images are provided for ease of printing.

Many talent flyers contain images that span two pages, or even three. The project team made a strategic decision that images that span pages should be presented to the public as coherent whole images. This requires that the images be "stitched together" after they are downsampled - a job that requires patience, time, and a keen artistic eye. Sometimes the colors of each scan are slightly different for the respective image halves due to unpredictable (and undefinable) equipment problems that require extensive staff time to correct. This is a task for the team member who supervises the students and the scanning process. Lesson: Consider carefully whether and how much one can create automated routines to prevent the need for extensive training and lots of "hand-work" on the part of project staff. The budget impact of the need for special handling can be substantial.

Putting It All Together

The strategy for presenting the collection to the public was the subject of much discussion during the grant writing phase. Should "live" SGML be presented to the public? That would involve customized scripting to convert SGML to HTML for display purposes which is entirely possible, but requires staff expertise that The University Libraries does not normally have on hand. Monies available through the grant were quite limited and although the Libraries administration was prepared for a substantial cost-share there was a limit to what we thought we should attempt. After some debate it was decided that the highly visual nature of the flyers would be equally well served by presenting only page images of the flyers and using the encoded text as the basis for full-text searching behind the scene, but not for display purposes. Lesson: This was the right decision! As the project progressed there were substantial other issues to address. The time required to test and perfect the SGML encoding and to write the scripts to translate text on the fly to HTML would have been over-burdensome and too costly.

The prototype website for the collection is now available and it includes a facility for basic searching on bibliographic data in the FileMaker Pro database. The next technical step is to begin to export the TEI header, pre-pend it to the text files that have arrived from the vendor, begin the process of linking text to page images, and develop full-text searching with LiveLink software.

The next policy step was to develop a copyright statement for the site. The Head of Special Collections drafted a statement indicating support of unfettered use by researchers of all ages, but requiring that permission be sought by commercial entities that might want to use the images. A fee schedule for high-quality reproductions was developed, with the copyright/use statement, had to be reviewed by the university's lawyers and administration. The statement as well as an updated method for ordering high quality reproductions is now on the website.

General Lessons Learned: Although hiring and training student staff is time consuming, the quality of the work of students and their facility with the technology has been wonderful. Equipment and scheduling "hiccups" have occasionally delayed work, but the scanners and the server have been robust. We could use more students, more equipment, and more hours in the day, but the experience gained in this project has been invaluable as a staff development and enrichment activity. Nothing replaces the opportunity to "get one's hands dirty."

In August 1999 the project staff gave a presentation to the University of Iowa Libraries staff about the project. Our colleagues were impressed with the complexity and scope of the project and were glad to learn more about exactly what is involved with the workflow. But what impressed us was their equal conviction that the Redpath Chautauqua Collection is indeed a treasure that should be available to the world. We share that conviction and look forward to offering "Traveling Culture" to people around the world.

URLs of Interest

1. Library of Congress/Ameritech Competition is at: http://memory.loc.gov/ammem/award/index.html .
2. Library of Congress American Memory is at: http://memory.loc.gov/ammem/amhome.html .
3. The Information Arcade is at: http://www.lib.uiowa.edu/arcade/index.html .
4. The University of Iowa of Libraries is at: http://www.lib.uiowa.edu/index.html .
5. The Redpath Chautauqua Collection Finding Aid is at: http://sdrc.lib.uiowa.edu/traveling-culture/findaid1.html .
6. Traveling Culture is at: http://sdrc.lib.uiowa.edu/traveling-culture/ .
7. The University Libraries' policy on copyright and reproduction of images is at: http://sdrc.lib.uiowa.edu/traveling-culture/copyright.html and http://sdrc.lib.uiowa.edu/traveling-culture/reproductions.html .

Acknowledgements

The author would like to acknowledge the invaluable assistance of Richard Kolbet, Special Collections Librarian, and Paul Soderdahl, Head, Information Arcade and Libraries Webmaster. Without their hard work and advice neither this article nor the project would have been possible.

Fostering Teacher Inquiry and Reflective Learning Processes through Technology Enhanced Scaffolding in a Multimedia Environment

Catherine McLoughlin
University of New England
Armidale, NSW 2351, Australia
mcloughlin@metz.une.edu.au

John Baird
University of Melbourne
Australia
jbaird@mail.edfac.unimelb.edu.au

Keith Pigdon, Marilyn Woolley
University of Melbourne
keithjp@mail.edfac.unimelb.edu.au , mwoolley@mail.edfac.unimelb.edu.au

Abstract: The capacity of computer technology to support cognitive and learning processes is illustrated in the Quality in Learning and Teaching Project (QuILT), a case and problem-based multimedia resource which presents critical aspects of classroom practice in order to scaffold critical inquiry, observation and reflection. QuILT is an interactive CD ROM program that provides teacher education students with a range of examples of authentic scenarios where they can observe, analyse, reflect and evaluate actions, pedagogies and decision-making through immersion and engagement in virtual classrooms. QuILT is now being used extensively within the Faculty of Education, University of Melbourne, Australia as part of the teacher education program. The software provides an enabling environment in which student teachers can develop the skills of analysis, prediction inference and interpretation. This integration of technology into professional education extends the range of experiences available to teacher educators and applies multimedia technology into new areas of learning support. This paper analyses and demonstrates the elements that have make QuILT a successful technological tool in the professional education of teachers. The key design elements are identified as the integration of authentic classroom scenarios with opportunities for reflection and articulation of beliefs, the involvement of students in new mediator roles and the provision of a powerful technology supported environment to create contexts for students' professional development.

Aim of the study

The aim of this paper is to demonstrate the capacity of interactive multimedia to scaffold teacher practices, inquiry and decision making in order to develop the skills and competencies required in professional practice. Information technology has not yet achieved a great deal of recognition in the professional education of teachers (Schrum & Dehoney, 1998; Davis, 1997, Collis, 1994). However, there are increasingly greater constraints on education faculties in terms of resources and staff-student ratios with the consequent problems of developing teaching and diagnostic skills that are transferable into actual classroom settings. It is important that professional development for teacher continues to be embedded in contexts and practices for which the skills are intended. Technology support for professional development through the interactive multimedia resource of QuILT enables novice teachers to interact, reflect and learn collaboratively in scalable and sustainable ways in authentic settings.

The design features of QuILT are analysed in terms of a cognitive apprenticeship model of teaching, constructivist learning principles and scaffolded learning processes (eg, Levin & Waugh, 1998; Guzdial & Keogh, 1998; Hmelo & Day, 1999). On the basis of their immersion in, and interaction with a range of authentic classroom situations, student teachers are supported in extending and modifying their understandings of teaching processes, decision-making and interpretation of classroom events.

Rationale for technology supported scaffolding in teacher education

The incorporation of experiential learning tasks to cultivate reflective thinking in teacher preparation programs at university is widely acknowledged in the literature Stuhlman, 1998; Collis, 1998). Through experience, teachers learn how different learning outcomes can be achieved and what skills are required in particular situations. In addition to teaching skills, teachers need to consider how different school settings, events and resources can impact on their teaching. Individual teachers working in isolation in schools do not have opportunities to share experience or to examine different perspectives on teaching, and to test their own developing skills against established criteria. According to Shulman (1987: 19), teaching requires reflective practice that develops through experience and sharing of information with peers and mentors. According to Shulman, reflection is :

..what a teacher does when she or he looks back at the teaching and learning that has occurred, and reconstructs, reenacts, and/or recaptures the events, the emotions, and the accomplishments. It is that set of processes through which a person learns from experience.

For the development of critical reflection, student teachers need to undergo a period of self-evaluation and reflection based on their own observations of teaching, their existing belief systems and their experience. This stage in the development of professional expertise has dominated the discussion of teacher education provision in recent years (Bright, 1995). Student teachers have been observed to undergo a steep learning curve at the beginning of their teaching career, when they abandon strongly held beliefs regarding pedagogy and educational values. This is the critical period of reflection when teachers learn from others, question and analyse their own experiences and develop the capacity for principled knowledge of teaching. For this to occur, there needs to be time, encouragement, monitoring and feedback in a context where critical reflection can unfold.

While teacher education programs advocate the adoption of 'reflective approaches' to their own practice, constraints imposed by the resource implications are impinging on the provision of opportunities and time for development of reflective teaching practice. In the current climate of decreasing staff-student ratios in many education faculties, and the reality that school placements of teachers are widely dispersed, the opportunities and tasks that foster reflection are very limited. New frameworks and instructional strategies for learning are called for, and technology offers both cognitive tools and resources to enhance learning for professional development (Robson, 1999).

Using technology to scaffold teacher reflection: The QuILT metaphor

Communications technology and multimedia can contribute to the range of tools that contribute to experiences of teachers and foster critical thinking. For example, electronic networks and e-mail contribute to reflective practice by enabling teachers to communicate and to share ideas and experiences (Wu & Lee, 1999; Pearson, 1999). In order to enhance the skills of teachers before they enter a real school setting, it is possible to use a variety of technological supports as facilitation. QuILT provides a complete multimedia experiential environment where teachers can engage in problem solving and diagnostic teaching. Through the scenarios presented in QuILT, teachers are scaffolded through a range of interpersonal, diagnostic and decision-making tasks. Through technological scaffolding, teachers encounter a broad range of experiences and also have the opportunity to learn skills in a safe environment, with feedback provided by peers, technology and mentors.

Four specific organisational devices have been designed to provide a visual and conceptual structure to assist users as they work through the program. The QuILT program allows the user to view and re-view authentic video recordings of teaching episodes (which reflect problem situations) from four major lenses:

1. What is the teacher doing?
2. What is the teacher thinking and feeling?
3. What are the students doing?
4. What are the students thinking and feeling?

Each of these lenses is signalled through colour coding and the use of icons that draw from aspects of weaving involved in quilt making. In addition, the lenses show patterns of how the four elements interrelate in and between teaching sequences. These interrelationships demonstrate that learning and teaching are complex, multiple and strongly dependent on personal, interpersonal, and physical contextual features. Research perspectives attest that the nature of quality learning and teaching is clearly pluralist and relativist in nature (Alexander, 1996) and this is integrated into the design of the multimedia environment of QuILT. Metaphorically, each of the four lenses are the fibres (colour coded to teacher-related lenses 1 and 2, and student-related lenses 3 and 4) that, through weaving, form the material's warp and weft. The Quilt is an intricate, complex web of teacher beliefs, understanding conceptual knowledge and action, that is woven from experience and reflection.

For learners engaging with this virtual classroom environment, an adequate interpretation of each of the episodes and consequent decisions regarding future personal teaching actions can only be achieved by consideration of the episode through many or all of these lenses. Encounters with multiple perspectives, decision-making and inquiry into action are the learning processes scaffolded the multimedia environment on QuILT, which is informed by constructivist learning theory.

Using multimedia technology as scaffolding: QuILT environment

The major purpose of QuILT is to create a multimedia environment whereby novice teachers achieve particular goals related to effective teaching. In presenting critical aspects of classroom practice the intended learning outcomes are that users:

1. critically observe sequences of teaching that present classroom based-problem situations and then respond to these by considering, determining and undertaking planned actions;
2. develop or modify their conceptions, values and beliefs in ways that indicate enhanced understandings of quality through a process of guided reflection involved in the performance of particular tasks;
3. make decisions, record these and then defend their choices within and outside the program. Some feedback will be within the program design, other feedback will come from other users and from the teaching staff; and
4. solve case-based problems in ways similar to the problem presented on the CD ROM applying strategies and thinking employed by effective teachers.

Task design is based on the pedagogy of problem and case-based learning (Savery & Duffy, 1995: McLoughlin & Oliver, 1999).) Problem and case-based learning reflects conceptions of learning, knowledge and understanding that are very different from conventional ideas on learning. For example, content or subject experts know a lot about a subjects and their expertise is judged on the amount of content known, or on the display of propositional knowledge (*to know that such and such is the case*). In professional areas it is also important to have procedural knowledge (*to know how to do something*). It is this alternative understanding of expertise that characterises problem-based learning. According to Margetson (1997: 38) "Expertise is the ability to make sound judgements as to what is problematic about a situation, to identify the most important problems and to know how to go about solving or at least ameliorating them".

In the professions and in the teaching world, the skills of identifying problems, managing solutions or improving problem-situations are considered to be important competencies that need to be scaffolded or assisted in novice learners. More recent work in technology-supported environments illustrates how the concept of scaffolding has expanded to include many innovative forms of support, increased responsibility for students and a fading of the directive of asymmetrical aspect of earlier work on scaffolding. Theoretical models of scaffolding in technology-supported environments have been elaborated by Winnips (1998) and McLoughlin (1999). In QuILT, the multimedia environment enables learners to engage critically with authentic cases and develop professional knowledge and awareness.

Employing the Technology: The Quilt metaphor as an architecture for design

The conceptual and procedural frames for the QuILT program are organised through the metaphor of a quilt. The construction of a patchwork quilt involves a number of processes: the weaving of the fibres to produce material from which the patches are made, the construction of the patches, the arranging and stitching together of these and their possible fashioning through embroidery. Each of these stages of construction is referred to iconographically as the program proceeds. For instance, the finished quilt is a metaphoric construction of the nature and practice of quality in classroom learning and teaching. This construction requires the user to create patches (one for each of nine major areas for study), and then arrange and cohere these patches to make a unified conceptual and methodological frame for professional thought and action. When constructing the patches, the user is guided by utilisation of four different 'lenses' with which to explore lesson activities and contexts. These lenses are teacher action, thinking and motivation, and student action, thinking and motivation.

This metaphor provides an integrated architecture for the design of the program. Continuous social interactions, a sequence of patterns and relationships, and a resultant creative harmony are necessary for successful crafting of a quilt. The social meanings inherent in quilt production vary according to the cultural setting, the materials and the technology available. Similar qualities and features are evident in quality learning and teaching.

Student Tasks: Action, inquiry and reflection interwoven

Progress through the program is framed according to nine professional focus areas that include planning units for learning, teaching individuals and groups, student and classroom management and evaluating learning. Users analyse teaching segments to interpret classroom activities, predict what actions will follow certain key points in teaching and learning, propose and justify actions they would take themselves in such a teaching situation and draw inferences and conclusions about feasible and appropriate teaching strategies to foster quality classroom practices. All segments are presented in a way that requires the user to induce, through a process of guided reflection, substantiated insights regarding effective and productive teaching and learning. In addition, users have access to numerous interviews with the classroom teachers and students. These interviews provide perspectives, feelings, explanations and interpretations of classroom interaction that are normally not available to observers.

Interactivity is manifested in various ways. The design of some sequences within the program prompts users to pursue alternative pathways and assess the quality of teacher action and decision making. As each pathway is enacted, the journey provides immediate feedback to the user who has chosen that particular pathway and then justified and recorded that decision. Other prompts within the program require users to record their individual observations, predictions, justifications and reflections. Thus, by providing support for inquiry, participants are scaffolded in developing their own understandings through active participation in a learning event. Each participant has the opportunity to learn within his/her own zone of development, and support is given to enable student to perform the task according to the level of their competence (Vygotsky, 1978). Offering choices of pathways, multiple perspectives and individual feedback combined with reflective action fosters self-regulation. In addition by scaffolding metacognitive processes through personal reflection and subsequent group dialogue, self directed-inquiry and decision making are intended learning outcomes (Boekaerts, 1995; Shin, 1998; Winne, 1995).

Reflection through an electronic notepad

Two software in QuILT tools allow for systematic staged reflection. An electronic notepad is available to users at all times and is saved to file server or local disk for further refinement. This notepad allows users to record their predictions, observations, inferences and analyses of classroom episodes and teacher and student interviews and to take a personal position. The second tool, known as an action planner, requires users to reshape and refine data from the notepad. This is achieved through a variety of devices that enable the user to summarise and synthesise, compare and contrast, signify and prioritise, review their positions and frame their teaching. Printouts of these files are brought to scheduled class workshops for sharing, reflection, analysis and synthesis. The classroom becomes a space for shared discourse where learners can negotiate and construct new understandings. Technology offers the initial support for learners when they encounter new experiences, and provides a facilitating structure and tools that enables them to make maximum use of their own knowledge and experience. This form of scaffolding has been referred to as procedural facilitation (Scardamalia & Bereiter, 1994; Scardamalia & Bereiter, 1989).

Summary: Categorising the range of scaffolds in QuILT

An overview of the forms of scaffolding provided in QuILT shows the diverse ways in which knowledge building and professional skills are developed. *Conceptual scaffolding* is provided when the problem under study is delineated, contextualised and defined so as to focus the learner towards central issues and concepts where there may be multiple interpretations. This is achieved in QuILT through the presentation of classroom scenarios and problems. *Metacognitive scaffolding* supports the underlying processes associated with learning management and reflection. It provides support for thinking through enabling tool (an electronic notepad) to enable students to record their thinking while engaging with the classroom scenarios. Metacognitive support is also provided by promoting and questioning learners to relate incidents to personal belief systems. In addition, QuILT fosters thinking processes by encouraging users to link cases with prior knowledge and experience. *Procedural scaffolding* supports learners in using available tools and resources. In QuILT, classroom scenarios are viewed from different angels, or lenses (teacher action and motivation, student action and motivation). Each of these lenses is signalled through colour coding and use of icons that use the metaphor of weaving, as in quilt making. Visual and conceptual forms of scaffolding are thus interwoven. *Strategic scaffolding* is afforded by emphasising alternative courses of actions and events that might be applied in classroom contexts. The presentation of multiple scenarios, events and perspectives in QuILT supports analysis, planning and decision making, which are valued skills in teaching.

Conclusion: QuILT as a cognitive tool

Initial assessment of user responses to QuILT have been positive. For novice teachers, the CDROM is an innovative and powerful cognitive tool, a multimedia resource that supports higher order thinking, decision-making and the development of critical reflective practice among student teachers. This resource provides experiential learning environment that fosters the reflective skills needed to become a professional educator.

References

Alexander, P. A. (1996). The past, present and future of knowledge research: A re-examination of the role of knowledge and learning and instruction. *Educational Psychologist, 31*(2), 89-92.

Bright, B. (1995). What is 'reflective practice" ? *Curriculum, 16*(2), 69-81.

Collis, B. (1994). A reflection on the relationship between technology and teacher education: Synergy or separate entities? *Journal of Technology and Teacher Education*, 7-25.

Collis, B. (1998). Implementing change through faculty. In R. M. Corderoy (Eds.), *Flexibility: The next wave. Proceedings of the 15th annual conference of the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE).* (pp. 15-22). Wollongong: University of Wollongong.

Davis, N. (1997). Do electronic communications offer a new learning opportunity in education? In B. Somekh & N. Davis (Eds.), *Using information technology effectively in teaching and learning* (pp. 167-182). London: Routledge.

Gudzial, M., & Kehoe, C. (1998). Apprenticeship-based learning environments: a principled approach to providing software-realised scaffolding through hypermedia. *Journal of Educational Multimedia and Hypermedia, 9*(3/4), 289-336.

Hmelo, C., & Day, R. (1999). Contextualised questioning to scaffold learning from simulations. *Computers and education, 32*(1), 151-164.

Levin, J., & Waugh, M. (1998). Teaching teleapprenticeships: Electronic network-based educational frameworks for improving teacher education. *Interactive Learning Environments, 6*(1), 39-58.

Margetson, D. (1997). Why is problem-based learning a challenge? In D. Boud & G. Feletti (Eds.), *The challenge of problem-based learning* (pp. 36-43). London: Kogan Page.

McLoughlin, C., & R.Oliver. (1999). Problem-based learning: Developing learning capability through the World Wide Web, *Open, distance and flexible learning: Challenges of the new millennium* (pp. 301-303). Geelong: Open and Distance Association of Australia.

McLoughlin, C. (1999). Scaffolding: Applications to learning in technology supported classrooms. In B. Collis & R. Oliver (Eds.), *Proceedings of Ed Media 99: World conference on educational multimedia and hypermedia* (pp. 1827-1832). Charlottesville: AACE Publications.

Pearson, J. (1999). Electronic networking in initial teacher education: Is a synthesis possible? *Computers and education, 32*(3), 221-238.

Robson, R. (1999). *WWW-based course-support systems: The first generation.* Paper presented at the Ed-Media 99, Seattle, USA.

Savery, J., & Duffy, T. M. (1995). Problem based learning: An instructional model and its constructivist framework. *Educational Technology, 35*(5), 31-38.

Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *Journal of the Learning Sciences, 3*(3), 265-283.

Scardamalia, M., Bereiter, C., R.McLean, & Woodruff, J. (1989). Computer-supported intentional learning environments. *Journal of Educational Computing Research, 5*(1), 51-68.

Scrum, L., & Dehoney, J. (1998). Meeting the future: A teacher education program joins the information age. *Journal of Technology in Teacher Education, 6*(1), 23-37.

Shin, M. (1998). Guidelines for instructional design. *Educational Technology, 38*(1), 38-44.

Shulman, L. (1997). Knowledge and teaching: foundations of the new reform. *Harvard Educational Review, 57*(1), 1-22.

Stuhlman, J. (1998). A model for infusing technology into teacher training programs. *Journal of Technology for Teacher Education, 6*(2/3), 125-139.

Vygotsky, L. (1978). *Mind in society: the development of higher psychological processes*. Cambridge MA: Harvard University Press. (Original material published in 1930, 1933 and 1935).

Winne, P. (1995). Inherent details in self-regulated learning. *Educational Psychologist, 30*(4), 173-187.

Winnips, K. (1998-1999). Scaffolding the development of skills in the design process of education multimedia. *http://scaffolding.edte.utwente.nl/*, http://scaffolding.edte.utwente.nl/.

Wood, D., & Wood, H. (1996). Vygotsky, tutoring and learning. *Oxford Review of Education, 22*(1), 5-10.

Wu, C. C., & Lee, G. (1999). Use of BBS to facilitate a teaching practicum course. *Computers and Education, 32*(2), 239-247.

A Web-Based Interactive Environment Based on Virtual Reality Simulation for Constructive Learning

Chi-Cheng Chang
Department of Educational Technology
Tamkang University
Tamsui, Taipei, Taiwan
samchang@mail.tku.edu.tw

Abstract: This paper discusses the potentials and limitations of web-based Virtual Reality (VR) in operating slide projector. A VR-based interactive and simulated environment on web for immersively learning slide projector operation has been designed, developed, and evaluated. The framework and functionality of the system described in this study are also presented. The evaluation results report that this learning material has positive effects on students' learning outcomes. Finally some indication of further researches to be done will be given based on using the material developed in this study.

Introduction

It has been reported that many students fail to easily understand the manipulation activity that occurs at a psychomotor level during the production and presentation of slides, and the operation of slide projector. Students usually do not have enough time to physically practice the operation of slide projector after the class due to insufficient equipment of slide projectors provided by the school. Students are therefore not well motivated to learn this subject and have difficulty grasping these complex procedures. Without sufficient simulation and visualized demonstration, students argued that transfer of skills and retention of knowledge for producing slides and operating slide projector would not effectively work.

VR-based learning environment on the Web could provide alternative to make presentation of learning materials more visualized and enables their demonstration dynamically. Students would be more motivated to actively learn, and able to highly visualize the complex process of producing slides and operating slide projector. Additionally, students could then manipulate the VR-based system dynamically and learn by their own hands-on experiences how slides are produced and a slide projector is operated that is impossible to observe in real situation. The application of distributed VR to online simulation for the hands-on experiences of operating slide projector on World Wide Web (WWW) are worthwhile creating for reasons of equipment, safety, expense, time, and distance. VR-based learning environment on the Web to learn slides projector operation (WebVR) would be very helpful for students to acquire and construct the needed knowledge in the social and active sense.

Application of VR to Psychomotor Learning

Virtual Reality are drawing more and more attention in skill training and psychomotor learning due to its capabilities of real-time interactivity, three dimensional animation, situated simulation, dynamic mediated environment, immersive sense of presence and so forth. In such a artificial 3D simulated learning environment based on VR technologies, students can highly interact with the virtual world, move around within it at will, highly control over their self-paced navigation through it, freely manipulate virtual objects insides, and immediately have a immersive sense of really being there. Additional, it allows students to visualize abstract concepts, and to observe events at atomic scales that cost, distance, time, and safety factors make unavailable (Youngblut, 1997).

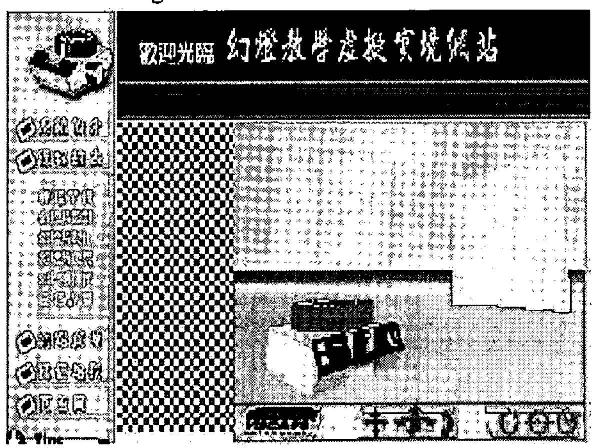
Repair to the Hubble Space Telescope were simulated in VR environment to enable the technicians to familiarize themselves with the dangerous manipulations they would experience before the actual repairs were done (Traub, 1994). Safe space and situation to practice skills of repair was provided in the virtual environment that was risky to do so in real situation. Skills learned in the virtual environment could transfer successfully to the telescope repair ability of real world. VR via the Internet and World Wide Web (WWW) may offer the possibilities of enabling students being able to collaboratively create their online virtual worlds or contribute to those created by others (Moore, 1995). The types of activities supported by VR capability facilitate current educational application that students are better able to acquire, master, retain, transfer, and generalized new knowledge whenever they are actively engaged constructing their knowledge in a learning-by-doing situation (Youngblut, 1997).

Design and Development of Learning Environment

Environmental Framework and Functionality

Students can easily move around within and freely navigate through the virtual worlds and do all kinds of actions, such as freely manipulating virtual objects in any degrees of freedom. Additional, students immersively existing in the 3D environment of WebVR may experience several degrees of freedom, including full freedom in navigation, the access to information through multiple interactions, and the capability to figure their own learning process.

Figure 1 Main menu of the WebVR



Designing Instructional Strategies

The constructivist principles of learning in the design of WebVR are proper approaches to the work of our instructional strategies. The main learning approaches to implementing the constructivist principles in the 3D virtual worlds are exploration, discovery, problem-solving, and learning by doing. Using web-based VR browser capabilities, students are able to freely explore the virtual objects, discover phenomenon, practice skills, move around and navigate through the 3D virtual worlds composed of simulated equipment and tools. The manipulation of an object in a virtual world supports the practice of constructivism. According to Salis & Pantelidis (1997), object manipulation in the virtual worlds is a powerful learning strategy frequently used for constructing a knowledge framework that presents concrete components for associating some superior knowledge. Additionally, transformation and rotation of the objects enable students clearly to observe their various situations that can be rarely observed in traditional situation. The attributes of virtual objects can be explored through direct interaction with them. In this study the WebVR was using these strategy to develop psychomotor skills for high level of human interaction and knowledge association from a motor answer to a stimulus which students received in the virtual worlds.

A self-space learning navigation system is employed in the WebVR to increase the opportunities for exploration, manipulation of objects, discovery, movements, and senses of real or not real by using visualized controlling elements within virtual worlds. The self-spaced learning navigation system for users through the virtual worlds was designed and used as a learning tool in search for information and objects so as to highly take control over their exploration and manipulation. In a virtual world students may use the navigation system to freely determine to select and manipulate the objects that might be of interest and for the observation at convenience. Visualization, navigation, and manipulation tools was developed in the WebVR to allow students to move around within a virtual world and to discover the attributes of an object.

Designing Learning Content and Activities

The content of this WebVR material for the VR simulation part (operating slide projector) was divided into four essential parts based on the results from a content analysis and task analysis, they are individually Set Up, Operate, Disassemble, Maintain, and Troubleshooting. The VR-based learning world contains many virtual objects such as slide, focus button, lens barrel, slide tray, lock ring, elevation leg, remote controller, forward button, reverse button, and selection button that are the components of a slide projector. Each object is made from many models and attributes. Models describe it outside appearance, while attributes present its interactivity and actions. Students are allowed to reinforce their experiences of operating slide projector through manipulating the virtual objects and exploring the virtual worlds.

When students pick up a virtual object, they may execute the actions predefined insides it by clicking the mouse button such as rotation or deflection. Students can pick up and move the objects, as well as observe them and their behaviors from various directions. The scenes in the virtual worlds have viewpoint so that students can quickly view the virtual objects from the front, back, left, right, top, and bottom. Object names are shown when students move the cursor on them using mouse, while the names disappear when the cursor is moved away. By this way, students may observe the various components of the slide projector, and learn the names, appearances, and attributes of the virtual objects. In other words, students must actively manipulate, explore, and interact with the virtual objects, otherwise they could not be able to learn their attributes.

In the VR-based learning world of operating slide projector, the functionality and simulated actions are as follows (Heinich, Molenda, Russell, & Smaldino, 1996):

1. Slides could be load into tray and locking ring could be tightened as users pick up the slides and place them into the tray, and adjust the locking ring on the tray by clicking mouse button and moving the mouse.
2. The slide would be pop up as users push and hold selection button by clicking mouse button.
3. Slide tray would rotate clockwise or counterclockwise as the users press forward or reverse button on slide projector or remote controller to project slides by clicking mouse button.
4. Lock ring could be locked on slide tray as users tighten it by clicking and moving mouse button. If it is not locked, system would present a warning message that "slides would drop out."
5. Lens barrel would move out or in as users adjust focus knob or move lens barrel to focus image, position it on screen, make it smaller or larger by clicking mouse button and moving the mouse.
6. User could remove slide tray and remove slides from the slide tray buy clicking mouse button and moving the mouse.
7 Slide projector could be viewed from different directions by clicking mouse button and moving the mouse.
8. Names of virtual objects such as button, lens barrel, slide tray, lock ring, elevation leg, remote controller, forward button, reverse button, and selection button would be shown up when users place cursor on them by moving mouse.
9. Slide's image would upside down or backwards as users remove the slide and reverse it by clicking mouse button and moving the mouse.

Development Platforms and Tools

Due to the factors of cost and convenience, a desktop virtual environment with less immersion was developed in this study rather than using a head-mounted display with higher immersion. In order to make interfacing uses as friendly as possible and keep the cost as low as possible in cases of educational institutions' using our system, we chose a standard mouse rather than a data glove or a 3D mouse. In addition, data golve and 3D mouse art still not popular to the public at large was taken into consideration for not using them. WebVR in the study may therefore support direct dynamic interaction with the virtual worlds and objects with a standard and regular mouse.

Recent advanced technology in WWW platform have provided with tools and browsers for the capability of A desktop Virtual Reality known as the Virtual Reality Modeling Language (VRML). 3D Webmaster, the ultimate software tool for designing interactive 3D WebVR worlds in the study, allows developers to create rich, interactive, real-time 3D worlds quickly and efficiently, as well as lets developers add interactive 3D virtual worlds to flat 2D Web pages. 3D Webmaster not only may support VRML and 3D web producing but also can integrate with HTML and JavaScript commands. In addition to hundreds of ready made components and Virtual Clip Art objects, there is a fully functional 3D Shape and World Modeller as well as Sound and Image Editors included in 3D Webmaster. This also includes the powerful VR control language SCL (Superscape Control Language) for assigning behaviors to virtual world objects (see http://www.superscape.com/). 3D Webmaster provide users interactions and offer a natural way for extending the practice environment to a virtual 3D practice world. This extension provides with more advanced simulation and enable learning transfer from a virtual situation to a real situation.

Prototyping WebVR materials including interface was first developed by using Frontpage, and then completed environments were further established on the WWW by using 3D Webmaster to create the 3D virtual worlds and objects relevant to slides production and slide projector operation. Superscape Viscape, the fastest 3D browser plugin, enables users to view the product developed by 3D Webmaster and lets users experience interactive 3D virtual worlds on Web. It is therefore needed to install for viewing the WebVR materials in the study.

Evaluation Methodologies and Results

We evaluated the quality of the WebVR through doing qualitative study for mainly examining the functions, interface, content, and learning experiences by means of questionnaires that embrace specific questions. The results from the survey of students' feedback on the satisfactions for the WebVR reported that the system interface is easily accessible and usable to users. They also indicated that there are many learning materials that can be delivered more effectively by video and audio media that are not provided in the WebVR materials. Students reported that they liked having hands-on experiences with the virtual worlds, and they felt comfortable with the simulated capabilities provided by the WebVR material.

In summary, the conclusions drawn from the evaluation study are as follows:

1. The majority of students had a very positive response in the functionality, usability, interface, and content of WebVR.
2. Students commonly enjoyed learning within the virtual worlds, and their learning process was highly motivated.
3. Students were not tolerant of the low running space that sometime occurred.
4. The use of WebVR could encourage students self-directed learning
5. The use of WebVR could captivate students' attention and foster active involvement in their learning process.
6. The test scores of students had higher learning performances than those of traditional instructions in classroom based upon the comparisons with last few semesters.

As a result of the evaluation study, the WebVR provides a promising platform for exposing students to actively learn in the domain of "Slides Projector Operation", draw a high attraction to students and can be employed for a wide variety of instructional purposes. A claim can be derived from observation study that identified a fact that WebVR does support the learning process, reception of information, and active participation. WebVR acts as an experience facilitator who allows students observe and explore phenomenon via their various senses. In short, our key insight to the evaluation results of the WebVR material is the verification of its successful design, creation and use experiences.

Conclusions and Summary

A VR-based learning environment on the Web was developed to examine the feasibility of applying VR to media education. However, the material does not want to replace the teacher, but only wants to be a teacher-assistant or student-assistant to help guide the student during the learning process. This means that if students experience difficulties learning, they may attempt to solve the problem in collaboration with their peers under the support of web-based VR technologies. Evaluation results of WebVR indicate that it is a helpful tool both for students and teachers in thc learning process. This is concerned about the experiences students gained from the free navigation and high interaction afforded to them, and from the exploration of basic skills of operating slide projector. In summary, this study not only refines the content of distributed VR-based learning materials on the Web developed to learning slides production and slide projector operation, but also help us verify a methodology for instructional designing uses.

We do believe that the application of VR on web not only highly encourage the creative design of learning environments, methods, and tools, but also bring us into the new instructional strategies and tactics. It is hopeful that more studies on the web-based VR learning environment will be conducted to benefit all students in teacher preparation program.

Suggestions and Future Work

The WebVR is currently a stand-alone application not associated with the learning support tools such as chat room, conferencing and discussion board on the Web. It would be greater to be integrated into a web-based instructional environment so that the high level of collaborative learning activities can more profoundly be developed and relative issues can more deeply be investigated. In this study, we experienced difficulties in displaying a large amount textual information, however some textual information is indispensable for learning slide projector operation. Therefore, how to display large amounts of textual information using current VR techniques is still a big problem that needs to solve. An experimental research to examine the real learning performance by comparing the classical classroom situation with the WebVR through statistically controlled group and experimental group is recommended being conducted in the future. (This research was supported by NSC Project No.88-2520-S-032-003 of Taiwan)

References

Heinich, R., Molenda, M., Russell, J., & Smaldino, S. (1996). *Instructional media and technologies for learning*. Englewood Cliffs, NJ: Prentice-Hall, Inc..

Moore, P. (1995). Learning and teaching in virtual worlds: Implications of virtual reality for education. *Australian Journal of Educational Technology, 11*(2), 91-102.

Traub, D. (1994). The promise of virtual reality for learning. In Loeffler, C. & Anderson, T. (Eds.) *The Virtual Reality Casebook*. New York: Van Nostrand Reinhold.

Youngblut, C. (1997). Educational uses of virtual reality technology. *VR in the Schools, 3*(1). Available on http://eastnet.educ.ecu.edu/vr/vrits/3-1young.htm

A Concept-Mapping Methodology to Eliminate Dangling Questions in Asynchronous Learning Forum

Chih-Kai Chang
Department of Management Information Science
Da Yeh University
Da-Tsuen, Chang-Hwa 51505 Taiwan, R.O.C.
E-mail: chihkai@aries.dyu.edu.tw

Abstract: After an instructor had used the Web-based forum in a course for years, the system database will contain an accumulation of discussion articles from different classes, which may be of similar topics. Furthermore, the discussion processes of some classes may be very heuristic for other learners in the same course. In general, the Web-based forum serves as an additional discussion channel for learners in the absence of an instructor. However, an instructor may want to guide learners to read the meaningful discussion articles in portfolios of previous learners when a similar question is asked. Hence, it is necessary to model the relationships between discussion articles of different classes. Furthermore, an instructor desires no unanswered question, called dangling question, in the Web-based forum because of the possible negative influence, such as discouraging learners to raise questions. This paper proposes a concept-mapping method for representing the relations between learners' questions and accumulated discussion articles, which enable a learner to find easily the set of discussion articles from the system database with conceptual similarity to his/her question.

Introduction

Many researches use portfolios for learning assessment, supporting instructors' decision making, or planning instruction (Wiggins, 1993; Chang and Chen, 1998; Chang, Chen, and Ou, 1998). Such usage of portfolio is only from an instructor's perspective. From a learner's points of views, portfolio means learning efforts of previous learners. For instance, portfolio of a previous learner may include the previous learner's discussion, project, and homework so on. The portfolios of a Web-based learning environment can be reused as recommended readings to eliminate dangling questions by filtering, encoding, and indexing previous learners' portfolios into a concept similarity representation. This paper proposes a methodology for reusing the discussion articles in portfolios to answer dangling questions by the concept similarity between dangling questions and discussion articles.

Most of the existing asynchronized discussion styles is thread-based on the Web. This means that an initial article was first posted, which followed by articles of the same subject. Discussion articles can be presented in different ways, for instance, by time order, author order, or subject order. However, most learners will use subject order because they need to know others' response to the subject before posting an article. Sometimes, a prior learner will use "please see a specific article posted before" as an answer to a question raised. Furthermore, new learners are very interested in the experience of the prior learners. For instance, new learners may want to know whether a specific topic had been discussed or not. Hence, it is necessary to find a method for reusing prior learners' discussion articles.

Very often, some questions are never answered in the discussion activity of the distance learning system. These unanswered questions are called as *dangling questions*. The dangling questions may occur for different reasons. For instance, the dangling question is so easy that other learners ignore it. Sometimes, other learners may not be discussing the topics related to the dangling question. Dangling questions are important both to the learners and the discussion group. If a dangling question is noticed and answered, the discussion that follows may be very abundant in some cases. Furthermore, some studies have indicated the positive effects of reducing the turnaround time of learners' question (Rekkedal, 1983). However, there is still no mechanism for triggering learners to review dangling questions.

There are many advantages for dangling questions to be answered by prior learners' discussion articles in the discussion process of a Web-based forum. First, the participation of the discussion activity will be enhanced because every learner may feel that there are responses to his/her question. Second, the group discussion will be more efficient because prior learners' articles will answer some types of questions, for instance, the frequently asked questions. Third, all learners will get an additional chance to reflect more on the dangling question in the light of prior learners' discussion articles.

Portfolios can also be used for active dialogue scaffolding. Discussion articles may contain any topic, for instance, discussing a misconception, exchanging notes, sharing an article, and even checking on the deadline for homework. If there is a prior learner in the new class, he/she will often use previous discussion articles to answer questions for the new classmates. The types of questions, answered by prior learners' discussion articles, varied from frequently asked questions for novices to very specific questions for experts; depending on whether the prior learners' discussion articles contain the topic of the new question or not. Hence, it is very difficult to reuse previous discussion articles without a prior learner in the new class. The issue is referred to as the *reusability* problem.

Learners do not know whether a specific topic in a course has been discussed or not. In general, learners will use the keyword search method to probe whether there are related discussion articles in prior learners' portfolios or not. However, the results of keyword search may be too much to handle. Hence, learners will use the Boolean system to improve the keyword search results. Using the Boolean system to retrieve answers from discussion portfolios, learners have to provide sufficient syntactical restrictions in their query to limit the number of articles retrieved. Worse still, these retrieved articles are not ranked in any relationship to learners' query. However, learners may not be familiar with the terminology of the specific domain, which could be used in the discussion articles. Furthermore, learners find it difficult to get consistently good results because they lack the training for expressing the complex query syntax required by the Boolean system. Consequently, some models for retrieving answers easily from prior learners' discussion portfolios should be constructed. This issue is denoted as the *recognizability* problem.

Prior learners' discussion portfolios are not meant for use by novices. Its organization is difficult for a novice to absorb prior learners' learning experience. Hence, it is necessary to reorganize prior learners' Web-based discussion portfolios so that even new learners can benefit from using them. Although learners can retrieve prior learners' discussion articles by asking questions, they may want to know why prior learners discussed this topic. There should be a mechanism not only for answering dangling questions, but for also providing a hyperlink to the beginning of the thread leading to the answer (the discussion article) of the dangling question. Furthermore, a thread of prior learners' discussion articles may contain a reference to other portfolios. Hence, the prior learners' portfolios should be more readable for novices to reuse and benefit from them. The issue is called the *readability* problem.

This paper presents a ranking method of retrieving discussion articles and detailed instructions on using ranking technology to answering dangling questions of a Web-based forum by the support of prior learners' portfolios in a distance learning system. First, we solve the *reusability* problem by answering learners' questions with retrieved articles from prior learners' discussion articles. Then, a concept-based mapping method is used to reorganize prior learners' portfolios so that learners can benefit from them without the *readability* problem. Finally, the relevance ranking in concept vector space is used to retrieve articles from portfolios for answering questions. Learners need not know whether there is any related discussion articles in prior learners' discussion articles before asking questions. Hence, the vector space model will solve the *recognizability* problem. The following table illustrates the relationships between the aforementioned problems, requirements and proposed methodology.

PROBLEMS	REQUIREMENTS	METHOD
Reusability	Reuse portfolios for scaffolding	Article retrieval
Readability	Reorganize portfolios	Concept-based mapping
Recognizability	Represent portfolios for answering questions	Vector space model

Table 1: Relations between problems and methods.

Illustrative Example and Article Retrieval

We assume that there are seven vocabularies in a specific domain, including "factors", "distance", "human", "portfolio", "collaboration", "learning", and "system". If a learner asks "Please tell me about collaboration in distance learning systems", the question will be transferred to the 7-dimensional vector as follows:

$$q = [0 \quad 1 \quad 0 \quad 0 \quad 1 \quad 1 \quad 1]$$

where q denotes the question. The terms in q are determined by whether the vocabularies appear in q or not. The question will become a *dangling* question if there is no answer to the question after a few days.

Suppose there are three learners' discussion articles, denoted as d_1, d_2, and d_3. Discussion article d_1 contains "distance", "portfolio", "collaboration", "learning", and "system" vocabularies. Hence, the 7-

dimensional vector for d_1 is as follows:

$$d_1 = [0 \quad 1 \quad 0 \quad 1 \quad 1 \quad 1 \quad 1]$$

Suppose discussion article d_2 contains "factors", "distance", "human", "learning", and "system"; while discussion article d_3 contains "factors", "human", and "collaboration". Similarly, these two discussion articles are denoted as follows:

$$d_2 = [1 \quad 1 \quad 1 \quad 0 \quad 0 \quad 1 \quad 1]$$
$$d_3 = [1 \quad 0 \quad 1 \quad 0 \quad 1 \quad 0 \quad 0]$$

To determine whether an article is a suitable answer to a dangling question, a dot product of the dangling question vector and each document vector is made. The document, with the highest result number, will be the answer to the dangling question. The $q \cdot d_i^T$ of d_1, d_2, d_3 is 4, 3, 2 respectively. Consequently, discussion article d_1 is retrieved to answer the dangling question.

The above method, though feasible, also causes some difficulty. First, the matching process may cost expensively because there are many accumulated discussion articles. An alternative is to cluster the discussion articles with the same *concept* into the same category. Second, the previous method determines the relevance degrees between a question and accumulated discussion articles by shared words. However, there is a vocabulary gap problem in retrieving discussion articles. The vocabulary gap problem means that two discussion articles may be related in concept but there may be no shared words. Consequently, a concept-based methodology is crucial for solving the vocabulary gap problem by vocabulary transformation.

Concept-Based Mapping Method

The goal of answer retrieval is to post a discussion article in prior learners' portfolios to a learner's question. The basic problem is how to determine the relevance of a discussion article in portfolios to a learner's question. In other words, this is a problem of relevance ranking of the discussion articles in portfolios. Once the discussion articles are retrieved with respect to a question, they can be ranked according to a relevance score. However, the vector representation of a discussion article does not indicate how the discussion articles can be arranged by a relevance score. In other words, the vector representation of a discussion article does not consider the learning requirements of a novice, which depends on the learning domain and concept.

To determine the relevance score of discussion articles to a learner's question, there should be a ranking method that is based on the conceptual similarity, rather than on words shared by the question and the retrieved answer. This method cannot assume that there is any shared vocabulary between the learners' questions and the discussion articles. Figure 1 illustrates an example of representing the discussion articles as a matrix. We use four discussion articles, each with its own set of concepts. There are two matrices, A and B, used to represent the concept mapping process. A row in matrix A means a discussion article and the words contained in the discussion article. The rows of matrix B are sets of concepts for each discussion article. We use w_i to denote the weight of a word because there are many methods for determining the weight of each word, for instance, binary weight, within-document word frequency, and inverse document frequency (Salton, 1989).

Discussion article 1. "distance" and "learning" □ contains Concept {c1, c3}
Discussion article 2. "human" and "factor" □ contains Concept {c1}
Discussion article 3. "portfolio" and "system" □ contains Concept {c3}
Discussion article 4. "collaboration" and "system" □ contains Concept {c2}

Word	**Weight**	**Concept category**
T1. Factors	w1	c1. Human factor in distance learning
T2. Distance	w2	c2. Collaborative learning
T3. Human	w3	c3. Portfolio system for distance learning
T4. Portfolio	w4	
T5. Collaboration	w5	
T6. Learning	w6	
T7. System	w7	

Matrix A is $\begin{array}{r} \\ Article1 \\ Article2 \\ Article3 \\ Article4 \end{array}\!\!\begin{array}{c} \begin{array}{ccccccc} T1 & T2 & T3 & T4 & T5 & T6 & T7 \end{array} \\ \begin{bmatrix} 0 & w2 & 0 & 0 & 0 & w6 & 0 \\ w1 & 0 & w3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & w4 & 0 & 0 & w7 \\ 0 & 0 & 0 & 0 & w5 & 0 & w7 \end{bmatrix} \end{array}$, representing accumulated discussion articles by relationship between articles and words.

Matrix B is $\begin{array}{r} \\ set1 \\ set2 \\ set3 \\ set4 \end{array}\!\!\begin{array}{c} \begin{array}{ccc} C1 & C2 & C3 \end{array} \\ \begin{bmatrix} 1 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \end{array}$, representing the concepts of a discussion article.

Figure 1: The matrix representation for the concept-mapping process.

Figure 1 depicts how to represent a discussion article with vocabulary (words) by matrix A and the concepts of a discussion article by matrix B. Hence, the concept-based mapping method can be implemented without shared words if the "magic" matrix F can be computed to transfer matrix A to matrix B. Now we are ready to find a matrix F that can be used to determine the relevance scores between the question and discussion articles by concept similarity. Theoretically, the problem is exactly like finding the Linear Least Squares Fits (LLSF) between matrix B and matrix F□A. Under this assumption, the LLSF method can provide a conceptual-based transformation of the original words of a question into the vocabulary of discussion articles in portfolios (Yang and Chute, 1993).

Definition: The LLSF problem is to find a matrix $F_{l\times n}$ that minimizes the sum of residual squares

$$\sum_{i=1}^{m} \left\| F\vec{a}_i^T - \vec{b}_i^T \right\|_2^2 = \left\| FA^T - B^T \right\|_F^2$$

where

$A_{m\times n}$ and $B_{m\times l}$ are given matrices representing the training pairs;

A^T and B^T are the transposes;

$\vec{a}_i$ and $\vec{b}_i$ are the ith pair in the training set;

$\|\cdots\|_2 = \sqrt{\sum_{j=1}^{l} v_j^2}$ is a vector 2-norm of an $l \times 1$ vector, and

$\|\cdots\|_F = \sqrt{\sum_{i=1}^{m}\sum_{j=1}^{l} M_{ij}^2}$ is the Frobenius matrix norm of an $l \times m$ matrix.

The LLSF problem was proven to have at least one solution. The singular value decomposition (SVD) method is often used to solve the LLSF problem. (Lawson and Hanson, 1974; Golub and Van Loan, 1989)

The intuitive meaning of the solution of the LLSF problem is to find an matrix *F* that can be used to measure the "distance" between a learner's question and a discussion article in previous learners' portfolios. Because the matrix F is derived from discussion articles of some classes, the matrix F is trained to assign properly a question to a set of discussion articles. The scenario may be as follows. A learner asks a question a few days ago and no one answers or follows his/her question. Then, the system uses the matrix F to find some related discussion articles from prior learners' portfolios as answers to the learner's question. Finally, the system asks the learner whether he/she is satisfied with the retrieved discussion articles or not. If he/she is satisfied with the retrieved discussion articles, the methodology works. If not, the system will notify a teaching assistant of the case. The teaching assistant will answer the learner's question or manually seek for some related discussion articles. Then, the system will retrain/derive the matrix F so that it can solve a similar case in future.

Hence, the system or the agent can reorganize the discussion articles according to the similarity between the transformed question and the concepts of discussion articles for a relevance order to choose a most suitable article in a suitable concept as the retrieved answer. Then, we can solve the *readability* problem by reorganizing the prior learners' discussion articles in a concept-based style.

The Relevance Ranking in Concept Vector Space

As the illustrative example demonstrates, every discussion article is viewed as an n-dimensional vector space in the concept vector space. Hence, a dangling question should be represented as an n-dimensional vector in the concept vector space before the system begins to find the suitable article. Then, an n-dimensional vector matching operation can be used to compute the similarity between a discussion article and a dangling question. Let d_j denote the j-th discussion article and q refer to the dangling question in concept vector space, $\vec{q} = (F\vec{x}^T)^T$. The system uses the following formula to compute the similarity in the concept vector space.

$$similarity(d_j, q) = \frac{\sum_{i=1}^{n} (td_{ij} * tq_i)}{\sqrt{\sum_{i=1}^{n} td_{ij}^2 * \sum_{i=1}^{n} tq_i^2}}$$

where

td_{ij} means the i[th] vocabulary in the vector for the discussion article d_j,

tq_i means the i[th] vocabulary in the vector for the dangling question, and

n means the number of vocabularies in the learning domain.

The vector space model has been proved useful in many experiments at Harvard University and Cornell University (Salton and McGill, 1983; Salton and Buckley, 1988). Learners' question will not be dangling any more if there is any prior learners' discussion articles related to the concepts of his/her question by the similarity in the concept vector space. Figure 2 illustrates the framework of our methodology.

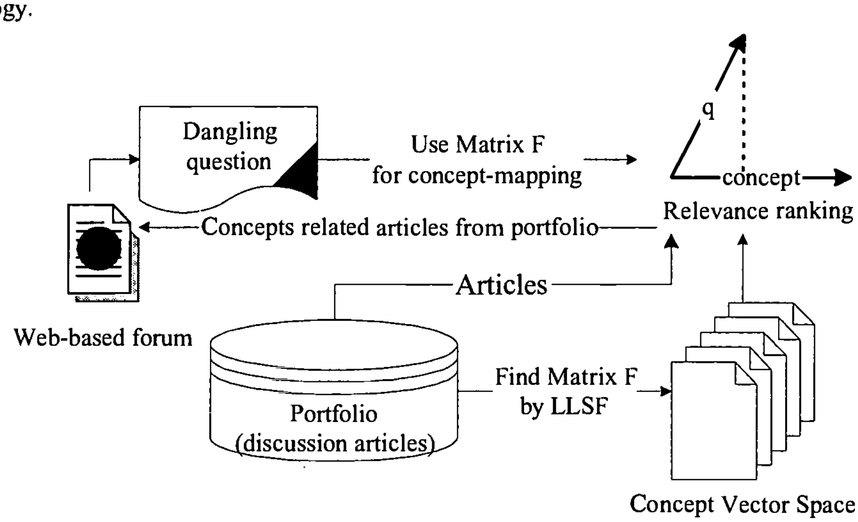


Figure 2: The framework of the concept-based transformation to answer dangling question.

Conclusion

This paper proposes a methodology for reusing the discussion articles of learners' portfolio by a vector space model. Since the Web-based forum has accumulated many discussion articles after years, an instructor may expect all learners in a new class to benefit from prior learners' discussion articles. Because an instructor providing a Web-based, asynchronized forum for his/her course becomes continual, the "concept-based" text retrieval methodology to quick search topics and scaffold learners by prior learners' learning experience becomes crucial. Consequently, the relations between the discussion articles of different class (with the same course) should be constructed.

This paper uses the information retrieval technology to retrieve a most suitable discussion article as the answer of a learner's dangling question. Consequently, a learner need not review all prior learners' discussion articles but can still benefit from the prior learners' discussion articles. Most important of all, the Web-based discussion portfolios not only can play the passive role in the Web-based distance learning research, but can also serve an active role by answering dangling questions. Hence, the forum will be full of suggestions that answers dangling questions from the perspective based on the prior learners' Web-based discussion portfolios.

References

Chang, C.K. and Chen, G.D. (1998) Learning flow and portfolio management for collaborative learning on the Web. *International Journal of Educational Telecommunications (IJET)*, Vol. 4, No. 2/3, 171-196.

Chang, C.K., Chen, G.D., and Ou, K.L. (1998) Student portfolio analysis by data cube technology for decision support of Web-based classroom teacher. *Journal of Educational Computing Research*, Vol. 19, No. 3, 307-328.

Hartley, R., & Pilkington, R. (1988). Software tools for supporting learning: Intelligent on-line help systems. In P. Ercoli & R. Lewis (Eds.), *Artificial intelligence tools in education*, 39-65. Amsterdam: Elsevier Science.

Lawson, C.L., and Hanson, R.J. (1974). *Solving Least Squares Problems*. Prentice-Hall, Englewood Cliffs, N.J.

Pilkington, R.M. (1991). *Intelligent help: Communicating with knowledge-based systems*. London: Paul Chapman.

Rekkedal, T. (1983) Written assignments in correspondence education: Effects of reducing turnaround time. An experimental study. *Distance Education, 4(2)*, 231-252.

Salton, G. (1989) *Automatic Text Processing: The Transformation, Analysis, and Retrieval of Information by Computer*. Addison-Wesley, Reading, Mass.

Salton, G., and Buckley, C. (1988) "Term-Weighting Approaches in Automatic Text Retrieval," *Information Processing and Management*, 24(5), 513-23.

Salton, G., and McGill, M. (1983) *Introduction to Modern Information Retrieval*. New York: McGraw-Hill.

Wiggins, G. (1993) *Assessing student performance: Exploring the purpose and limits of testing*. New York: Jossey-Bass.

Yang, Y., and Chute, C.G. (1993) An application of least squares fit mapping to test information retrieval. *Proceedings of the 16th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*. ACM, New York, 281-290.

VirtUOS: A Multi-user Desktop VR Environment for Experiential, Simulation-Oriented Learning

Yam San Chee
School of Computing, National University of Singapore
3 Science Drive 2, Singapore 117543
cheeys@comp.nus.edu.sg

Yong Bing Khoo
School of Computing, National University of Singapore
3 Science Drive 2, Singapore 117543
khooyb@comp.nus.edu.sg

Abstract: In recent years, there has been a worldwide trend toward greater integration of technology use in teaching and learning. There has also been a concomitant shift away from traditional teacher-centered instruction towards interactive, peer tutoring, collaborative group learning, and global education. By leveraging off the dissemination of technology, we have developed a system that allows multiple geographically remote learners to participate simultaneously in a simulation-oriented VR-based collaborative learning environment. Virtual environments allow users to participate in experientially-grounded simulation environments and support the exploration of activities that may be impractical to perform in real life. Moreover, users can benefit from mutual tutoring and interactions with experts.

Our system development work is based entirely upon open standards. For this reason, the system is called *VirtUOS* (**Virt**ual Reality Learning Environment **U**sing **O**pen **S**tandards). Adherence to open standards ensures that the system is portable across hardware platforms thus benefiting a wide range of users.

Introduction

The use of desktop virtual reality (VR) to support learning presents educational technologists with exciting opportunities as well as significant challenges that need to be overcome. Desktop VR is ideally suited to use in domains that benefit from the use of simulation, experientially-grounded learning, and socialized learning. However, desktop VR systems have traditionally been realized by various commercial organizations using their own proprietary technologies and file formats. In view of this, we have developed a desktop VR learning system directed at supporting collaborative learning in a simulation-oriented environment. The objective is to allow learners to learn collaboratively in real time by sharing learning experiences as well as by articulating and refining conceptual ideas related to these learning experiences. In line with developments in the VR field, our system moves beyond the first generation of navigation-oriented VR to the development of interactive VR, where interactions with virtual world objects give users richer learning experiences.

Theoretical Underpinnings

Constructivist theory is perhaps the most widely accepted pedagogical standpoint adopted by teachers today. Constructivism views the student "as one who acts on objects and events within his or her environment and thereby gains some understanding of the features held by the objects and events" (Boger-Mehall). Constructivism suggests that people make significant progress when they collaborate. Moreover, mutual tutoring, shared visions, and collaboration produce substantial impetus to learning. The Internet makes this collaboration process convenient and viable. However, as McKenzie (1997) points out, technology does not remove the need for traditional sources of knowledge. Studies by Strommen (1992) also show that technology is a completing augmentation rather than a competing aggravation.

A constructivist orientation requires the adoption of a fresh perspective on technology. Instead of viewing computers as a knowledge presentation device, we should view them as tools for supporting a pedagogical focus on communications in collaborative learning ventures (Koschmann et al., 1993). If we are able to bring a group of people together to interact in a model of a real environment, then we also have a tool for constructivist learning. Imagine a music composition class where the students can compose music and present their individual works to the rest of their class in a virtual mode. Or perhaps a chemistry class where students can mix chemicals and test chemical reactions in the safety of a virtual chemistry laboratory.

Gagnon and Collay (1996) posit that a successful Constructivist Learning Design (CLD) should provide familiar environments that reflect the thinking processes of the participants; in such environments there must be trust and public sharing of knowledge in this environment. Moreover, the Across-Schools Pedagogy Issues group (Koschmann et al., 1993) endorses the "necessity of large-area networks for particular contexts, instructional goals, and learner characteristics." Injecting constructivism into the educational system culminates in a revolution, from planning for teaching to designing for learning (Gagnon and Collay, 1996). Fosnot (1996) rightly asserts that the "key to reinventing our educational system . . . lies in what our teachers believe about the nature of knowing."

Working within the constructivist paradigm, we have developed a system that creates virtual environments where users can perform experiments and experience simulations in support of collaborative on-line learning. In such environments, users can engage in experiments that may be expensive or even dangerous to perform in real life. Our system supports user interactions that facilitate mutual tutoring and knowledge sharing. The system can be used by academic institutions that offer courses through distance learning, or it may be used as a complementary form of on-line collaborative learning in on-campus education. In particular, such institutions can conduct laboratory classes with visual demonstrations and presentations in real-time. The system can also be used to give guided tours of museums, art galleries, and show rooms of new houses.

Research Focus

There have been several attempts to create similar VR environments. We reviewed four representative systems among these applications. The first system, *VR for Learning* (Lim, 1997), is limited in that it does not store its world data in a database. Moreover, avatars are static and non-standard, and they *float* in virtual worlds rather than *walk*. The second system that we reviewed is *Active Worlds*. This proprietary-standard virtual world browser has a remarkably fast response time. However, this fast response time is achieved at the price of only supporting avatars that are more coarsely defined. The third system, *Community Place*, is designed to be scalable to support many "geographically dispersed users, interconnected through low bandwidth, high latency communication links". However, *Community Place* separates the chat and whiteboard windows from the virtual world navigation window. This separation increases the semantic distance between the different components of the system. The final system, *blaxxun*, has the advantage of using Humanoid Animation 1.0 (HANIM, Roehl, 1997) compliant avatars. However, *blaxxun*'s avatars float instead of walk. While the avatars move very quickly, realism is compromised.

In order for our system to benefit as many users as possible, we implemented our work using open standards. Our system uses a third-party virtual world browser, *Cosmo Player*. The other components of the system are implemented in Java. Hence our sytem is portable to hardware platforms that support the virtual world browser. Moreover, the system is designed to support a large number of users while maintaining reasonable performance.

Given that we wanted to help users participate in learning environments and not in learning how to use the system, considerable attention was given to designing an engaging interface that would make the system pleasurable to use. A pleasant experience will attract users back to the virtual learning worlds, resulting in more experiential learning and familiarity with the learning context.

Our system moves away from traditional navigation-oriented VR to interactive VR that enriches users' learning experiences. In *VirtUOS*, virtual object states are modified by manipulating components of these virtual models directly. Each object has unique behaviors and properties, or is able share behaviors and properties with other similar objects. This concept is similar to Object Oriented Programming where each object has its own variables and methods. *VirtUOS* processes new object states and updates virtual worlds accordingly. By storing object states, users can collaborate in discussions that span several login sessions. Moreover, *VirtUOS* models avatars realistically in that they no longer *float* around virtual worlds. Instead, the avatars perform life-like *walking* motions as users navigate in virtual worlds. Avatars are instrumental for promoting user interactions because they allow users to establish presence in virtual worlds by simulating the sense of "being there."

System Design

Our design considers the database, avatar animation, object interaction, and user interface aspects of the system. A database is needed to provide storage and retrieval of virtual world states. Avatar animation is desirable because it increases the realism of virtual worlds. Moreover, interaction with virtual world objects is necessary to give users a rich learning experience. Furthermore, users should be able to use the system without any training or instruction.

Given that *VirtUOS* is targetted at Internet users, we use VRML to model our virtual worlds and objects. In a traditional VRML environment, the states of virtual worlds are not maintained. Hence, objects appear at their same default locations every time users log in afresh. Users also always enter a world at the same location regardless of where they were when they last logged off. Lim's system (Lim, 1997) simulates a database using Java. But the database does not exist on a persistent medium or in a form that can be queried and updated using standard commands (such as SQL statements). Furthermore, Lim's system has to explicitly consider concurrency control issues that are inherently taken care of in a database environment. As we believe that there is no reason to re-code a SQL database, we make use of the comprehensive set of functions provided by Java that standardizes database access.

The design of our world objects to provide object behaviours requires our system to be able to encapsulate avatar (and any virtual object in general) animations, behaviours, and properties as though they are Object Oriented classes. Hence, it is necessary to have a standard structure for representing an avatar. *VirtUOS* uses the Humanoid Animation 1.0 (HANIM) standard (Roehl, 1997). HANIM 1.0 is an extension of the VRML 2.0 standard that defines the scene graph of any humanoid VRML model. Standard avatar structures allow animations, behaviours, and properties to be reused by all other avatars. Each avatar has its own instantiation of the animations, behaviours, and properties. Moreover, shared animations need to be downloaded only once from the web because Internet browsers cache downloaded documents. Subsequent accesses (within the same browser session) are read from cache.

The plethora of possible objects in a virtual world makes it impossible to define a rigid structure for the VRML representations of arbitrary objects. However, it is possible to characterise the common attributes (e.g. position and orientation) while letting the other attributes be object specific. For example, batteries, resistors, and bulbs have position, orientation, and resistance attributes (and associated "methods" to *get* and *set* the attributes). But only batteries have a voltage attribute, and only bulbs have a *power* attribute and a *set* method. The power attribute indicates the power that the bulb is designed for, and the *set* method is used to tell the bulb the amount of power that the circuit is supplying it with.

The design of the user interface must ensure that the system is engaging and pleasurable to use. Moreover, the interface should be simple enough for users to use without any prior training or instruction. It is difficult to provide users with an extended user interface, e.g. popup menus for interacting with virtual objects, because the system makes use of a third-party application, such as *Cosmo Player* or *Cortona*, as the VRML browser. Consequently, there are no easy means of extending the user interface of the browser to support interactions between users and virtual objects. In our system, *Cosmo Player* is chosen as the browser for *VirtUOS* because it is better established than newer browsers such as *Cortona*.

Functional and Performance Requirements

In this section, we set out the functional and performance requirements that our system is designed to support. Most of the functional requirements that we propose are desirable for enhancing the realism of virtual worlds and providing a rich learning experience. On the other hand, the performance requirements are directed at supporting virtual world interactions realistically with minimal latency.

Functional Requirements

Our system has been designed to support the following functions:

- Allow users to change their avatar representations and to reflect these changes on all other clients.
- Allow the storage of virtual world states and the restoration of these states when users log in afresh. This feature facilitates the building of complex virtual structures spanning several sessions.
- Allow animated avatars that walk instead of float. The system also allows users to walk in arbitrary step sizes and directions. Users need not walk in full steps, nor is the walking restricted to moving forward.
- Allow users to navigate by using the cursor keys/mouse to interact with a virtual world browser. The system should not use navigation controls outside of the virtual world because users may have difficulty mapping such controls to the virtual world.
- Allow different actions to be associated with an avatar with minimal changes to the system. This would free us from making significant modifications to the system when we include experiments requiring new avatar behaviors.
- Ensure concurrency control over virtual objects that users can manipulate. The system should not allow two or more users to update an object at the same time in order to maintain consistency of virtual worlds across all users.
- Allow the alignment of virtual objects that users can manipulate by snapping to a grid. This "forcing function" frees users from having to manage minute details of object orientations and positions.

- ❑ Provide a user interface to support object interaction. The interface provided by *Cosmo Player* allows only mouse clicks and dragging actions. However, some simulations need to support several actions that depend on users' choices. Hence, it is necessary to extend *Cosmo Player*'s user interface to circumvent this restriction.
- ❑ Allow users to hide the avatars of other users whom they do not wish to see. Users can also use this function to speed up the system when too many users are logged on simultaneously.

Performance Requirements

It is desirable for the system to meet the following performance requirements:

- ❑ Virtual world updates should be propagated fast enough to all clients so that users can interact with one another in real-time.
- ❑ The rendering process should take less time when avatars are hidden.
- ❑ The system is expected to run on Pentium II PCs with at least 32MB RAM.

System Description

This section is divided into two parts. First, we describe our system by means of a simulation-oriented virtual world model that we have created. In this description, we present a typical scenario of how users learn collaboratively using our system. Second, we discuss the technical innovations in the development of our system.

Simulation-oriented Collaborative Learning

VirtUOS is capable of supporting multiple virtual worlds. Each world has its own learning goals and users can teleport between these worlds. Figure 1 (Fig. 1) shows a screen snapshot of *VirtUOS* viewed through *Netscape 4.5* and *Cosmo Player 2.1*. The *Chat* client and *Multi-user* client are displayed at the bottom left and bottom right of the virtual world respectively. The HTML display on the right hand side of the *Netscape* window explains the goals of the virtual world that *Cosmo Player* displays.

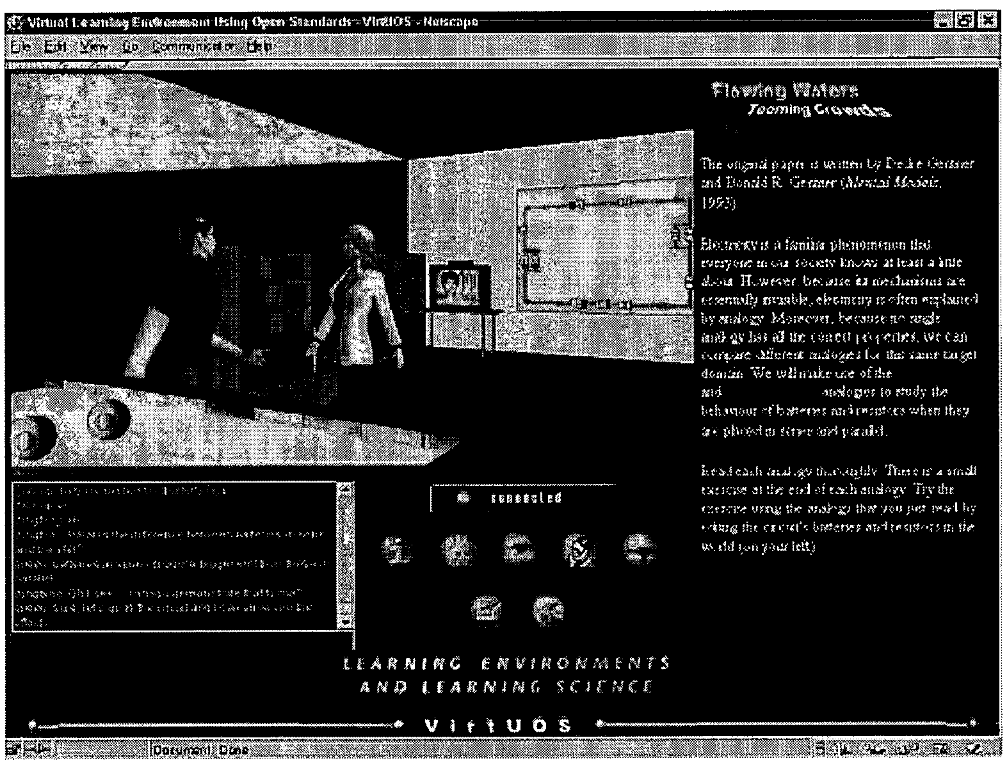


Figure 1: Screen capture of *VirtUOS* learning environment

One particular world in our implementation uses the flowing waters and teeming crowds analogies (Gentner and Gentner, 1983) and colliding billiard balls (Humphrey and Topping, 1949) to demonstrate the system's ability to support collaborative learning. We built a virtual electrical circuit that contains several batteries, resistors, and a bulb in a virtual physics laboratory. The background information on the right of the virtual world describes the flowing waters and teeming crowds analogies. Users are asked to predict and compare the effects of the circuit using the analogies when batteries and resistors are placed in series and parallel on the circuit. In addition, users can use the virtual VCR (shown on the left side of the virtual circuit in Figure 1) to view MPEG movies that demonstrate the tasks that the experiments require them to perform. The virtual VCR plays any MPEG movie indicated by a URL input by the user into a system dialog when the VCR is clicked upon.

In order to make our virtual laboratory more engaging, the system plays soothing spatialized background music. Our system also provides audio feedback when users interact with the virtual circuit components and with the billiard balls.

Users can manipulate batteries and resistors of the virtual circuit directly by dragging and dropping the components using the mouse. Our system prompts users for the orientation of the components in the circuit by using a popup menu. The orientation is not set automatically because orientations of components serve as valid learning goals as well. Batteries that are placed in opposite directions cancel out the voltages of one another. On the other hand, resistors produce the same resistance even when they are placed in opposing directions. However, when either batteries or resistors are placed perpendicular to the wire of the circuit, they are disconnected from the circuit. Hence, they do not contribute to the overall voltage and resistance in the circuit.

While some users are performing these battery and resistor arrangements, other users can comment on their progress. Futhermore, users can collaborate in the circuit building process. Users who are more proficient can help others by sharing knowledge and understanding with the weaker users. The text chat facility allows participants to engage in collaborative knowledge building activities. Consequently, teaching becomes more participative and distributed across users.

The second simulation in this virtual world investigates impulsive forces using colliding billiard balls. *VirtUOS* allows users to modify the friction and restitution between billiard balls and the billiard table as well as the maximum initial force applied to a billiard ball. The ease with which users can change these environmental parameters is impossible in real life. For example, it is unlikely to find tables and billiard balls with zero frictional force. It is similarly difficult to find such a setup with zero restitution. Moreover, unless experimenters are expert billiard players, it is difficult to hit billiard balls squarely at the center of gravity all the time. Although hitting billiard balls off the center of gravity can be another modifiable parameter, uncontrolled variations of such parameters are likely to impede users' investigations of simulations that they choose to focus on (such as the conservation of momentum).

Users can vary the initial force acting on a billiard ball by holding onto the ball. The length of time is used to estimate the initial force proportionately with respect to the maximum force. Hence, clicking (and holding) onto a ball for a longer period will cause the ball to have a higher initial speed compared to clicking (and holding) onto a ball for a shorter period.

We intend to conduct empirical evaluations on users in order to determine the usability and effectiveness of our system. These evaluations will include the time taken for users to be familiar with the system, the amount of knowledge retained from virtual world learning experiences, and the willingness of users to use our system repeatedly.

Technical Innovations

In supporting the shift from navigation-oriented to interaction-oriented VR, we achieved the following:

- Encapsulation of object behaviours in VRML. Object behaviours are created separately from the objects that use the behaviours. As a result, these behaviours can be shared among many objects at the same time. An example of shared behaviours is the walk animation. Avatars in *VirtUOS* walk instead of float in virtual worlds. All avatars share the same walk animation behaviour.
- User-interface support for object interactions. *VirtUOS* extends the user-interface of *Cosmo Player 2.1* by adding popup menus. These menus are displayed as VRML objects rendered by Cosmo Player in virtual worlds.
- *VirtUOS* provides database access for VRML objects. *VirtUOS* uses the database to store and retrieve virtual world states. These states are updated as users interact with virtual worlds.
- *VirtUOS* provides network support for VRML objects. The system enables VRML events to be propagated to clients over the Internet hence allowing other clients to reflect changes to virtual world states.
- Concurrency control for object manipulations. *VirtUOS* uses a database to provide concurrency control so that only one user can update a virtual object at a time.

Conclusion

VirtUOS supports collaborative learning through simulated virtual environments. These virtual environments allow users to actively participate in collaborative activities. Users can accelerate their learning processes by engaging in mutual tutoring and knowledge sharing through the virtual environments that *VirtUOS* provides.

VirtUOS extends the existing user interface of *Cosmo Player* so that users can interact with virtual objects. For example, *VirtUOS* displays a popup menu that can be used to control the orientation of virtual objects. Because popup menus are not part of *Cosmo Player*'s virtual world representation, we developed this functionality.

There are four possible future enhancements to our work. First, in order to increase system efficiency, we plan to partition virtual worlds so that only visible portions of the worlds are updated on every client computer. Second, it is desirable to exploit users' hearing as an alternative perception channel. Consequently, the system should be able to receive audio input from users and propagate that to other users. Third, *VirtUOS* does not currently indicate which user is moving a virtual object. Hence, there is a detached feeling when other users see non-living objects move on their own. The system should show users holding or pushing the objects that the users are moving. Fourth, the system should allow users to manipulate virtual world objects more directly. The current implementation of our system uses a popup menu for interactions between users and virtual objects.

In summary, our work deals with the synthesis of technology and learning by using desktop VR to facilitate experientially-grounded collaborative learning. Neither component replaces the other; rather, the two complement each other. The ongoing rapid evolution of various VRML standards such as DIS (Brutzman, 1998), HANIM, and External Authoring Interface (EAI), means that *VirtUOS* has to be maintained and updated constantly to be up-to-date with the open standards. Fortunately, the highly modular design of *VirtUOS* makes the system readily modifiable to conform to new standards. Using *VirtUOS*, we are attempting to reach out to a global community of learners to collaborate in the exciting new world of VR-based constructivist learning.

References

Brutzman, D. (1998). Distributed Interactive Simulation DIS-Java-VRML Working Group. http://www.stl.nps.navy.mil/dis-java-vrml/

Boger-Mehall, S.. Behaviorist and Constructivist Theories. http://www.coe.uh.edu/~smehall/theory/construct.html

Fosnot, C. (1996). *Constructivism: Theory, Perspectives, and Practice.* New York: Teachers College Press.

Gagnon, G. W. Jr., & Collay, M. (1996). Teachers' Perspectives on a Constructivist Learning Design. http://www.prainbow.com/cld/clds.html

Gentner, D., & Gentner, D. R. (1983). Flowing waters or teeming crowds: Mental models of electricity. In Gentner, D. and Stevens, A. L. (ed.), *Mental Models*. pp. 99-129, Lawrence Erlbaum.

Humphrey, D. and Topping J. (1949). *A Shorter Intermediate Mechanics*. Longmans, Green and Co.

Koschmann, T., Newman, D., Woodruff, E., Pea, R., & Rowley, P. (1993). Technology and Pedagogy for Collaborative Problem Solving as a Context for Learning: Report on a CSCW '92 Workshop. *ACM SIGCHI Bulletin, 25* (4), pp. 57-60.

Lim, K. P. E. (1997). *VR for Learning*. National University of Singapore, Department of Information Systems and Computer Science.

McKenzie, J. (1997). In Defense of Textbooks, Lectures and Other Ageing Technologies. *From Now On: The Educational Technology Journal, 6* (8), http://www.fromnowon.org/may97/defense.html.

Roehl, B. (1997). Specification for a Standard VRML Humanoid Version 1.0. http://ece.uwaterloo.ca:80/~h-anim/spec.html

Strommen, E. F. (1992). Constructivism, Technology and the Future of Classroom Learning. Bank Street College of Education. http://www.ilt.columbia.edu/k12/livetext/docs/construct.html

PATTERNS OF LEARNER-LEARNER INTERACTION IN DISTANCE LEARNING NETWORKS

C. Candace Chou
Interdisciplinary PhD Program in Communication and Information Sciences
University of Hawaii
Honolulu, Hawaii 96822
chou@hawaii.edu

Abstract: This study examines the different patterns of online interaction between asynchronous communication and synchronous communication networks. Discussion transcripts were analyzed and coded using Bale's Interaction Process Analysis (IPA) model (revised and expanded version). The preliminary findings showed significant differences in the interaction between social-emotional and task-oriented contents. There was a higher percentage of social-emotional oriented interaction in synchronous communication. Whereas in asynchronous communication mode, a significantly higher percentage of online interaction were task-oriented. Furthermore, asynchronous discussion appeared to be mostly one-way communication and synchronous discussion showed evidence of two-way communication.

INTRODUCTION

Computer-mediated communication (CMC) systems have become an integral part of distance learning. Distance courses are conducted over CMC systems and learners interact with instructors or peers through computer conferencing. Studies on interaction over CMC networks have provided educators and researchers information on learners in terms of both intellectual growth and social development. Research findings on how interaction contributes to intellectual growth such as knowledge construction (Gunawardena, 1997), academic achievements (Hartman et al, 1995), and critical thinking (Newman, Webb, & Cochrane, 1995) indicates that cognitive development can be achieved over distance learning networks. Research on the social aspect of interaction also furthers the understanding of learner behaviors and dynamics in distance education (Johanson, 1996; McDonald & Gibson, 1998).

The majority of research on learner interaction was conducted over asynchronous computer networks which are the primary media for distance education (Lewis et al., 1999). Few studies have been done on learner interactions in a synchronous communication network and even fewer research projects have been designed to compare both synchronous and asynchronous communication. Factors such as difficulty in coordinating meeting time, high cost in good quality synchronous communication technology, and tool stability may explain the under-utilization of synchronous CMC systems. Nevertheless, with the improvement in CMC technology and more affordable tools available, synchronous conferencing systems have become more common in distance learning environments.

The problems of the previous research can be summarized as follow: a). lack of long-term study: most of the research uses previously unacquainted participants and short-lived group; b). lack of study on synchronous interaction: much emphasis has been placed on interaction over asynchronous communication networks; and c). lack of study on the comparison of asynchronous and synchronous interaction.

Moore (1989) defines three types of interactions in distance education: learner-content interaction, learner-instructor interaction, and learner-learner interaction. A comprehensive understanding of each type of interaction can help educators better plan learning activities and make use of the CMC technology for maximum effectiveness. Most of the research on online interaction draws conclusions from studies on asynchronous communication networks, e.g. electronic mail, listserv, web-based bulletin, BBS, etc. Little research has been conducted over synchronous networks. What are the nature and patterns of synchronous interactions? To what degree can learner interactions over synchronous learning networks contribute to learning? It is the purpose of this proposed study to examine learner-learner interactions in a collaborative online learning environment. The objectives for this study are:

1. To identify the patterns and developments of learner interactions over time, especially on task-oriented versus social-emotional oriented content;
2. to determine if there is a difference in the interactions when learners assume the roles of moderators and participants; and
3. to compare learner-learner interactions between synchronous and asynchronous communication networks.

LITERATURE REVIEW

Learners' abilities to interact with the instructor, the peers, and the content can affect their performance in distance learning. Acker and McCain (1993) state that "interaction is central to the social expectations of education in the broadest sense and is in itself a primary goal of the larger educational process and that feedback between learner and teacher is necessary for education to develop and improve" (p. 11). Online interactions take into consideration the characteristics of the learners as well as the communication technology. The interactive features of the current CMC systems, such as two-way video and instant feedback, have provided more options for learner interactions. Gunawardena (1998) interprets interaction as "the process through which negotiation of meaning and co-creation of knowledge occurs in a constructivist learning environment" (p. 141). Wagner (1998) argues that interaction can serve as a means to an end of enhancing learning and performance.

The design of the learning environments influences the results of learner-learner interactions. Scardamalia et al. (1992) found significant difference in the verbal scores from a Canadian standardized achievement test between elementary students who used Computer Supported Intentional Learning Environments (CSILE) to collaborate with teammates and those who used CSILE for individual study. CSILE is a multimedia learning environment that allows students to collaboratively contribute to one another's learning through co-construction of a knowledge database. As suggested by Martens et al. (1997), interaction is "supported by the user interface that enables the learner to access and manipulate the objects in the knowledge base" (p. 46). Good interface design provides students the opportunities to learn by interaction with their peers.

One should not equate interaction with learning. It depends on whether the goal of an interaction task or activity is for the purpose of enhancing understanding of the subject matter or for improving interpersonal connections. Learner interactions require planning and structure in order to achieve the goal of active learning. Rohfeld and Hiemstra (1995) suggest tasks such as debates, guest lecturers/discussants, polling, brainstorming, or student-moderated discussions via CMC networks to increase student interactions for learning. The principles of student-centered discussion accord the students the responsibilities of facilitating online conversations. The process serves well for both cognitive and affective purposes. On the one hand, the process stimulates intellectual growth and enhances organizational skills; on the other hand, it improves the student connection at the interpersonal level (Paulsen, 1995). When the activities and tasks become an integral part of the learning process, learner interactions can be conducive to learning.

Bales' Interaction Process Analysis (IPA) (1950) has been utilized to examine small group interactions in both face-to-face and CMC groups (Rice & Love, 1987; Sorensen & McCroskey, 1977). IPA consists of twelve categories which fall into two main areas: social-emotional oriented and task-oriented contents. IPA was first developed in 1950 as the result of studies of group processes, e.g. who did what, who spoke to whom, and how interactions developed and changed (Bales, 1950). Bales' IPA describes well the process of interaction and the dynamic in small groups. The twelve categories were modified for this study in order to better described the nature of online interactions. More details will be described in the following section.

RESEARCH DESIGN

RESEARCH QUESTIONS

To further the understanding of online learner-learner interactions, the research questions will address learner interactions in the following areas: learning tasks, learning environments, learner characteristics, and the relationship with learning. The main questions are listed as follows:

A. Learner-learner interactions in social-emotional oriented contents versus task-oriented contents: How do online interactions develop over time in terms of social-emotional versus task-oriented content as outlined in Bales' Interaction Process Analysis? Is this pattern of interaction different between asynchronous communication mode and synchronous communication mode?
B. Learning task: Will role-taking, such as assuming the role of a moderator or a participant, make a difference in online interactions?
C. Learner characteristics: Do learner characteristics such as gender, attitude toward computer networks, experience in using computer, confidence in computer skills, affect the way they interact online?
D. Learning environments: What are the similarities and differences in learner interactions via synchronous and asynchronous networks?

METHODOLOGY

This study used mainly qualitative methodology with the support of statistical analysis program. Content analysis was employed to examine learner-learner interactions and learning. Bales' Interaction Process Analysis (IPA) with minor modifications was used as the basis of content analysis for learner interactions. The procedure was to systematically code student's weekly postings and online seminar transcripts in order to detect the interaction patterns.

The research was carried out by surveying distance learners and analyzing student written data in a ten-week writing-intensive online course titled "Theory and Application of Computer-Mediated Communication." This course was delivered via a courseware called WebCT at the University of Hawaii in 1998. The data include weekly postings in the bulletin board (asynchronous data) and transcripts from a weekly seminar (synchronous data). In the weekly seminar, students met in a chat room in real time to discuss course-related topics from any locations that they could access a computer. Students were divided into five three-member small groups. Each group took turns to moderate one online seminar throughout the whole semester. Two researchers who specialize in instructional design worked on the coding of the data. The software program *QSR NUD*IST* was used for the coding of online transcripts. The unit of analysis was the sentence. A total of 5,015 text units (sentences) from the random sample transcripts were coded. The phi coefficient for intercoder reliability was .80.

Bale's IPA was expanded from 12 categories into a total of 16 categories as shown in table 1. The original 12 categories can be divided into two main areas and four sub-groups. The two main areas are social-emotional contents and task-oriented contents. The social-emotional area consists of two groups: positive reactions and negative reactions. The task-oriented area consists of two groups that are attempted answers and questions. These areas represent the domain of interactions in small group discussions. The categories may not be comprehensive enough to describe the patterns of online interactions but the overall scheme does address most online interaction patterns. In his study on social-emotion interaction over computer-mediated communication networks, Rice (1987) expanded category 6 and 7 into two sub-categories. Category 6 on "gives orientation, information, repeats, clarifies, confirms" was divided into "gives personal information" (socioemotional) and "gives professional information" (task). Category 7 was divided into "asks for professional information" (task) and "asks for personal information" (socioemotional). For this study, category 6 and 7 were furthered divided into three sub-categories: "gives/asks topic-related information" (task), "gives/asks personal information" (socioemotinoal), "gives/asks technical information" (task). After the initial round of coding, the researcher found that the original category 6 and category 7 were too broad to reflect the actual online interaction patterns from the samples used for this study. Technical questions, topic-specific discussions, and personal information exchanges were frequently seen in the synchronous discussions and yet they were missing from the original IPA model. The researcher decided to include these new categories in order to better reflect the patterns of online interactions.

DISCUSSIONS

Coding online transcripts is a time-consuming process. In order to meet the submission deadline of the conference proceedings, only the data for the first research question is available for this report. The author will report the results of the data analysis for the rest of the research questions during the EDMEDIA2000 conference. The revised and expanded version of Bale's IPA is shown in table 1. There were significant differences in online interactions between asynchronous and synchronous communication modes using analysis of variances. In terms of each individual category, the differences were significant in the following categories: category 4 (gives suggestion, $p < .01$), category 5 (gives opinion, $p < .01$), category 7.2 (asks topic-related information, $p < .05$), category 7.3 (asks personal information, $p = .01$), and category 11 (show tension, $p < .05$). In terms of the four sub-areas, i.e. positive reactions ($p = .05$), negative reactions ($p < .05$), attempted answers ($p < .01$), and questions ($p < .01$), the differences were significant. In terms of the two main areas of interaction, both social-emotional oriented contents ($p < .05$) and task-oriented content ($p = .01$) indicate the significant difference between the synchronous and synchronous communication networks (table 2).

A closer look in category 4, 5, 7.2, 7.3, and 11 will provide a better understanding in the different interaction patterns between the two communication modes. First, there was virtually no interaction in category 4 (giving suggestion or direction) in asynchronous discussion mode. The mean sentence in category 4 is 0 for asynchronous discussion and 9.36 (SD: 7.49) for synchronous discussion. Category 9 (asking suggestions) is the counterpart of category 4. The mean sentence for category 9 is 0 too. It is understandable that in asynchronous communication most interactions focus on task-specific discussion and less on social-emotional oriented contents since there was a lack of immediacy. Most students either internalized their attempts to ask for suggestions or email the instructor for advice. The time lag in asynchronous mode may have prevented students from asking or providing suggestions. Interestingly, the mean sentence in category 5 (giving opinions) is 247.33 (SD: 129.1) for asynchronous mode and 62 (SD: 42.05) in synchronous mode. It is a clear indication that in asynchronous mode, participants devoted most of the discussion to task-related discussion and less on social-emotional interaction. Although, there was no interaction in giving/ asking suggestion (category 4 & 9), the interaction in giving/asking opinion (category 5 & 8) was not scarce in asynchronous mode.

Whereas in the synchronous communication mode, student felt it more imperative to ask and receive instruction or direction in order to participate fully. Synchronous communication mode also made it easier to provide immediate feedback to information seekers. The high standard deviation in synchronous interaction also reveals the unequal participation in online discussion. Some students were active in engaging in discussions and some students reserved most of their opinions until they were asked to say something. The researcher observed that when the students were divided into three-member small groups, the participation was more even among members of a small group. In addition, there were more social-emotional oriented discussions in synchronous mode that is indicated in the difference in category 7.3 and 11. In synchronous mode, participants asked more personal questions and revealed their frustration or needs for help without hesitation. Personal questions such as one's occupation, schooling history, professional training were given more "air time" in synchronous discussion.

Table 1: Bale's IPA (revised and expanded)

Code	Category	P value
Social-emotional Area: Positive Reactions		**= .05***
1	Shows solidarity, raises other's status, gives help, reward	= .013
2	Shows tension release, jokes, laughs, shows satisfaction	= .015
3	Agrees, shows passive acceptance, understands, concurs, complies	= .047
Task Area: Attempted Answers		**< .01 ***
4	Gives suggestion, direction, implying autonomy for other	< .01 *
5	Gives opinion, evaluation, repeats, clarifies, confirms	< .01 *
6	Gives orientation, information, repeats, clarifies, confirms	
6.1	Gives personal information (social-emotional)	= .121
6.2	Gives topic-related information	= .248
6.3	Give technical information	= .327
Task Area: Questions		**< 0.1***
7	Asks for orientation, information, repetition, confirmation	
7.1	Asks technical information	= .30

7.2	Asks topic-related information	< .05*
7.3	Asks personal information (social-emotional)	= .01*
8	Asks for opinion, evaluation, analysis, expression of feeling	= .07
9	Asks for suggestion, direction, possible ways of action	= .07
Social-emotional Area: Negative Reactions		**< .0.5***
10	Disagrees, shows passive rejection, formality, withholds help	= .44
11	Shows tension, asks for help, withdraws out of field	< .05
12	shows antagonism, deflates other's status, defends or asserts self	= .48

In comparison of the two main areas in social-emotional oriented content and task-oriented content as shown in table 2, the mean sentence for social-emotional content in synchronous mode (68.18) is significantly higher than that in asynchronous mode (28.67). Task-oriented content consists of category 4, 5, 6.2, 6.3, 7.1, 7.2, 8, and 9. Social-emotional content consists of category 1, 2, 3, 6.1, 7.3, 10, 11, and 12. The breakdown in category 1, 2, and 3 shows that the mean sentence in synchronous mode (40.73, 5.36, 9.64 respectively) is much higher than those in asynchronous mode (7.5, 1.0, 6.5). In synchronous communication mode, there were more interactions in greeting, providing help, joking, and showing agreement. Whereas the mean sentence of task-oriented content in asynchronous mode (307.33) in significantly higher than that in synchronous mode (139.18). Student tended to give their opinions without asking other's opinions. It was done mostly through one-way communication in asynchronous discussion. The mean sentence of category 5 is significantly higher in asynchronous mode (247.33) than in synchronous mode (62.00). The interaction in task-oriented content indicated that in synchronous mode most of the discussions were two-way communication through the acts of providing and asking opinions on course-related subjects.

Table 2: ANOVA table for Social-emotional oriented content vs. task-oriented content

	Asyn. mean	Asyn. SD	Syn. mean	Syn. SD	t-value	F-value	p-value
SE content	28.67	20.81	68.18	39.95	-2.24	5.016	0.041*
TASK content	307.33	159.37	139.18	81.93	2.91	8.48	0.01**

CONCLUSIONS

Studying online interaction can further the understanding of how people communicate over the networks. The main difference between this study and other studies is the focus on the comparison of synchronous and asynchronous communication networks. The preliminary findings highlight the significant differences in both social-emotional oriented interaction and task-oriented interaction between the two communication modes. These differences indicate the very different nature of online interaction in both modes. Educators may want to design activities that will ensure a focused online discussion without diverting to only interpersonal exchanges in synchronous communication mode. Whereas in asynchronous mode, activity design to enhance interpersonal connection may facilitate more two-way communication.

Further analysis on the effects of learner characteristics and learning tasks on interactions and the relationship between interaction and learning will be conducted in the near future. The research findings will contribute to the knowledge base of learner interaction in both synchronous and asynchronous networks. Educators, researchers, and instructional designers working on distance education can all make use of the knowledge to maximize the effectiveness of distance learning.

ACKNOWLEDGEMENTS

The author would like to acknowledge Xun Ge, Kelly Yamashiro, and Jenifer Winter for their assistance in coding the online transcripts and suggestions for this study. Also the author would like to thank Stephen Philion for his support and correction of this report.

BIBLIOGRAPHY

Acker, S. R., & McCain, T. A. (1993). The contribution of interactivity and two-way video to successful distance learning applicatins: A literature review and strategic positioning, *The Center for Advanced Study in Telecommunications* . The Ohio State University, Columbus, Ohio.

Bales, R. F. (1950). *Interaction Process Analysis: A Method for the Study of Small Groups*. Cambridge, MA: Addison-Wesley Press.

Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1998). Transcript analysis of computer-mediated conferences as a tool for testing constructivist and social-constructivist learning theories, *Proceedings: Distance learning '98: The 14th Annual Conference on Distance Teaching and Learning* (pp. 139-145). Madison, WI: University of Wisconsin.

Hartman, K., Neuwirth, C. M., Cochran, C., Palmquist, M., & Zubrow, D. (1995). Patterns of Social Interaction and Learning to Write: Some Effects of Network Technologies. In M. Collins & Z. Berge (Eds.), *Computer-mediated communication and the online classroom* (Vol. 2, pp. 47-78). Cresskill, NJ: Hampton Press.

Lewis, L., Snow, K., Farris, E., & Levin, D. (1999). *Distance Education at Postsecondary Education Institutions: 1997-98*, [Statistical Analysis Report NCES 2000-013). National Center for Education Statistics, U.S. Department of Education, Office of Educational Research and Improvement. Available: http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2000013

Martens, R. L., Valcke, M. M. A., Portier, S. J., Weges, H. G., & Poelmans, P. H. A. G. (1997). Research with interactive learning environments in three content domains: Descriptive statistics, continuous mathematics and substantive criminal law. *Distance Education, 18*(1), 44-58.

McDonald, J., & Gibson, C. (1998). Interpersonal dynamics and group development in computer conferencing. *The American Journal of Distance Education, 12*(1), 7-25.

Moore, M. G. (1989). Editorial: Three types of interaction. *The American Journal of Distance Education, 3*(2), 1-6.

Newman, D. R., Webb, B., & Cochrane, C. (1995). A content analysis method to measure critical thinking in face-to-face and computer supported group learning. *Interpersonal Computing and Technology: An Electronic Journal for the 21st Century, 3*(2), 56-77.

Paulsen, M. F. (1995). Moderating educational computer conferences. In Z. L. Berge & M. P. Collins (Eds.), *Computer-mediated communication and the online classroom, volume three: distance learning* (pp. 81-89). Cresskill, NJ: Hampton Press.

Rice, R. E., & Love, G. (1987). Electronic Emotion: Socioemotinal Content in a Computer-Mediated Communication Network. *Communication Research, 14*(1), 85-108.

Rohfeld, R. W., & Hiemstra, R. (1995). Moderating discussions in the electronic classroom. In Z. Berge & M. Collins (Eds.), *Computer-mediated communication and the online classroom, volume three: distance learning* (pp. 91-104). Creskill, NJ: Hampton Press.

Scardamalia, M., Bereiter, C., Brett, C., Burtis, P. J., Calhoun, C., & Lea, N. S. (1992). Educational applications of a networked communal database. *Interactive Learning Environments, 2*(1), 45-71.

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. New York, NY: John Wiley.

Sorensen, G., & McCroskey, J. C. (1977). The prediction of interaction behavior in small groups: Zero history vs. intact groups. *Communication Monographs, 44*, 73-80.

Wagner, E. D. (1998). Interaction strategies for online training designs. *Proceedings of Distance Learning 98: 14th Annual Conference on Distance Teaching & Learning* (pp. 417-421). Madison, WI: University of Wisconsin System.

An Electronic Performance Support System (EPSS) for Instructional Designers and Developers: Neurocognitive Learning Science at Your Fingertips!

N. James Christman
University of Phoenix
San Diego, CA
United States
jimchris@email.uophx.edu

Edward Kazlauskas
University of Southern California
Los Angeles, CA
United States
kazlausk@mizar.usc.edu

Abstract: An Electronic Performance Support System (EPSS), featuring an extensive knowledge base of learning science and theory, is discussed and demonstrated. The EPSS is designed for use by instructional designer-developers of computer-mediated instruction (CMI) to help in the application of contemporary learning science in the design and development of instructional materials. The EPSS addresses the problems faced by practicing designer-developers in trying to keep up with the rapidly developing literature of learning science, and the heavy cognitive loading inherent in the CMI design and development process. Implemented as a HTML document, the EPSS features concise, prescriptive, practical guidelines in an operationalized checklist format. Hyperlinks lead to expanded checklists, explanations, examples, and Internet resources.

Introduction

Instructional designers and developers often do not apply contemporary learning science in the creation of computer-mediated instruction (CMI) (Brown 1997; Cooper 1997). Instead, they rely primarily on craft and heuristics for guidance (Clark & Estes 1998). The resulting materials, without the benefit of a science basis, are less effective than would otherwise be possible (Fletcher 1996; Chadwick 1997; Luterbach 1997; Radwan 1997; Winn 1997; Schmidt 1997).

Applying learning science and theory in CMI design and development is a challenge for several reasons. First, many designer-developers have neither formal training in learning science nor the time to learn and stay current with the rapidly developing learning science literature. Also, the application of learning science dramatically increases the cognitive loading of the design task; using heuristics is quicker and easier. Finally, popular authoring tools offer no support for the application of leaning science, nor are practical reference tools available (Brown 1997). The EPSS developed in this project is an attempt to help overcome some of these challenges.

To help designer-developers in applying learning science and theory to CMI materials, this project developed a prototype Electronic Performance Support System (EPSS) for use as a real-time reference tool. The EPSS provides cognitive support and makes available for real-time reference a large amount of learning science information in the form of practical guidelines. This type of cognitive support can enable non-experts to perform their work tasks in a manner approaching the level of expertise demonstrated by expert performers (Gerry 1995).

The underlying knowledge base for this project distills a broad sampling of information from cognitive constructivism science and theory, and uses neural science research data to support and embellish the cognitive materials. Access is provided by three indexes: an instructional process index, a learning theory taxonomy index, and an alphabetical index. Knowledge base contents are expressed as short, prescriptive guidelines in an operationalized checklist format. Implemented in HTML, the EPSS features a rich network of hyperlinks to access increasingly detailed levels of information, explanations, and examples, including numerous links to Internet resources.

Project Background

The body of science and theory selected for use in this project includes cognitive science and learning theory and the neural sciences. The EPSS is based primarily on cognitive science literature but draws from the neural science literature to support and, in some cases, to extend the cognitively based information. The two fields of cognitive science and neurological science have historically developed separately, but today they are rapidly merging to provide a combined physical and conceptual understanding of how human senses, perception, memory, and recall work as a system for learning.

The rationale for using the cognitive and neural sciences as the basis for this project is as follows:

1.Cognitive constructionism was selected as the learning theory basis for this project because: (a) it comprises the greatest amount of contemporary work in progress, (b) it is based on scientifically designed experiments involving objective observation, controls, and repeatability, (c) it subsumes a great deal of work accomplished over the past 50 or 60 years, and (d) it is supportable from the perspectives of many contemporary sciences including the neural sciences (Collins & Smith 1998; Osherson & Lasnik 1990; Posner 1989; Gardner 1985).

2. The learning models and theories of John Anderson (Anderson & Lebiere 1998), Jerome van Merriënboer (1998), Robert Gagné (Gagné & Medsker 1996), and Ruth Clark (1998) are used to represent contemporary cognitive learning theory because: (a) they are presented in newly published literature and represent the most recent thinking on the subject, (b) they are firmly based in scientifically designed research, (c) collectively they address a broad range of considerations within the human learning domain, and (d) collectively they comprise a complementary set of perspectives ranging from a broad treatment of human cognition in John Anderson's theory to specific instructional design features in Ruth Clark's work.

3. Neural science data were added to the above because: (a) they provide insight into sensory and perceptual processing events that are not addressed in cognitive theory, (b) they tend to affirm and complement cognitive theory, and (c) they point the direction for future cognitive research.

EPSS Design Considerations

Guidelines in the EPSS are provided in abbreviated, checklist format with prescriptive statements pertaining directly to design and development decisions. For experienced and knowledgeable professionals, the top-level indexes will provide sufficient support to assure that important considerations are not overlooked. For users who need additional support second- and third-tier indexes, definitions, explanations, and additional background materials are available by hyperlink connectivity.

Several means are provided to access information in the knowledge base including a process oriented index, a learning theory taxonomy index, and an alphabetical index. The process-oriented index is based on Gagné's 9 events of instruction (Gagné & Medsker, 1998) with one additional event added for this project. Each of the events is developed by using material from several sources. As an example, the first event, "Gain Learner's Attention," lists 5 categories of attention-gaining measures taken from both cognitive materials, especially Clark (1998), and neural data (Gazzaniga, Ivry, & Mangun 1998). The second event, "State the Learning Objectives," combines Mager's objective oriented instruction approach (Mager 1984) with Gagné's knowledge types (Gagné & Medsker, 1998) and Bloom's taxonomy of knowledge levels (Bloom, 1989). The third event, "Help the Learner to Recall (and Use) Prior Knowledge," is based largely on Gagné's material as supplemented by information from Ruth Clark's work on how to encourage recall and also neural data on why it is important to do so. The forth event, "Present the Instructional Content," draws heavily on both Gagné and Clark, but includes working memory data (Chandler & Sweller 1991; Mousavi, Low & Sweller 1995; Cooper 1997), and information from neural science as well. The remaining events, provide learning guidance, elicit performance, assess performance, reinforce retention, and reinforce transfer to the workplace, each draw on Gagné and Clark as supplemented by the other sources mentioned.

The learning theory taxonomy index is based in part on the sequence of events that occurs in processing sensory inputs into learned information: sensing and perceiving, working memory (WM), long term memory (LTM), and transfer to the workplace. Additional categories include the following: types and levels of knowledge, supporting cognitive processes, and individual learner differences.

Implementation of the EPSS

The EPSS knowledge base is developed in HTML code to facilitate the use of many useful features available in this format such as hyperlinking. Also, the HTML format is usable in any standard web browser, with which all designer-developers are well familiar. Using a hyperlink format, additional explanatory information is readily available for designer-developers who need increased levels of support. Second- and third-tier data present expanded checklists and discussions including explanations and examples to support the checklists. Embedded in the expanded discussion are hyperlinks to sources of expanded presentations of the research and theory, including links to sources on the Internet when appropriate. This multi-level approach takes after Gerry's description of an effective EPSS (1995).

Example materials from the EPSS

The following excerpt from the instructional process index shows how hyperlinks are used to access increasingly detailed levels of guideline checklists. The arrow indicates the link selected by a user to access the next index list shown. The top-level index is based on Gagné's nine instructional events, with the addition of a tenth step borrowed from Clark (1998), to reinforce the transfer new knowledge to the workplace.

- Instructional Process Index
  - Gain Learner's Attention ===> (hyperlink to 2nd tier)
  - State Learning Objectives
  - Help Learner to Recall (and Use) Prior Knowledge
  - Present Instructional Content
  - Provide Learning Guidance
  - Elicit Performance
  - Provide Feedback
  - Assess Performance
  - Reinforce Retention
  - Reinforce Transfer to the Workplace

The second-tier index, below, is hyperlinked from "Gain Learner's Attention," above, and expands on the concept by providing several specific ways to gain attention. Each of the methods listed should be considered.

- Gain Learner's Attention
  - Change stimuli suddenly - to gain involuntary sensory attention. ===> (hyperlink to 3rd tier)
  - Change topic, perspective, or approach - to gain voluntary cognitive attention.
  - Present the logical importance of the topic - to gain intellectual attention.
  - Present an emotionally impact full appeal - to gain motivated attention.
  - Regain and refocus the learner's attention at each instructional step.

A third-tier index in linked from "Change stimuli suddenly," above, and expands further on the concept by providing some specific ideas for implementing the guideline.

- Change stimulus suddenly - to gain involuntary sensory attention.
  - Change the screen contents or appearance where attention should be focused.
  - Momentarily flash a symbol, picture, word, or other visual stimulus.

- Use a momentary sound effect as a signal for the learner to be observant.
- Use a pointer that moves to, or flashes near, the item that should be attended to.
- Use stimulus changes to draw attention to content, not distract away from it.
- Stimulus changes that support content can increase continuity but do not necessarily increase learning.

==> (hyperlink to explanations and examples)

An additional level of detail, in the form of explanations and examples, is available for many sections, and hyperlinks to Internet resources are provided for many topics as well.

Usability Evaluation and Project Conclusions

The EPSS prototype was field tested by a number of graduate students in instructional technology and professional instructional designer-developers of CMI materials. They responded to the following questions, which are patterned after Gloria Gerry's criteria for EPSS design (Gerry 1995). The purpose of the evaluation was to assess the perceived usefulness and usability of the EPSS tool:

- Aids ID task goal establishment?
- Structures work process and progression through tasks?
- Contains embedded knowledge in the interface and support resources?
- Uses language that capitalizes on users' prior learning?
- Is compatible with the natural ID work situation?
- Provides alternative views of the document interface and resources?
- Provides layers to accommodate various user knowledge levels?
- Provides access to underlying logic?
- Provides alternative knowledge search and navigation mechanisms?
- Allows customization?
- Provides obvious options, next steps, and resources?
- Employs consistent use of visual conventions, language, visual navigation, and other system behavior?

The usability and usefulness of the prototype EPSS was rated at about 80% - a mean rating of 4 on a Likert scale of 5 possible points. This result is interpreted as representing fairly strong support for this EPSS concept, especially since it was tested only in a prototype configuration. Overall conclusions from the project are as follows: (1) learning science literature contains a large amount of practical, usable data, (2) such data can be expressed in abbreviated, operationalized terms, and (3) field testing showed the EPSS document to be both useful and useable in presenting learning science knowledge for CMI designer-developers to use.

Future Directions

The current EPSS project provides a conceptual starting point for future development in several directions. Three principle areas being considered for future development are: (1) inclusion of additional relevant learning science information, (2) addition of material on accommodating to individual learner's capabilities and needs, and (3) providing automated links to instructional authoring tools.

The current project knowledge base was developed on a framework developed from cognitive learning theory literature. This procedure tended to focus the literature search on subjects addressed in this literature. Late in the project, however, neural science data pointed to the important effects of stress and emotion on the learning process that are not developed in the cognitive learning materials. Stress and emotion appear to be of such importance to the learning process that their inclusion is seen as essential in the future development of this EPSS.

Additionally, the neurological basis for individual differences among learners was explored in sufficient depth to understand clearly that the use of computer capabilities to make individualized accommodations is the way for CMI to bring a real revolution in training and education. Differences among learners are not small or subtle, they are large and have a significant impact on how each person processes information. The inclusion of data on accommodating to individual learners will be an important addition to the present project.

Finally, this EPSS will achieve a great deal of additional usefulness when it is linked with popular instructional design authoring applications so that the learning science embodied in its knowledge base can more easily be included in the development of CMI materials of the future.

References

Anderson, J. R. & Lebiere, C. (1998). The atomic components of thought. Mahwah: Lawrence Erlbum Associates, Publishers.

Brown, A. (1997). "Designing for learning: What are the essential features of an effective online course?" Australian Journal of Educational Technology, 13 (2), 115-126. (Available at: http://cleo.murdoch.edu.au/ajet/ajet13/su97p115.html)

Clark, R.C., (1998). Building Expertise: cognitive methods for traiing and performance improvement. International Society for Performance Improvement: Washington, DC.

Clark, R. E. & Estes, F.(1998). "Technology or craft: what are we doing?" Educational Technology Sep/Oct

Clark, R. E. (1983). Reconsidering research on learning from media. Review of Educational Research, 53(4), 445-459.

A. Collins, A. & Smith, E. E. (1988). Readings in cognitive science: a perspective from psychology and artificial intelligence. San Mateo: Morgan Kaufmann.

Cooper, G. (1997). Research into Cognitive Load Theory and Instructional Design at UNSW. Unpublished manuscript.

Chadwick, D. K. H. (1997). Computer-assisted instruction in secondary mathematics classrooms: A meta-analysis. (Doctoral dissertation, Drake University, 1997). Dissertation Abstracts International, 58 (09), A3478.

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. Cognition and Instruction,8, 293-332.

Chandler, P., & Sweller, J. (1992). The split attention effect as a factor in the design of instruction. British Journal of Education Psychology, 62,
233-246.

Chandler, P., & Sweller, J. (1996). Cognitive load while learning to use a computer program. Applied Cognitive Psychology, 10, 151 - 170.

Fletcher, J. D. (1996) "Does This Stuff Work? Some Findings from Applications of Technology to Education and Training" Proceedings of Conference on Teacher Education and the Use of Technology Based Learning Systems. Warrenton, VA: Society for Applied Learning Technology (Available at: http://www.ott.navy.mil/1_2/salt.htm)

Gardner, H. (1985). The mind's new science. New York: Basic Books.

Gagné, R. M., and Medsker, K. L. (1996). The conditions of learning: Training Applications. New York: Harcourt Brace College Publishers.

Gazzaniga, M. S., Ivry, R. B., & Mangun, G. R. (1998). Cognitive Neurocience: the biology of the mind. New York: W.W. Norton & Company.

Gerry, G. (1995) "Performance centered software design." Performance Improvement Quarterly.

Lutterbach, K. J. (1997). Refining instructional design theories: A comparison of constructivist instructional strategies for teaching computer mastery (undergraduates, cognitive psychology). (Doctoral dissertaion, Indiana University, 1997). Dissertation Abstracts International, 58 (08), A2987.

Mousavi, S. Y., Low, R., and Sweller, J. (1995). "Reducing cognitive load by mixing auditory and visual presentation modes." Journal of Educational Psychology, 87(2), 319-334.

Osherson, D. N. & Lasnik, H. (Eds.). (1990). Language: an invitation to cognitive science (Vol 1). Cambridge: MIT Press.

Posner, M. I. (Ed.). Foundations of cognitive science. Cambridge: MIT Press.

Radwan, Z. R. (1997). Evaluation of the effectiveness of a computer assisted intelligent tutoring system model developed to improve specific learning skills of special needs students (CAI). (Doctoral dissertation, The George Washington University, 1997). Dissertation Abstracts International, 58 (04), A1254.

Schmidt, F. L. (1997). "Impact of instructional strategy on training effectiveness." (Doctoral dissertation, University of Iowa, 1997) [Abstract from UMI ProQuest Digital Dissertations, AAT 9805649]

van Merriënboer, J. J. (1997). Training complex cognitive skills: A four-component instructional design model for technical training. Englewood Cliffs: Educational Technology Publications.

Winn, W. D. (1997). "Advantages of a theory-based curriculum in instructional technology." Educational Technology. Jan/Feb: 34-41.

The Design and Integration of Interactive Multimedia Learning Environments: Content, Ergonomic, Evaluation and Collaborative Issues

IsaBelle*, C., Nkambou**, R. et Dufresne***, A.

*Université de Moncton, Département d'enseignement au secondaire, Moncton, Canada
** Université de Sherbrooke, Département de mathématiques et informatique, Sherbrooke, Canada
***Université de Montréal, Département de communication, Montréal, Canada

Abstract : The integration of Information technologies into the educational system has spurred the creation of new courses to effectively train teachers. Hypermedia environments are becoming essential tools for the enrichment of pedagogical values in the teaching area. WWW technology has made using these environments much easier since such hypermedia resources can be accessed via the Internet. Hypermedia environments, however, do not truly meet the needs of the teachers: Often, they are too far removed from teachers' true concerns and needs with regards to the integration of educational technologies. Furthermore, several MILE (Multimedia Interactive Learning Environments) designers are placing the focusing on the development of sophisticated functionalities which seldom make tasks easy for the user. This paper introduces a system called CINEMA[1] which is committed to the design and integration of new multimedia learning environments. This system is ideally suited to the needs of teachers who are eager to know what to do with multimedia and how to develop their abilities using multimedia.

1. Introduction

Education professionals are called upon to integrate multimedia in their courses, thereby renewing the teaching/learning process (Tardif,1998) by designing multimedia teaching materials. They are confronted with a teaching process that increasingly requires the use of Information technologies. Teachers are caught in an technico-educational paradox (IsaBelle, 1999): the general population demands that the educational community offer training which meets the needs of the today's society; yet, the majority of teachers receive little, if any, training. Much of the time, what little training they do get hardly emphasizes the importance of information and communication technologies in the classroom. While some interactive learning environments for distance education are available, there are relatively few teachers who use them. First and foremost, these environments present contents that are too far removed from teachers'actual concerns and needs with regards to the integration of Information technologies. Secondly, although the majority of methods used to design Multimedia Interactive Learning Environments (MILEs) involve more explicit reflections of the learning process (Rouet and de la Passardière, 1998), several designers still emphasize the development of sophisticated functionalities which often do not facilitate the user's task (Nkambou, IsaBelle and Frasson, 1998; Barthe, 1995). This paper introduces CINEMA, a unique system for the design and integration of new multimedia learning environments, which is actually tailored to the real needs of teachers who are eager to know what to do with multimedia and how to develop their abilities .

2. Elements for effective learning

In order to support effective learning, the person learning must feel involved through:

- general knowledge and know-how (the cognitive dimension),(Giordan and de Vecchi(1987)
- motivation (the emotional dimension)
- a relationship with his peers and/or the teacher, (Aumont and Mesnier, 1992).

[1] CINEMA: Conception et Implantation de Nouveaux Environnements Multimédias d'Apprentissage.

Many MILE designers neglect the pedagogical dimension when developing their systems. The learning process must allow the user to work in a constructive environment. In fact, this environment must promote active, constructive, co-operative, authentic and intentional learning (Jonassen and al., 1999).

3. Designer Traps

The ergonomics of interfaces deal primarily with facilitating navigation as well as addressing the effects of the cognitive load (Rouet and Tricot, 1995; Dufresne, 1997). However there are some traps which await MILE designers. The Technological trap provides the user with powerful, fast and visually attractive MILEs that often totally ignore the pedagogical aspects. The Ergonomic trap places the emphasis on the ergonomic aspects without taking into account the cognitive values of renewed pedagogy which result from the constructivism of Piaget (Choplin, Galisson and Lemarchand, 1998). On one hand, ergonomic experts emphasize the user in order to facilitate the system's use and decrease the complexity of the user's task. On the other, pedagogues may design tools that encourage the ideas of rupture, deconstruction, or dissonance, in order to facilitate the development of the learner's intellectual abilities(Giordan, 1996).

Therefore, ergonomic experts try, as much as possible, simplify and clarify the use of computer software. Didactic experts, on the other hand, prefer to create more difficulty, which is necessary to any learning(Choplin, Galisson and Lemarchand, 1998).

In any MILEs design, the task is complex because the designers must strive to balance the "user side" with the "learning side" of any subject. Can there truly be a system which succeeds in finding the perfect balance between the ergonomic and didactic entities while still granting important emphasis to each side of a subject?

4. The CINEMA system

The CINEMA system was conceived by a team made up of an educator, a designer and a computer scientist. Collectively, they have built, deconstructed and rebuilt a model (Gregori, 1999) of an effective interface, a relevant content, even a content presentation corresponding to the essential dimensions in a learning process that would allow the creation of pedagogical multimedia material. The CINEMA program is available on the Internet. It is easy to use yet still allows sufficient questioning during information processing. The primary objective of the site is to make it possible for users to create pedagogical material, in most cases an educational Web page.

CINEMA provides special attention to the application of constructivism where user commits him/herself to a process of "Learning how to learn" (Bordeleau, 1994). The system is made up of six modules: *Learning*, *Storyboarding*, *Ergonomics*, *Production*, *System* and *Implantation* (see figure 1). The first five modules are specific to the creation of multimedia and interactive learning materials. The sixth module details how to integrate this environment in a school context. In fact, it is important to plan for the integration of the developed environment early on in the design phase. Without addressing this concern, there is the risk of obtaining a MILE too far removed from the school needs, and therefore difficult to integrate into the school context (Depover and Strebelle,1996).

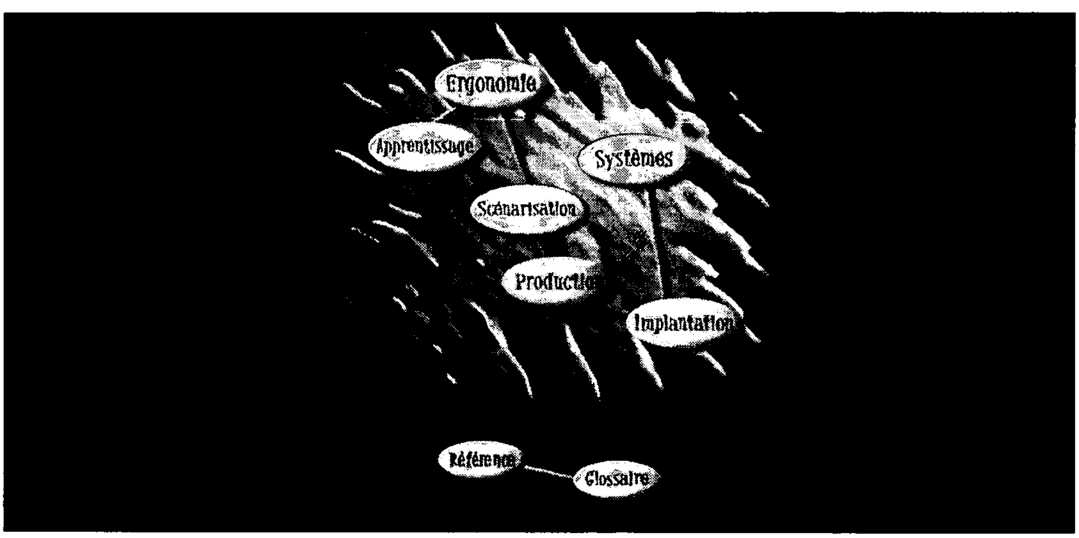


Figure 1: A view of the CINEMA system

4.1. Educational content
In each module, the user is presented with the declarative and procedural knowledge involved. This is done through objectives and many interactive exercises provided for the learner.

Learning module
In this module (figure 2), the teaching/learning methods, the styles and the learner profile are detailed. The module also includes information about computer applications which promote the development of multiple intelligence (Forcier, 1999, Gardner, 1997).

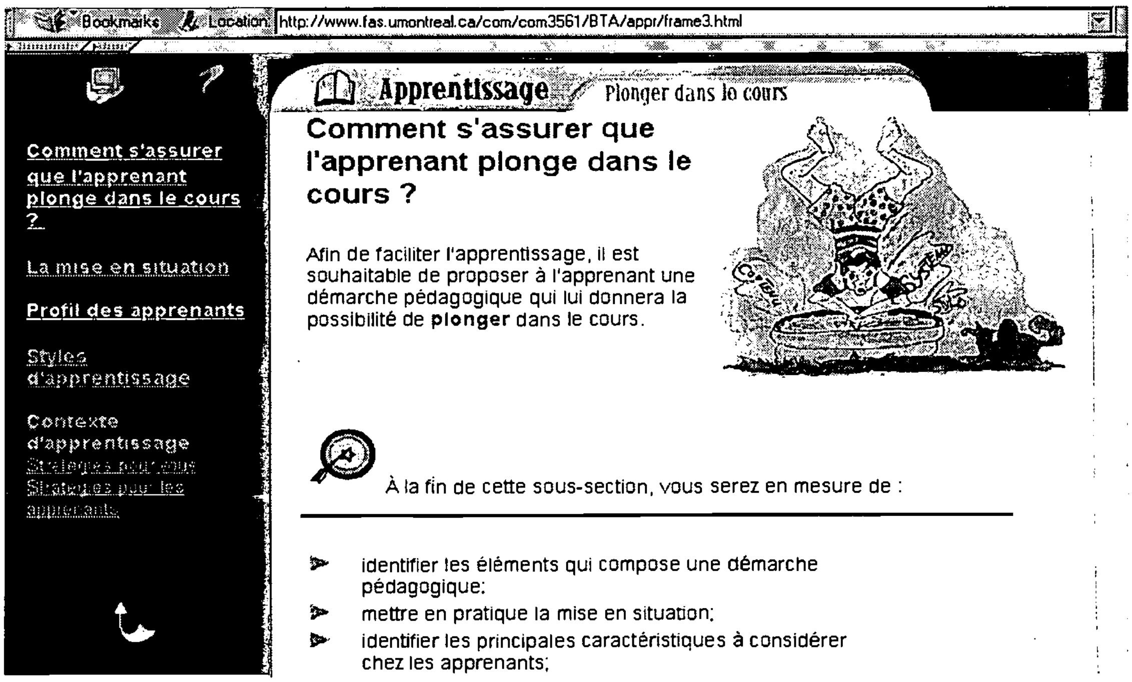


Figure 2 : An example of Learning section of CINEMA

Storyboarding module
In this module, the user discovers the logic which sustains the elaboration of a storyboard, adapted to the needs of "future designers ", for the creation of a Web page. Specific guidelines, designed to help schools create their own web pages, are also included in this module.

Ergonomic module
This section is specifically devoted to understanding the human-machine interaction. Detailed theories about human information processing are provided. Ergonomic principles and the eight golden rules of interface design, according to Schneiderman (1998), are explained. These help future teacher-designers to create better Web pages as well as evaluate existing systems.

Production module
This module covers the basic elements of an Internet Site, such as tables, frames, etc. as well as ways to produce them. The basic and advanced feature of an authoring tool (Dreamweaver 3.0) which facilitates web-page creation and site organization is also covered.

System module
The System module introduces two interactive surveys to evaluate educational Web sites and CD-ROMs. The first questionnaire (IsaBelle and Zucchiatti 1999) is made up of 60 criteria for evaluating the pedagogical aspects of a MILE. The second consists of 60 criteria, which allow the evaluation of interfaces on an ergonomic level. For briefer

evaluations of educational and ergonomic aspects, two " express " surveys of 15 criteria each are also available. Given the number of CD-ROMs and educational Web sites already on the market, there is a great demand for evaluation criteria within the teaching community as well as a need for systems already assessed by professionals. The System module of CINEMA allow users to evaluate educational CD-ROMs and web-sites using an interactive form. It is also possible for users to share the results of their evaluation with others.

Implantation module
This module outlines four conditions which ensure the quality of educational technologies:

1. Changing the beliefs and the attitudes of the whole educational community;
2. Incorporating technology into the pedagogical structure ;
3. Supporting teachers and encouraging collaboration between educators;
4. Transforming teachers into agents for "change".

Beyond showing teachers a way to integrate educational technologies into the practice of renewed learning, this module outlines how to use the CINEMA system, further helping to enhance their multimedia knowledge.

The CINEMA system also offers the user more navigational freedom. Although the program's built-in suggests a specific browsing and reading order, the user is free to start with the module of their choice. By offering this freedom, CINEMA's creators wanted to allow the user to question him/herself about their learning process (Choplin, Galisson and Lemarchand, 1998).

4.2. Ergonomic aspects

The CINEMA system was designed to be easy to use, freeing the user to concentrate on content. Each icon was carefully selected for its significance, in order to represent all possible types of activities. For example, a hand giving a "thumbs up" indicates the presence of a positive example. The "muscular" arm symbolizes an exercise which must be performed by the learner.

All examples, exercises and tests are opened in a new, smaller window in order to communicate their context to the learner. To help the user navigate, the title of the current module is displayed above the work area while the menu on the left indicates sub-menus which have already been visited. Each module is also colour-coded with a specific colour for easier identification.

4.3. Collaborative learning: communication issues

Tardif (1998) addresses the importance of vertical and horizontal communication to support learning. In distance education, there are significant communication elements which are considered crucial to maintaining a students' motivation and encouraging them in their learning process. According to a study by Moore and Kearsley (1996), as many as 30% to 50% of all students who start a distance education course drop out before finishing it. In order to increase the students' success ratio, the study recommends: establishing a learning community between the students and the instructor, as well as providing teacher-feedback to the students. This learning community includes collaborative training and socio-affective exchanges between students. Studies (Bertrand, 1996) show that the socio-affective aspects of the student are very important.

Studies further suggest that collaboration between experts and other learners facilitates the acquisition of skills and knowledge. A Vygotsian perspective states that it is important for less skilled people to learn from an expert within the zone of proximal development (ZPD). Through this process, the learner gradually builds their own skills and knowledge with help from someone of greater ability (Vygotsky, 1978).

Thus CINEMA provides a complete and relevant discussion forum (Figure 3). This includes three distinct boards (contents, technique and café) allowing the learner to exchange according to the contents and technical aspects of a course, as well as according to more personal aspects (café).

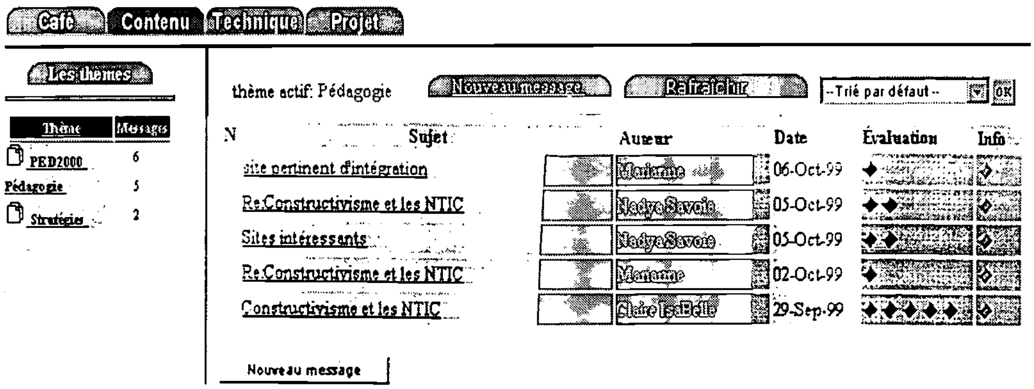


Figure 3 : A view of Forum of CINEMA

4.4. Prototype Evaluation

It often seems that many systems are introduced without being fully evaluated and yet this stage remains as significant as the design phase itself. Espéret (1998) indicated the importance of generalizing evaluation and experimentation methods. Within the framework of this project, and in order to ensure a use which truly meets the needs of those concerned, four types of evaluation were proposed. These would be conducted by various groups: future teachers, students registered in a course on ergonomics, teachers studying educational technology and practicing teachers who want to create educational multimedia environments.

Right now, the evaluation by future teachers has taken place at the University of Moncton and at the University of Montreal. They specifically revised the contents as well as the interface. They also proposed new interactive examples and exercises. Furthermore, more than a hundred students registered in the "Interface et multimedia" course at the University of Sherbrooke are currently evaluating the system. This group,in particular, will evaluate the ergonomic aspects of the CINEMA using a heuristic evaluation technique.

As part of the "Training and the Information and Communication Technology" course, offered at the University of Moncton during the fall of 1999, teachers used the CINEMA system and had to share their comments and evaluations, especially concerning its pedagogical aspects (contents, examples, exercises, pedagogical strategies...). By the end of the course, each "teacher in training" involved had also created an educational Web page.

Finally, within the context of a research project relating to distance education and Web page creation, teachers at an elementary school showed great interest in the use of this system to develop their school and/or classroom Web sites. This use of the CINEMA program by the very users it targets will gather invaluable data concerning CINEMA's unique, symbiotic balance between the didactic and the ergonomic in the suggested learning environment.

5. Conclusion

The CINEMA system offers a unique blend of solid content and optimized functionalities ideally suited to the real needs of teachers, especially when it comes to information technology. While everyone can benefit this comprehensive program, regardless of their profession, the CINEMA system addresses the important need to adequately prepare and empower educators, involving them in the process of change to integrate Information technologies into the school system. It is hoped that other new designers of MILEs will be as eager to offer users such versatile contents and optimized functionalities.

6. References

Aumont, B. & Mesnier, P.M. (1992): *L'acte d'apprendre*. Paris : PUF.

Bertrand, Y. (1996). L'avenir de la formation et la médiation technologique. *Vie pédagogique*. Vol.7 No.100. Montréal.

Bordeleau, P. (1994). L'intégration pédagogique de l'ordinateur : Pour une écologie de l'école. In Apprendre dans des environnements pédagogiques informatisés. Montréal : Les Éditions Logiques.

Champy-Remoussenard, P. & Gregori, N. (1999). Hypermédias éducatifs : conception et précautions d'usage. *In* J.F. Rouet & B. de la Passadière, *Hypermédias et apprentissages.* Acte du quatrième colloque. Poitiers : INRP. 334-336.

Choplin, H., Galisson, A. & Lemarchand, S. (1998). Hypermédias et pédagogie : comment promouvoir l'activité de l'élève ? *In* J.F. Rouet et B. de la Passadière, *Hypermédias et apprentissages.* Acte du quatrième colloque. Poitiers : INRP. 87-98.

Depover, C. & Strebelle, A. (1996). Fondements d'un modèle d'intégration des activités liées aux nouvelles technologies de l'information dans les pratiques éducatives. *In* G.-L. Baron et É. Bruillard (dir.), *Informatique et éducation : regards cognitifs, pédagogiques et sociaux* (p. 9-20). France : INRP.

Dufresne, A. (1997). Conception d'interfaces pour l'apprentissage à distance. *La Revue de l'Éducation à Distance*, XII(1/2), 177-200.

Espéret, É. (1998) Notes de synthèse sur le colloque Hypermédias et apprentissages. *In* J.F. Rouet et B. de la Passadière, *Hypermédias et apprentissages.* Acte du quatrième colloque. Poitiers : INRP. 339-342.

Forcier, R.C. (1999) *The computer as an Educational Tool. Productivity and problem solving* (2nd ed.). New Jersey : Prentice Hall.

Gardner, H. (1997). *Les formes de l'intelligence*. Paris: Éditions Odile Jacob.

Giordan, A. (1996). Les conceptions de l'apprenant. *Sciences humaines*. Hors-série, no. 12, Fév.-mars. Auxerre.

Giordan, A. & de Vecchi, G. (1987). *Les origines des savoirs*. Neuchâtel : Delachaux.

IsaBelle, C. (1999). *Pouvons-nous favoriser l'intégration des NTIC par l'étude des représentations des futurs enseignants.* Communication au colloque du 6e Congrès des sciences de l'éducation de langue française - AFDEC. Université de Montréal. Québec (à venir les Actes du colloques).

IsaBelle, C. & N'Kambou, R. (1998) A framework for Web-based distance learning environments. In *Proceedings of the ITS 98* (Fifth International Conference on Intelligent Tutoring Systems). Workshop on Web-based ITS, San Antonio, Texas. (p.1-6)

Jonassen, D.H., Peck, K.L. & Wilson, B.G. (1999). *Learning with technology. A constructivist perspective.* New Jersey : Prentice-Hall.

NKambou, R. , IsaBelle, C. & Frasson, C. (1998) Design and technical issues in a Web-Based distance learning environment. In *Proceedings of New Technologies in Information and Communication in Engineering Education and in Industry 98.* France. (p.107- 115).

Rouet, J.F. & de La Passadière, B. (1998). Hypermédias et apprentissages : outils, utilisateurs, usages. *In* J.F. Rouet et B. de la Passadière, *Hypermédias et apprentissages.* Acte du quatrième colloque. Poitiers : INRP.7-9.

Rouet, J.-F. & Tricot, A. (1995). Recherche d'informations dans les systèmes hypertextes : les représentations de la tâche à un modèle de l'activité cognitive. *Sciences et techniques éducatives*, Volume2 - no 3. Paris :Hermès.

Shneiderman, B. (1998). Designing User Interface Strategies for effective Human-Computer Interaction (3rd ed). Massachusetts: Addison-Wesley, 639p.

Tardif, J. (1998). *Intégrer les nouvelles technologies de l'information. Quel cadre pédagogique ?* Paris: ESF éditeur.

Vygostsky, L.S. (1978) Mind in society : The development of higher psychological processes. M.Cole, V. John-Steiner, S. Scribner et E. Souberman, Éds and Trans. Cambridge, MA : Havard University Press.

Holding the storyline in an educational hypermedia

Luigi Colazzo, Andrea Molinari*, Luisa Tomasi°*

* Università di Trento - Dipartimento di Informatica e Studi Aziendali - Via Inama 5, 38100 Trento Italy - Tel. +39 0461 882144 882324 Fax +39 0461 882124 E.mail colazzo@cs.unitn.it, amolinar@cs.unitn.it
° Università di Trento - Dipartimento di Informatica e Studi Aziendali - Laboratorio di Ingegneria Informatica - Via Zeni 8, 38068 Rovereto (Trento) Italy - Tel. +39 0464 443138 Fax +39 0464 443141 E.mail tomasi@lii.unitn.it

Abstract: The paper presents a prototype that manages the reading paths in a set of multimedia documents. It allows to create the path while the user navigates not only on Web pages, but also on local documents or documents non necessarily on the Web. The system stores the references of the information fragments, allowing the user to save the created path, to review it, to replay the sequence and finally to distribute the path to students, thus avoiding (or limiting) the disorientation phenomenon. The prototype also supplies some simple but powerful methods for manipulating the paths and creating new ones. These primitives consist of a series of basic operations on paths, like the concatenation of two paths, the intersection of a series of paths in order to find common nodes, the difference of two paths and so on.

1. Introduction

Hypertext systems have been for long time the only software tools to produce non-linear organization of information chunks. Nowadays, we have a plethora of software tools that can produce hypermedia documents (word processors, presentation tools, graphic tools etc.), and we have a standard language to produce hypermedia and put them on the Web, i.e., HTML. The problem is that, generally, the integration of these different hypermedia documents into one unified hypermedia is difficult. Building a meta-hypertext of many different documents coming from different software sources is a task where technical skills are necessary. A good example of this difficulty is the relation between a hypertext system and another software data management system used to handle geo-referenced data, i.e., a Geographic Information System (**GIS**)[Colazzo et al. 97]. At the time of our experiments in this field, we had to choose the option of extending the functions of a commercially available hypertext system by adding primitives that handle maps, rather than adding hypertext functions to a commercially available GIS. In fact, GIS capabilities of performing hypertext functions have little similarity with the current standard of hypermedia systems.

Besides the problem of integrating information chunks coming from different sources, the organization of these chunks in different reading paths (as we usually do while building hypertexts) does not mean necessarily to cancel the linearity of the learning process. In most hypertexts, the reader does not proceed randomly in the navigation. The author guides the navigation by proposing some standard "routes" of comprehension. The paths built in this way are often the only reasonable way of navigation for the user, and can not be changed by him/her. However, these paths could not satisfy all the user needs, and in this case s/he should be able to create her/his own path, for example by taking information chunks from different hypermedia and by combining them in a new personalized path. The paper presents a prototype that allows the reader to build custom paths on hypermedia documents derived from different sources, and to review, cancel, modify and aggregate these paths by using some specialized primitives. Every path connects a potentially large number of information chunks deriving from different development tools, like word processors, HTML pages, Postscript or PDF files, presentation slides, technical sketches etc. The prototype creates generalized lists of chunks coming from these different sources, by allowing a virtual "sequence" among documents technically different but logically connected. This could be very useful in educational environments where the only availability of HTML pages for creating hypermedia limits the creativity of the author.

1.1 Relevant works

Hypertext paths, also called tours, are a concept as old as hypertext self. Bush [Bush, 45] incorporated in Memex the paths to provide a personal means for organizing found information and to provide a means to communicate that information to other persons. Generally, the paths implemented to help to solve two major problem, namely "user disorientation" in hypertext networks and the additional "cognitive overhead" needed to create, manage and choose among links [Conklin, 87]. Paths appear in many implemented systems: for example, Textnet paths [Trigg et al., 86], HyperCard scripts [Goodman, 87], Guided tours in NoteCards [Halasaz et al., 87], Hammond & Allinson's guided tours [Hammond et al., 88], Petri nets in αTrellis [Stotts et al., 88], Scripted Documents [Zellweger, 89]. There have been several different implementations of paths in hypertext systems: the history trail, which automatically logs every location the reader visits, and the guided tour, which is a predetermined set of locations that can be stored and visited over and over, in the same order

[Mylonas et al., 90]. Besides, generally, the hypertext systems are specialized mechanism built for their own customized environments: the published accounts suggest that they were intended for use by a sophisticated audience of hypertext authors and readers. In last time, the concept of hypertext paths is applied to the WWW. For example the Walden's Paths [Furuta, 97]: the reason is the heterogeneity of the web and the desirability of supporting the teacher-student relationship. Walden's Paths is designed to enable teachers to make use of materials available via Internet by creating directed paths over the World-Wide Web. The system consists of two main components: the Path Authoring and the Path Server. The first enables the teacher to create, modify, validate and reuse paths: especially, it supports the process of locating sites whit relevant information, ordering and annotating those pages to form the path. The path server is the implementation means through which the students navigate the path: when it receives a request, it determines the path and page number of the request.

2. Different chunks from different tools

Our work starts from a simple consideration concerning the current state of the process of distributing educational material from producers (teachers) to consumers (students). The WWW has given a strong impetus to the concept of distance learning, but in part it has also distorted its meaning and limited the use of multimedia and technical documents, i.e., what is not easily adaptable to an HTML file or an GIF/JPEG image. In addition, it is difficult to recreate a full interaction with the user in Web pages: for example, a multimedia package is surely more suitable than a Java applet to build an animation simulating an industrial automation process. The idea presented here is to leave the educational material in the "best suited" format, i.e., the original format, having a meta-tool that manages the hypertext chunks by launching the specific viewer when the reader needs it. Moreover, some attributes can be assigned to the elements of these paths for subsequent retrieval, and a series of primitives can be performed of these lists of references. Here follow two examples that show how useful is to build generalized paths on different sources of information chunks. The considerations here explained are extensible to other fields, though both situations have the educational material as common background.

2.1 A hypermedia system used to project slides

The construction of a slide for a lecture is a time-consuming operation, and it is advisable to design slides so that they can be reused several times. A collection of slides to expound a set of arguments has an intrinsically linear structure: indeed, the arguments can only be presented in a temporally linear sequence. There is therefore close connection between the sequence of the arguments discussed and the fragments used during the lesson. However, it is obvious that not all the lessons have the same audience or the same communicative purpose. Moreover, an argument can be treated in different ways according to the level of the students' knowledge. It follows that, even if the structure of the navigation among the slides is linear, the teacher must reorganize the slides with every new lesson. In principle, the lecturer could duplicate slides to construct a new sequence, but this work takes a certain amount of time and leads to the proliferation of copies of the same slide. If changes are made to one slide, these changes must be reproduced in all the lessons that use the modified slide. In some cases, the lecturer must make an impromptu change to his/her exposition in order to deal with an unexpected event during the lecture. The only thing that the lecturer can do is try to find the slides relating to the topic and navigate through the directories of the file system opening different collections of slides. If the paths among the slides are managed as objects endowed with their own behaviors and methods, it is no longer necessary to duplicate the slides: all that is required is to create several paths through the same slides and give different labels to them.

2.2. Reading paths in a CD for teaching purposes

Every path in a hypertext inevitably interweaves with many others. As a consequence, the same fragment may belong to several reading paths organized into difference sequences. The creation of reading paths is a crucial stage in the design of a hypertext. The designer must place him/herself in the shoes of the future user and create links among the various fragments according to a unitary and systematic logic, which prevents reader disorientation. In this way, as the reader follows a route, s/he must be able to grasp the meaning of that particular sequence.

The creation of personalized paths among hypermedia documents has been the subject of a joint project undertaken by the Department of Computer and Management Sciences of the University of Trento and IPRASE of Trento (an educational research center). The outcome of the project is a CD-ROM on medieval history, with particular reference to the Trentino area of Italy.

However, a teacher may want to deal with the material from a different point of view: for example, the teacher may decide to present a sequence of frescoes to be found in various medieval castles in the area, thus extracting this information from the medieval history CD. The teacher may also make it possible for the students to upset this sequence by adding further information that they believe relevant to the topic. Moreover, the teacher may have another hypertext available, which presents, for example, a collection of medieval jewelry.

Another example is taken from a CD-ROM with educational content regarding botany and biology (see fig. 2). The hypermedia includes the navigation tool with some extensions and peculiarities. In particular:

- It is possible to recall the navigator while selecting a path, instead of starting the navigation with the tool;
- From a simple integration the tool has become the main navigation tool of the CD. The opera contains a huge number of different paths, which can be modified, added, deleted because they are stored on the disc. Moreover, the user can build new paths based on his/her own needs.
- The tool allows the creation of paths that include documents from tools other than the original (Asymetrix Toolbook), for example integrating Word documents with Toolbook hypermedia and HTML pages.

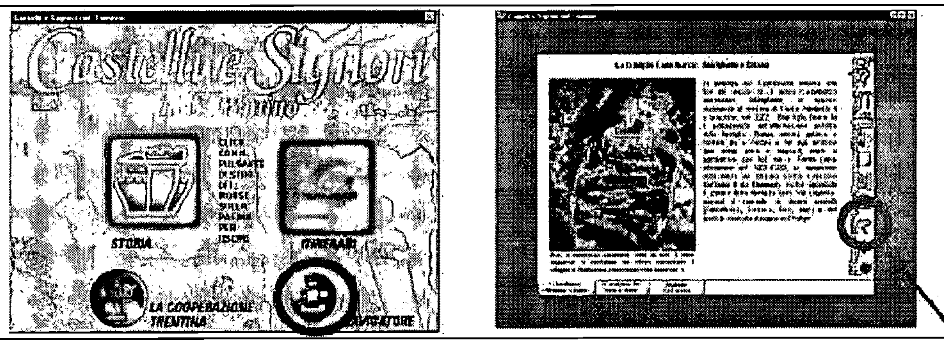


Figura 1a-b. Activation of the navigator in the hypermedia "Castles of Trentino". There are two icons: one of the home page of the CD, the other is a internal page with the navigator icon inserted among the other navigation buttons

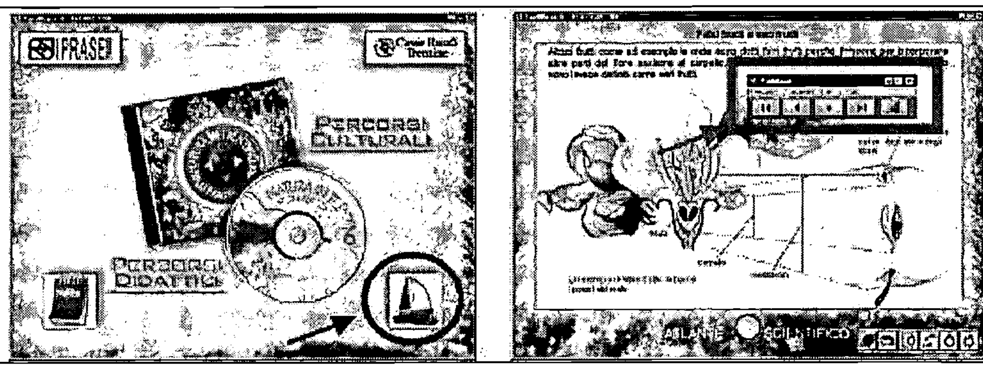


Figure 2a-b. Icon of the navigation tool in the main page of the CD-ROM and the navigator active on a page

3. The prototype

The prototype is an application that enables the user, or group of users, to handle abstract objects called *Paths*. A path is defined as a class of objects called References. A Reference has the following attributes:

- *Application*: carries the name of the application that has generated the file. It may be absent in cases when the operating system is able to recognize the file from its extension, as happens in MS Windows;
- *File location*: gives the path which identifies the position of a file in the file system;
- *File name*: gives the name of the file with its extension;
- *relative address of the node*: fragment identifier allowing to position on a specific part of a document;
- *script*: a piece of code in the specific scripting language of the application for precise positioning at a certain fragment/page/node etc. of the document.
- *Comment*: optional, helps user during navigation by appearing in the title bar of the navigation tool.
- *Keyword1, 2, 3*: descriptive fields in which the user can insert a keyword for subsequent search. This is useful, for example, when information chunks have a common attribute that characterizes them.

The references in a path are arranged into an order established by the creator of that particular path. As well as its ordered list of references, every path is given a number of attributes when it is first created (figure 3): *Title*: one for each path; A*uthor*: the name of the creator of the path; *Type of author*: student, teacher, researcher; *Date of creation*; *Comment*: annotations on the path;*Password* (optional) to prevent cancellation or alteration of the path by other users.

The application, which permits the creation and management of paths, is based on a stratified architecture comprising two distinct but linked components. The actions performed by the user at the FrontEnd are translated into actions based on data that constitute the BackEnd of the application

3.1. Creating a path

Once activated in path creation mode, the prototype works in background and presents itself as an icon. Whenever the user decides that a particular file or node is of interest to the path that s/he wants to create, s/he clicks on the prototype's icon. The prototype transparently stores the data relative to the information node chosen by the user in the BackEnd. We are working on some extensions of the creation step: in fact, it is possible to imagine the paths as being constructed by an automatic process (experiments have already been conducted). For example, in products constructed with multimedia authoring systems, it is possible to activate a process of automatic creation based on identification of objects endowed with specific properties. The process analyzes all the information nodes included in the list of inputs retrieved from the BackEnd and creates an order according to the values of the property selected. It finally translates the order obtained into a sequence of references.

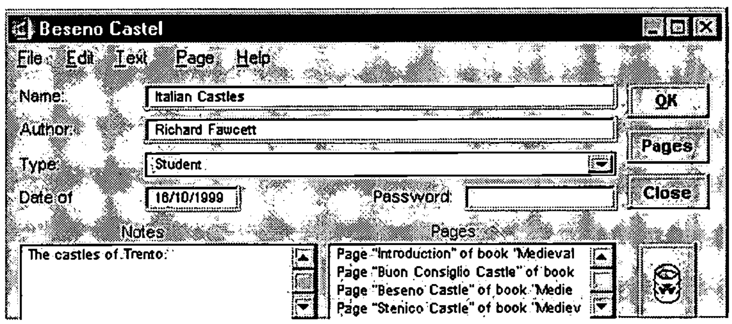


Figure 3: the attributes of a path

3.2. Changing and combining paths

The prototype allows the user to inspect the paths produced and to act in two distinct ways: alter the references of individual paths or combine paths to produce new ones. In the former case, it is possible to: 1) change the characteristics of the path;2) alter the sequence of links among the references; 3) remove certain references; 4) remove the path itself; 5) insert a new reference at an arbitrary point in the sequence.

In the latter case, composition functions can be applied to the references constituting two paths. These are automatic processes which, when applied to two or more paths, produce a further one (figure 4). The prototype in its current form comprises the following composition functions:

1. Intersection of two paths A and B: a path formed from references included in both A and B;
2. Union of two paths A and B: this is a path formed from all the references belonging to at least one of the paths A and B: duplicated references are eliminated;
3. Difference of two paths A and B: (in the order given) path A references which are not in B;
4. Concatenation of two paths A and B: a path with all the references in A followed by all the references in B;
5. Specific nodes from two paths A and B: a path consisting of nodes which are not shared by A and B, i.e., they are present in one of the two paths but not in both of them.

It is similarly possible to define the intersection, union, concatenation, etc. of more than two paths.

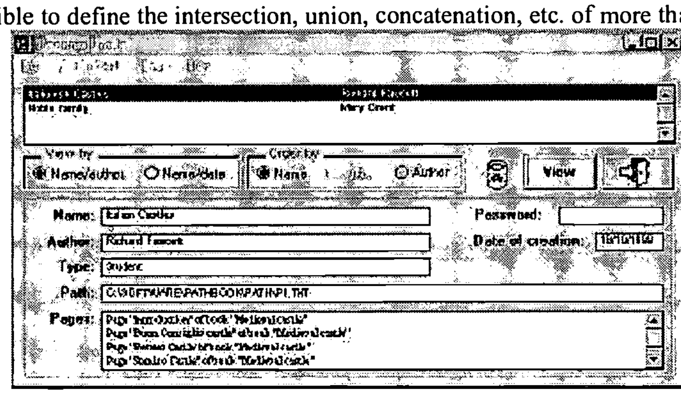


Figure 4: example of combining two paths

3.3. Following a path

When the prototype is used to follow an already-existing path, the reader works with an interface like the one in Fig. 5, reduced to the minimum so that it is as unobtrusive as possible. There are six buttons: one to close the program, four to navigate through the paths created, and one to consult the list of references that are in the path. After selecting the desired path, the reader uses the buttons to view the following pages: *First reference*: shows the first path reference; *Next reference*: shows the reference following the current one; *Previous reference*: shows the reference previous to the current one; *Last reference*: shows the last reference in the path; *List references*: shows a listbox with the references in the current paths and the current reference marked. This helps the user to understand where the path will lead next (figure 6). The reader can change path at any time, by only choosing another path among those handled by the prototype. The reader may also explore paths starting from a specific location. S/he can obtain a list of all paths that traverse the current reference. For example, if the reader is at reference X (Figure 7), s/he can obtain a list of all possible paths which pass through that reference and continue to navigate by changing direction and following one of the alternative paths: for example, paths 1, 2 or 3.

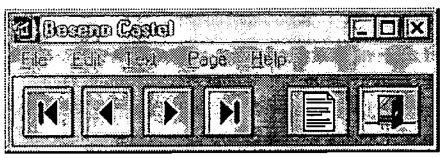


Figure 5. Main window of the prototype

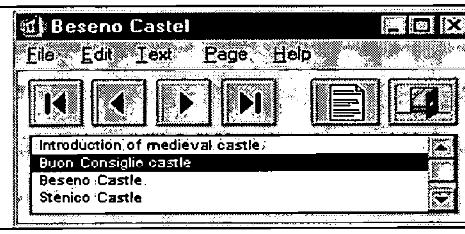


Figure 6. The list of nodes available with the current node highlighted

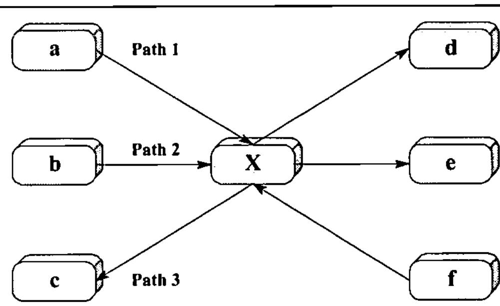


Figure 7. Paths intersecting a reference X

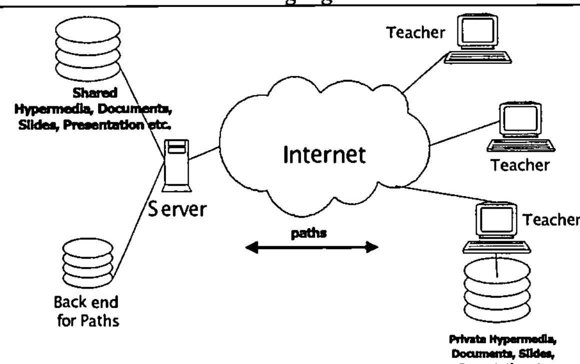


Figure 8: Architecture of the distributed version of the navigation tool

4. Extending the prototype: sharing paths among users

We are currently testing another extension of the prototype that regards the distribution of the created paths to a centralized database accessible through the Internet. This has some evident advantages:

- Teachers/students that are not currently on their computer can use the stored path wherever they are taking the lesson, thus allowing distributing not the material, but the sequence that constitutes the lesson. Under this perspective, we can think to the prototype as a "sequcncer" of hypermedia
- the powerful primitives of the system can be applied not only to local paths, but also to educational paths that a community of teachers has decided to share. This could be interesting, for example, for a multi-national corporate, where huge amounts of hypermedia presentations are created. Single teachers use them but share not only the slides, but also the sequence among them. It could be, for example, very useful to provide an "intersection" primitive on all path created for a presentation of a new product, in order to verify what the different salespersons have presented.
- The use of a centralized database as back-end (figure 8) for storing the paths has evident advantages of administration regarding the references contained in the corpus. We can imagine an institution / company that administer its educational material in a better way by providing a centralized administration not only of the paths but also of the physical documents and slides composing the educational material. On the market there are some products that provide centralized administration of educational material, but in terms of costs and complexity of the system we are moving towards a far simpler solution.

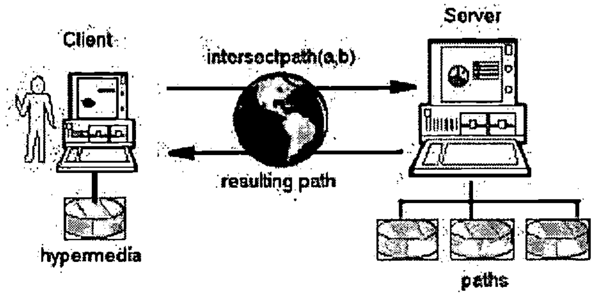


Figure 9: the simple architecture for sharing simple primitives on a distributed database

The architecture of the system is based on a proprietary though simple communication protocol that allows two remote instances of the prototype to exchange commands and data regarding the paths required by the user. The protocol is based on Tcp/ip, thus allowing the connection among computers connected to the Internet, but does not imply the sophisticated structure typical of client/server approaches, like DCOM or CORBA. The application is simply the same, it is only activated in server mode or client mode (figure 9).

In the first case, it does not navigate by itself, but receives from the Internet requests of executing primitives on the database stored on the server computer. The content of the packets exchanged among the clients and the server is relatively simple and small, and so there are few issues regarding network performance.

5. Conclusions and future developments

We presented a software tool that abstracts from the software that manages digitized information. The tool integrates the path that an author creates on these different chunks of information, allowing connecting pieces of information coming from different applications in a hypertextual structure. The prototype manages these paths allowing: a) the transportability of the path without encapsulating the single chunks of information; b) the abstraction from the application that creates the document, thus allowing the integration of different types of digitized information in an unique hypertext; c) the management of multiple paths, thus sharing different hypertexts from different authors; d) some elementary operation on the paths, like intersection, union etc.

The prototype has been successfully used in some informative and educational CD-ROMs and has other undergoing projects in which it will be used as the main navigation mechanism. The current development is oriented to the integration of the prototype with a mechanism of remote archiving of the paths through Internet.

We believe that our prototype, even though it is experimental and simple in its approach, prompts reassessment of the role of 'rationalized sequences' in computer-mediated teaching. Good feedback from users who have consulted the CDs produced with the navigator demonstrates their natural but documentable 'familiarity' with the concept of sequence. It also demonstrates that teaching materials are more easily assimilated if they can be consulted: (A) along a path created by an author; (B) where the path corresponds exactly with the metaphor of sequence and the elementary navigation operations (first, last, next, previous); (C)it is possible, with the sufficient knowledge, to operate simultaneously on paths viewed as sets of links. Evaluation of these features with a complete benchmarking system is indispensable for clearer understanding of the issues involved in computer-supported learning.

Acknowledgment

We would like to thank Romano Nesler for his helpful comments and valuable discussion on the implementing of the prototype.

References

[Bush, 45] Bush, V. (1945). *As we may think. The Atlantic Monthly*, ACM Press, New York

[Colazzo et al., 97], Colazzo A., Molinari A.(1997) Geographic Maps as Navigation Tools in Educational Hypermedia, , ED-MEDIA 97, World Conference on Educational Multimedia & Hypermedia, Calgary, Canada

[Conklin, 87] Conklin, J., (1987). *A survey of hypertext*. MCC Technical Report STP-356-86, Rev. 2, Dec. 1987

[Furuta, 97] Furuta, R., (1997). *Hypertext Paths and the World-Wide Web: Experiences whit Walden's Paths*, Proc. Of Hypertext '97, Southampton, UK, 1997, ACM 167-176

[Goodman, 87] Goodman, D., (1987). *The complete HyperCard Handbook*. Bantam Books, New York, 1987

[Halasaz et al., 87] Halasaz, F. , Moran, T. & Trigg, R.(1987). *NoteCards in a nutshell*. Proc. ACM CHI+GI'87 Human Factors in Computing Systems and Graphics Interface, Toronto, Canada, April 5-9, 1987, 45-52

[Hammond et al.,88] Hammond, N., & Allison, L. (1988). *Travels around a learning support enviroment: rambling, orienteering or touring?* Proc. ACM CHI'88 Conf., Washington, DC, May 15-19, 1988, 269-273

[McKendree et al 95] McKendree, Reader and Hammon (1995). *The Homeopathic Fallacy in Learning from Hypertext*, Interactions July,1995

[Mylonas et al., 90] Mylonas, E., & Heath, S., (1990). *Hypertext from the data point of view: paths and links in the perseus project*, Proc. of European Conf. On Hypertext, INRIA, France, Nov. 1990

[Stotts et al., 88] Stotts, P.D., & Furuta, R. (1988). *Adding browsing semantics to the hypertext model*. Proc. ACM Document Processing Systems Conf., Santa Fe, NM, December 5-9, 1988, 43-50

[Trigg et al., 86] Trigg, R. H., & Weiser, M., (1986). *TEXTNET: a network-based approch to text handling*. ACM Trans. Office Info. Syst., 1-23

[Zellweger, 89] Zellweger, P. T. (1989). *Scripted documents: a hypermedia path mechanis*, Proc. Hypertext '89 , Pittsburgh, Pennsylvania, , 5-8 nov.1989, ACM, New York, pp. 1-14

The Design, Assessment, And Implementation of a Web-Based Course

Leon L. Combs, Ph.D.
Department of Chemistry
Kennesaw State University
Kennesaw, GA
Lcombs@kennesaw.edu

Abstract: The design of a web-based course is discussed based upon considerations of content, pedagogy, learning styles, and assessment. The learning styles are examined as primary considerations and indeed dictate needed elements in a web-based course. Assessment is also considered in the initial planning of such a course. These design elements are discussed with particular web elements given for each design element. Further illustration of the design procedure will be demonstrated by an application to a freshman chemistry course. All considerations may be used both for a web-enhanced course and a course taught totally online.

INTRODUCTION

To design a course for optimum impact, the following should be simultaneously considered: the course material; the students' learning styles; pedagogy, which includes methodologies of presentation; and assessment. These items then need to be considered as itemized below.

- Regarding course material, experienced educators know the needs of thc customer regarding the content of the courses. The students (learners) need courses that are current and that are relevant to their career choices. Because most faculty members keep up with their disciplines and their relevance to other disciplines, they generally know what is needed in the lower-division courses and in the upper-division courses. Course content is not constant over the years, and all educators must work to keep up with subject advances. However, the area of course content is usually the most dependable part of course design. But read below for web implementation.
- Learning styles often vary significantly among a typical group of freshman students. However, most faculty members often omit consideration of the students' approach to the course. The teacher often will teach the course based upon his/her learning style and the way that he/she was taught. Certainly most faculty members usually don't plan their course presentations based upon the myriad learning styles of their students. Many students leave science partly because of our poor planning regarding these learning styles (1,2). This area is usually the weakest component of course design.
- Pedagogy appropriate for each particular course must drive the development of the course (3). Although course content may be well known, and the relevance of the subject matter to many disciplines well known, often not enough thought is given to the pedagogy required for the best development of student learning. Methods of effective presentation can vary widely among disciplines. The white board is still an excellent tool for presentation, but now we also have the smart board. The importance of small group work is also well known now. Student presentations are also an important component of educational methodology. Faculty members now have a wide choice of technology suitable for enhancing their teaching of the courses. Modern technology can considerably enhance their applications of good pedagogy. So we must consider how to incorporate these techniques into a web-based course.
- Course assessment must also be considered at the development stage of a course – note in the title that assessment is listed before implementation. Many books have been written about course assessment (4). At the beginning of the course, it is very important to know the beginning level of student understanding of the subject. It is also important that all of the students know their own learning styles, and the best way to approach learning based upon their individual learning styles. The student and professor must also understand their personality profiles to aid in a more proficient learning experience. Assessment will involve studies of content knowledge, before and after taking the course; learning styles; personality profiles; and environment.

WEB SITE CONSIDERATIONS

When we begin our course development/design considering the course material that needs to be mastered, pedagogy, the possible learning styles of our students, and assessment, a new paradigm of course design develops. *What follows can be used for either on-campus or on-line courses. It can also be applied to any other area of learning (government, industry, etc).*

We will assume that the *gross course content* is not an issue. For the first-year teaching faculty member, putting together the first set of course material can be quite a daunting task. Also every year the faculty member must fight against the tendency to use the "yellow notes" from previous years. It is very important for all faculty to keep their course content current, but we will assume that such a consideration is a given. However, putting the material on the web presents some additional considerations. We want to make the best use of the web medium to maximize the constructivist possibilities (5). There will be some elements of objectivism in the presentation because some material has to be memorized so that deeper understanding can be based upon that memorized base. This discussion is now overlapping between course content and pedagogy, but such an overlap is an essential part of the design process.

The *pedagogy* and the *method of presentation* have to be reconsidered every year by the faculty member. New technology for use by the educator is being developed every month. A good example of the use of modern technology is in the development of a web component to a course. The amount of web involvement for a course can vary considerably from a very minimal involvement of putting a course syllabus on the web to the considerable effort of developing a web-based course. Web-based courses are courses that have a major component of all aspects of the course on the web. These web-based courses can be used as course supplements for lectures or for totally on-line courses. Because they can be used in both venues, the development time is optimized for its effectiveness. As stated in the preceding paragraph, we want to maximize the constructivism that can occur based upon the design of the web site. In chemistry, we do want some objectivism in the design so we will have some drill exercises. However we will want to clearly use that memorized base to lead the students into a constructivist approach to their knowledge development. Abstract topics such as in chemistry and physics can be considerably enhanced by the use of simulations and animations. The simulations can also have a student interface allowing for students to change the operational parameters of the simulations and thus lead to a deeper understanding of the concepts.

The *consideration of the learning styles* of our students is usually the most often neglected item. Below are some learning styles and the course elements needed for those learners.

Learner Type	***Needed Course Elements***
Visual Learners	Graphics (illustrations, films, slides, and diagrams), flow charts, discussion bulletin boards, animations.
Auditory Learners	Films, sound-enhanced slides, Microsoft Net Meeting
Read/Write Learners	Written web material, referrals to other web sites, written assignments such as chapter summaries, suggested exam questions, etc.
Kinesthetic Learners	Different web pages for different materials (makes them take a needed break), short web pages, memorization drills, animations requiring input, non-web assignments (surveys, lab experiments).
Sequential or Global Learning	Give a good overview of each section and provide a logical progression through the material that can be chosen by the learner.
Inductive Approach	Facts and observations given, principles developed
Deductive Approach	Principles given, consequences and applications deduced

Active Learners These learners need group work. We can make assignments to groups of students and require presentation of results over the web using a course management system such as WebCT. Case studies appropriate to the discipline can be used very effectively in this component. Reports of these assignments should be due often (every two weeks).

Reflective Learners These learners need time to think over the material before trying it out. On-line quizzes that are taken at the time of their choosing appeals to these learners. A thorough assignment due at the end of the semester also appeals to these students.

Other authors have also examined utilizing some of the implications of learning theory and web-based instruction (6).

It is recommended that faculty begin work on designing the web site and how to include course material while considering *assessment*. The methods of assessment need to be in place well before the first semester of use begins, and a specialist in assessment should be part of the team. The assessment needs to include comparisons with an on-campus class covering the same subject, and the best arrangement is for the same professor to teach the on-campus and on-line class. Before the classes begin, both classes need to take a subject matter test, a personality profile test, the Learning and Study Strategies Inventory (LASSI) test, and at least two different kinds of learning styles tests. It is best if a standardized subject matter test can be found such as is offered by the American Chemical Society for chemistry tests. At the end of the class the students need to then take the subject matter test again. Studies of the student environment involve the actual class-related experiences of the student during the course. Obtaining student input on the environmental issues is very important. For a web-based course the environmental issues are ease of site navigation, usefulness of various sections, ease of use of audio/video components, ease of electronic correspondence with other students and faculty, etc. The assessment expert should help the faculty member choose the proper tests and opinion surveys, and aid in the analysis of the correlations.

WEB SITE CONSTRUCTION

For effective use of everyone's time, it is very important to use a team approach to the construction of the web site. It is unreasonable to expect one person to become an expert in all needed areas. The team should consist of a content expert, an instructional designer, a programmer, a web interface designer, a graphic designer, and an assessment expert. There are a number of good references for considerations in the web design process (7).

At this point we know the discipline material needed on the web site, how to design the web site for optimal use by the students, the methodologies of presentation, and the methods of assessment. Now we can begin to develop our web-based course by including all of the above elements in our design. From the above we see that we need: synchronous and asynchronous means of communication among the class members, video clips, sound bites, simulations and animations, photos with sound and text, access to a conference software package like Microsoft Net Meeting, short web pages, different web pages for different topics, drill routines for help in understanding and memorizing, animations with input, a good overview of each section and of the entire site, prepared method of progression through the site for those who need such, methods for inductive and deductive approaches, short-term and long-term group assignments, and on-line quizzes at appropriate locations to help students gauge their educational progress.

Now we are ready to design the web site for the course. From the above considerations, there are many needed components of the web site. Now the team must examine the course material and begin to storyboard it into needed segments, and requisite interactions among the segments. As also seen above, the overall site should be designed so that a student can be guided through it, *or* so that a student can choose his/her own path. At this point it is a good idea to use a hierarchy program and place the titles of all segments in the spaces and begin to determine the best arrangement and interactions. Because we are trying to maximize the constructivist element of the web site design, the placement of the course material must be done with that priority. It is very important to remember that the individual web pages need to be short, so a given chapter of material will need to be divided into appropriate small sections.

It is also time to begin to determine what animations and simulations will be placed with what sections and where to place drill exercises. Drills are to be placed at necessary points in the objectivist portion of the site (such as in the learning of significant figures). If a programmer is part of the team then he/she needs to begin developing the needed animations, simulations, and drills. Generous faculty members at many universities are also willing to share their work, which could save a lot of time. There are also a number of software packages that can help in constructing these portions of the site.

Once the design of the web site has been determined, the conversion to html coding begins. Much of this work *can* be done with word processors, although usually such conversions have to be considerably modified to appear as desired. Because most of us are never satisfied with the html conversion of word processors, it is advisable to just create all the code with an appropriate web page software suite. There are many software packages available for constructing web pages. We have found Dreamweaver 3 and Coursebuilder for Dreamweaver 3 (8) to be very good packages for this work. Coursebuilder can be used to add short quizzes at appropriate places in the sections of the web material.

The style of the writing needs to be different from that in a textbook. The writing should be friendlier and written like one would talk when tutoring a student in the office for that is what a good site is — an electronic tutor. A good method is to start with lecture notes and then fill in details and modify the tone of the writing. A good reference point for the writing is to think about explaining the material to your 15-year old child or grandchild. The entire course should begin with a broad overview; each "chapter", and each "section" of each chapter should have an overview and learning goals clearly stated. Each "section" should then be followed with a conceptual quiz to help the students assess their progress.

The learning style considerations revealed that one needed component was video, which presents some problems if students are accessing the material from off-campus, as most will be doing. The videos should be short, approximately ten minutes, and narrowly focussed in content. We produced short topical lectures on many topics in freshman chemistry and compressed them for Real Streaming video presentation over the web. However the pipeline to homes is still too narrow for the effective use of such video. We have decided that for the next few years, the best method for delivering such videos to students is via CD-ROM disks. The video on the disks can be assessed from the web course material, and it is easy for the students to then watch at their convenience. The videos should be produced in their original form with streaming video in mind (few motions, simple background, simple scenes, etc), so that they will compress into as small a file as possible. Later, when the technology improves for video delivery over the web, the same videos can probably still be used over the web.

The synchronous and asynchronous communications among the students can be accomplished by a course management software package such as WebCT, Blackboard, Web-Course-in-a-Box, or needed individual components may be used. We chose to use WebCT for the discussion forum, chat room, and mail aspects of the web course. We also use WebCT for on-line tests to be made available to the students a couple of days before each test. These on-line tests are of similar coverage and difficulty as the real tests. For some students who have the computer capability, we also make available a server for use with Microsoft Net Meeting. Using Net Meeting we can schedule on-line office hours and students can schedule group meetings.

A web site that has general information about the campus and specifics about on-line learning should also be available for the students. We constructed a site called "ChemNet" that contains links to the university homepage, campus resources, admissions, financial aid, the catalog, the bookstore, library resources, the university on-line registration site, and a site where the students can obtain free e-mail and web pages. The site also contains a link to a site that discusses on-line learning, that has links to needed software, and that has on-line learning style tests. This site also has links to information about all degrees offered on campus, and links to the on-line courses available from this campus. Such a site is essential to including the students of the on-line class into the on-campus scene.

IMPLEMENTATION

Now that the site is constructed, it is time for implementation. It is very important to have an on-campus meeting before the course begins. At this one mandated meeting, the students get to see the professor and each other, work through some of the details of the class in a computer lab, and take some of the assessment tests. I also prepared a web site that walks the students through the various aspects of the web-based course that is useful for those students who can't attend the on-campus meeting and as a review for those who did attend the orientation.

Each chapter should have group assignments that are due every two weeks. Testing should be frequent. Optimally the students should be given a test every two weeks and group assignments due every two weeks with the timing such that something official happens every week. For a semester course, there will then be eight proctored tests, eight on-line quizzes, the final exam, eight group assignments, short quizzes, and homework (due the day of the test) all to be used in some combination to give a grade. It is preferable to require that the tests be proctored either on or off campus. The validity of off-campus proctors must also be carefully checked. If this sounds like a lot of work for the students and the professor, it is! An on-line course conducted in this manner forces the students to study as we ideally want all students to study, but we know that probably only about ten percent study this intensely. Professors and students must be warned about the extra work before the course starts. Our data show that students finishing such a course in freshman chemistry scored 57% better on a standardized test, so for the serious student such an approach is worth the effort.

The professor must check all possible student input at least daily. It is critical to keep the students involved in the course and motivated to learn. Nothing turns off a student as much as a request for information to sit in a mail hopper for days, or for a posted message to the discussion forum go totally unanswered for days. It is a good procedure for the professor to enter himself/herself as a counterfeit student in the class so that the professor can pose as a student, see the material from the student's view, and discuss issues with the students from a different perspective. Students will discuss concepts more openly with other students than they will with a faculty member. Of course, usually someone begins to wonder who the kid is who seems to know all the answers! It is also a good stratagem to let the discussions continue on the bulletin board without intervention unless the students are getting way off course on trying to understand some concept. Students learn more when they teach other rather than having the professor answer all questions immediately. It is also a wise procedure to sometimes enter as the counterfeit student and pose a question to try to get the discussions focussed properly.

Assessment tests and surveys are also available on-line for ease of taking and analyzing.

Upon implementation the professor becomes the guide through the material. The web site must also be kept updated, which includes checking all referenced links often, changing course content as needed, modifying and adding new animations and simulations as needed, monitoring the use of synchronous and asynchronous communication tools so that the most effective methods are used from the students' perspective, modifying areas of the site as needed to meet the needs of all learning styles, and continual use of assessment data to make the site optimally effective.

CONCLUSIONS

Assembling a web-based course is not an easy task and requires a lot of time and commitment of the professor and the team. After the initial implementation, the professor is forever in a continuous iterative process of assessment, modification, learning modern techniques, and implementation. However, this iterative process has always been the job of the professor. The web era has not introduced any new job description, just different details and a new medium that can be used to develop constructivist learning in a more effective manner than ever before. This last statement is a rather bold statement, but we believe that it is true, especially for rather abstract subjects. The use of computer simulations with feedback loops, animations, drills for memorization, and computer models of molecules and their interactions (again with feedback loops) afford a method for active learning that was not available until recently. The web-based uses of these techniques all the students to be repeated as often as the student desires rather than just once in class. The use of the electronic bulletin boards for discussions generally afford a deeper level of discussion as students can think more about their comments than most do in person-to-person interactions.

A major benefit of a web-based site from the students' perspective is that the students leave such a course with better-developed abilities to be life-long learners. They will always have to be learning on their own, and the web is a fantastic tool for education. They will also have learned how to approach the web cautiously regarding the validity of information on the web. They will have developed skills in working with other individuals using various technologies. Most corporations now use the web for training employees and keeping employees modernized in their knowledge relating to their jobs. The successful completion of a web-based course is then an excellent part of a student's education and at least one such course should be required of all students.

The presentation will more completely discuss all the elements of design; the assessment results of four semesters of teaching General Chemistry, a chemistry course for science majors; and show some of the actual details of the web-based courses.

REFERENCES

1.) Tobies, Sheila, *They're not Dumb, They're Different: Stalking the Second Tier*, Research Corporation, Tuscon, 1990.
2.) Felder, Richard M.; Forrest, Krista D.; Baker-Ward, Lyne; Dietz, e. Jacquelin; Mohr, Phyllis H., A Longitudinal Study of Engineering Student Performance and Retention; I. Success and Failure in the Introductory Course, J. Engineering Ed., 82, pages 15-21, 1993.
3.) Robert Roberts and Robby Robson, http://pass.orst.edu/edmedia99/references.html, Many excellent references are given at this site.
4.) Astin, Alexander W., *Assessment for Excellence*, American Council on Education and the Onyx Press, 1993. There are many other excellent references in this book.
5.) http://ils.unc.edu/disted/cmi/final2.html is a site that discusses some elements of objectivism vs. constructivism.
6.) Henke, H. A., *Applying Learning Theory to Computer Based Training and Web-Based Instruction*, 1997, http://scis.nova.edu/~henkeh/story2.htm .
7.) Henke, H. A., *Evaluating Web-Based Instruction Design*, 1997, http://scis.nova.edu/~henkeh/ from which this paper may be obtained.
8.) Macromedia, Inc., 600 Townsend St., San Francisco, CA 94103.

Evaluation of a support tool for musical problem-seeking

John Cook
University of North London,
School of Informatics and Multimedia Technology,
166-220 Holloway Road, London N7 8DB, UK
j.cook@unl.ac.uk

Abstract: MetaMuse is a pedagogical agent that supports the fast generation of musical ideas and which specializes in interactions that aim to foster learner problem-seeking (i.e. the first stages of creative problem-solving). This paper provides a overview of MetaMuse and then gives details of an evaluation of MetaMuse with teachers and learners. The evaluation results were favorable. In particular the evaluation participants rated highly the learning support approach taken by MetaMuse (i.e. getting students to learn how to make predictions about musical ideas and then encouraging reflection on what actually happened when the idea was played back).

Introduction

A pervasive musical education problem is that there is often no "correct" body of knowledge to teach (Johnstone, 1996, p. 247). In musical composition it is not just a question of solving a problem, it is more a question of seeking out the nature of the problem and then devising an approach to solving it. More generally, Lipman (1991) has suggested that in the humanities and arts, the subject matter itself is treated as essentially problematic and that it is more a question of problem-seeking than problem-solving (Lipman, 1991, p. 175). We have extended this notion (Cook, 1994) by proposing that when reflecting about creative problem-solving, the first stage is often to problem-seek, i.e. to define, formulate, find, invent, or create the problem before a method for arriving at a solution can be identified.

This paper first presents a pedagogical agent called MetaMuse. The agent is a learning support tool that has been developed to promote problem-seeking and problem-solving interactions in the area of undergraduate musical composition. We also report on an evaluation of MetaMuse with teachers and learners.

MetaMuse: A Support Tool for Problem-Seeking and Creative Reflection

In the empirical work reported in Cook (1998), the author of this paper describes a formal analysis of teacher-learner dialogues. One outcome of this analysis was prescriptive models of interactions described at the level of participants' goals and communicative acts (the latter being seen as a way of achieving goals). The prescriptive models generated by the analysis of empirical data were used in the design and implementation of an computer-based pedagogical agent called MetaMuse. The agent is able to engage in interactions that aim to promote problem-seeking.

MetaMuse can only deal with a small task revolving around the chromatic transposition of a four note phrase. Furthermore, MetaMuse can not understand natural language. The system is not able to engage in dialogue about the 'free text' inputs by the learner. As a result the system sometimes lets the user input some thoughts on what they are doing, stores these explanations and reflections in an Interaction History and then moves on to the next part of the session. Interactions with MetaMuse thus typically take the form of structured questioning by the system and menu and button selections by the learner. However, within certain limitations, the system is able to comment on a musical phrase input by the learner. MetaMuse also has various (empirically derived) prescriptive models of expected interaction patterns which it uses as the basis for problem-seeking interactions. An example of the MetaMuse interface is shown in Figure 1 (note that "phrase" in the text refers to a musical phrase).

MetaMuse has the ability to provide the student with a Learner Profile (a summary of the learner and teacher interactions) that can form the basis for further reflective engagement and dialogue with fellow students or with the teacher. This ties in with one approach to supporting reflection and speculation about music (Auker, 1991). Auker has suggested that students should be allowed to develop the appropriate spoken language by interacting with each other. They can then adapt and take ownership of this language as they begin to internalise and 'reflect' on creative opportunities, and hence build the appropriate mental structures of their creative intentions.

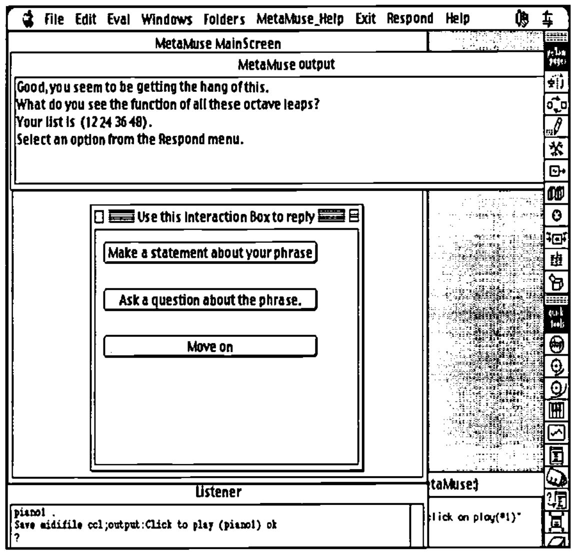


Figure 1: An example of the MetaMuse interface

MetaMuse attempts to engage in a 'mentoring' style of teaching. Mentoring is an approach to teaching that aims to support learners' creative, metacognitive and critical thinking, these being essential to musical composition and other open-ended, problem-seeking domains. Specifically, mentoring intends to promote learner 'creative reflection', which is a constrained type of metacognition. In the domain of musical composition, creative reflection would be defined as the ability of a learner to imagine musical opportunities in novel situations and to then make accurate predictions (verbally) about these opportunities. An example of 'imagining a musical opportunity' would be an utterance like: 'I don't want to repeat the same note twice in my phrase'. An example of creative reflection would be a learner first writing a phrase using musical notation, then predicting verbally how that phrase will sound, then playing the phrase back on a piano and finally evaluating if the prediction was accurate or not. To succeed at creative reflection there should be a correspondence between what a learner predicts will happen and what actually happens.

What the pedagogical agent 'knows' is very limited. The focus for the pedagogical agent is on the potential that the choice of musical intervals provides for musical material to be sectionalised into phrases. Heuristics on how this is taught have been taken from the interaction data (Cook, 1998) and augmented by some musical grouping constraints as proposed by Lerdahl (1988).

The pedagogical agent is capable of certain types of symbolic reasoning based on its knowledge. For example, the pedagogical agent 'knows' that 'an interval leap of 23 or more may indicate a musical phrase boundary'. The agent also knows some good teaching tactics; for example, a tactic called 'critical probing' involves an attempt to get the learner to imagine that they are playing their phrase on an instrument, as this can help the learner firm up their own perception of the purpose of the interval leap (in metacognitive terms 'go-above' and regulate their knowledge). This gives a good example of the challenge of mentoring in a problem-seeking domain, i.e. mentoring involves tutoring with non-absolute rules, where there is no right or wrong answer. Normally, if the MetaMuse detects a large leap then 'critical probing' would be selected as an appropriate intervention.

State Transition Networks, i.e. prescriptive models, derived from dialogue modeling (Cook, 1998) are used to plan interactions. Often, more than one exit was possible from a state node. Interactions are structured by offering all of these choices to a learner as 'Respond' menu options (these options would vary from one node to the next). Preferred options would, it was decided, sometimes be indicated to the learner if there was a strong basis (empirically based) for the pedagogical agent making a suggestion to the learner. Thus, the State Transition Networks are used to give options for choice and provide expectations of answers. A measure of confidence in the degree of learner co-operation can be built up over time, based on the degree to which a learner fails to match the pedagogical agent's expectations (e.g. how often do they ignore advice given by the pedagogical agent?).

Evaluation of MetaMuse

The evaluation was in two parts. In part one five individuals evaluated MetaMuse. In part two six pairs of collaborating learners were used to help evaluate MetaMuse. Thus the total number of participants in the evaluation was 17. We will refer to the participants in part 1 of the evaluation as participant numbers 1 to 5. We will refer to the participants in part 2 of the evaluation as participant numbers 6 to 17.

The Evaluation Study Set-Up

The method that was used for the evaluation (parts 1 and 2) was questionnaire. The specific aim of the evaluation was to get initial feedback (by the use of questionnaires) from music teachers, educational technology researchers and students on six related questions:

1. Details of participants' current post, professional qualifications and experience with music teaching and educational technology.
2. How interesting participants found MetaMuse.
3. How useful participants found the way that MetaMuse promotes creative reflection about a musical phrase.
4. Participants' assessment of the potential that MetaMuse has for assisting in undergraduate composition classes.
5. Participants' assessment of how useful they found the guidance provided by MetaMuse.
6. Participants' assessment of how useful they thought the learning approach used by MetaMuse was for musical composition education (i.e. learning how to make predictions and reflecting on what actually happened).

There were various aims behind the above questions. The second question was used as a general question to catch user impressions of the pedagogical agent. Another aim of the questions was to see if users felt that the agent could reproduce, at the formal level, interaction that were similar in structure to a human pedagogical agent whose goal was 'creative reflection' (the third and sixth questions). The pedagogical agent, in its current implementation, has no natural language understanding; there is a lot of processing going on behind the scenes (although response time was very fast) and some interface activity. Given this limitation, the fourth question attempts to identify the applicability of the system, could it be used in the classroom with students? The fifth question attempted to ascertain how the participants evaluated the help screens and messages provided by the pedagogical agent.

Part 1 of the evaluation was conducted in London and at a Department of Music in a University College in the north-east of England in May and June, 1998. This part of the evaluation was conducted with one AI-Music-Education researcher/lecturer (in London) and with four musical teachers (at the Department of Music). Part 2 of the evaluation took place at a British University in the south-east of England in March 1999. In part 2, six pairs of learners worked with MetaMuse in each session. The twelve participants in part 2 of the evaluation ranged from undergraduate students, postgraduate students, research fellows and members of staff (teaching and support). The participants in Part 2 had varying levels of musical ability. For the whole evaluation eleven participants were male and six were female. Each session in both parts of the evaluation lasted between 30 and 50 minutes.

The evaluation subjects (one participant and one observer per session in Part 1; pairs of participants and two observers per session in Part 2) sat in front of a composer workstation, which consisted of a Macintosh Centris, with MetaMuse installed, attached to a midi-device and speakers. Each session involved the participant being asked to carry out a small composition task (10 minutes of the session were set aside for participants to read the notes and ask questions of clarification; in Part 2 the pairs were simply asked 'to work together on the task'). Briefly, the compositional task was for the participant to attempt, using MetaMuse, to create a phrase by the repeated chromatic transposition of an initial four note motive (C C# F# G). When using MetaMuse to compose a phrase, participants were asked, in the task sheet and by MetaMuse, to limit the approach used (when transposing the phrase) to repetition, contrast and trajectory. The reason for taking this constrained approach (of only allowing repetition, contrast and trajectory) was that MetaMuse knows more about how to interact than it does about music (later versions will improve on this lack of musical knowledge). Thus, constraining the types of activities that the composer was allowed to undertake would, it was hoped, give MetaMuse a chance of being able to analyse what the participant was doing (and hence MetaMuse would have a reasonable basis for mentoring interactions).

Participants were informed that the current implementation of MetaMuse could only recognize the following approaches (which are based around the work of Lerdahl, 1988), and were asked to limit themselves to variations on one of these approaches when composing a phrase: octave leaps, descending trajectory, ascending trajectory, large leaps, repeated transposition and small phrase. Each evaluation participant individually filled in a questionnaire following a session. It is these questionnaires which are used as the basis for our evaluation. Following the very first evaluation session some minor changes were made to MetaMuse. Consequently, sessions 2 to 11 (i.e. with participants 2-17) were conducted with a slightly improved version of the pedagogical agent.

Results and discussion

Table 1 shows average response scores (out of possible maximum score of 5) to interview questions.

	q 2	q 3	q4	q5	q 6
Av.	4.06	3.35	3.65	2.76	4.35

Table 1: Average Response Scores (out of 5) to Interview Questions

The number of study participants, at 17, was small and so some caution is required when attaching significance to these results. Given this reservation, however, the results seem favorable: the total average response score for questions 2 to 6 was 3.63 (out of 5). We will now discuss the above results in the context of the underlying purpose of the questionnaire, which was outlined above.

Impression of the Pedagogical Agent (q2)

With an average score of 4.06 the overall impression of MetaMuse seems good. The comments made by participant 5 (a former head of department of music) were encouraging:

> "Compositional value in teaching very useful. Patterns are quite limiting - which make a good test of both 'learning' and 'ingenuity'. It would be further use in teaching to [be able to] play around with the pattern (invert, retrograde) and with tempo." (Participant 5)

Participant 13, who has a degree in Music (and who specializes in musical performance) made the following comment:

> "With the facet that we were looking at, it was interesting to hear what the transposed phrase sounded like ..." (Participant 13)

Comments against this question (q2) also tended to make some suggestions for improvement. Following the above comment, Participant 13 went on to make a suggestion:

> "I would like to see it incorporate rhythm and volume of sound and a few musical variations like staccato and legato, varying tempi etc." (Participant 13)

Were the Interactions Able to Promote 'Creative Reflection'? (q3 and q6)

The average scores of 3.35 (for question 3), and 4.35 (for question 6) we feel are further indicators that MetaMuse is 'on the right track'. However, one comment made against question 3 recognized the need for a more sophisticated analysis of what has already been said by the learner, in order to avoid repetition:

"It would probably be more helpful if it were able to pick up on key words in the responses and therefore not ask questions which have already been answered. However, the process of evaluation is useful, although I'd be interested to see how it coped with larger structures." (Participant 4)

The issue raised in the ending of participant 4's comment above ("I'd be interested to see how it coped with larger structures") was also picked up by participant 5 ("Needs to explore further how small components can contribute to a larger frame (structure : form)"). Indeed, in her comments with respect to question 3, participant 8 (who plays classical guitar) made the following useful suggestions about the way MetaMuse tutors phrases:

"Not always clear quite what was required — needed "tuition" element — e.g. we are now going to look at phrasing marks; the effect of phrasing marks on a particular sequence — now try it out. Difficult to say how would phrase if cannot try it out. Difficult (for me) to say how would play without seeing it written in standard notation." (Participant 8)

Future work could develop MetaMuse's ability to work with larger phrases and sections (i.e. structures). The question of musical notation is more problematic. In the design of MetaMuse we deliberately avoided the use of notation and opted for numerical transposition values. The reason for this was that we wanted learners with varying musical backgrounds to be able mentally image their musical ideas. Hence the use of the numbers would, we hoped, assist in this process of imaging (we could not assume that users were able to read music). However, future versions of MetaMuse could include the ability to handle musical notation. The impact of doing this on the types of interactions and reflections that would then take place is, however, unclear.

The responses to question 6 (which received the highest average score for any question, at 4.35) was very positive, and as such several selected comments are included below:

Participant 2: Except on a one to one basis, I cannot imagine any other way of achieving this experience. This does test and help develop memory and critical thinking in a relatively non-threatening manner.
Participant 3: Most undergraduates would be at too high a level. Better on Primary/Secondary.
Participant 4: Overall, I think this could be very useful in terms of a learning tool in encouraging students to think about both local events and (potentially) larger scale events; and the process of constructing events to create cohesive work.
Participant 5: Excellent introduction to awareness of sound.
Participant 8: Hearing rather than seeing a representation of the phrase is useful.
Participant 11: This is the basis for all my own compositions, and I am trying to encourage this approach in other subject areas by assessing reflections rather than task solution.
Participant 12: Would be useful to music education even at late primary/secondary level.
Participant13: It is a good approach because encourages composition in the head without playing first, which is a very useful skill.
Participant 17: Quite a lot of potential.

Interestingly participant 3 (who was the only music teacher participant not to give question 6 a score of 5 out of 5) is not actually a composition lecturer, unlike participants 2, 4 and 5, who do teach composition at undergraduate level and who do see the 'full' potential for MetaMuse to teach creative reflection.

Could MetaMuse be used in the Classroom with Students? (q4)

As far as Part 1 of the evaluation went (i.e. participants 1 to 5), opinion on question 4 seemed to be split between those who do not teach composition (participants 1 and 3, who thought that MetaMuse may be appropriate in schools) and those who do teach composition (participants 2, 4 and 5, who thought it would be useful for first year undergraduates). Participant 12 (who is a research fellow in computing, but who plays the bagpipes) in his comments, quoted above in the context of question 6, appears to agree with participants 1 and 3. Subject 13 also added to the split decision on who MetaMuse should be aimed at:

"I would see this tool to be more appropriate at the secondary or 6th form level. I think it would be a bit basic for undergraduate level." (Participant 13)

If MetaMuse were given more domain knowledge then we feel that it would appear more convincing to non-composition teachers and undergraduate users. Improving MetaMuse's domain knowledge would provide an interesting project for future work. However, once again we should point out that the implications for MetaMuse (in terms of the type of interactions and reflective thinking that it would then encourage) of 'adding' more domain knowledge remains unclear. The approach taken in MetaMuse is to constrain what the composer is allowed to do. This is a perfectly valid compositional learning technique, often called a study or exercise.

Evaluation of the Help Screens and Messages Provided by MetaMuse (q5)

This question received the lowest average score (2.76). The help screens and the language used by MetaMuse clearly need improving. Participant 2 (when actually answering question 2) probably put his finger on the weakness of the help screens and messages:

> "The language and display of text needs a radical rethink! A session with students on the language used would be essential - and a good thing to do anyway as this kind of formal language use is not (but should be) encouraged." (Participant 2)

The many responses to question 5 provided us with a useful source of user data on how to go about improving the usability of MetaMuse.

Conclusions

This paper has described the evaluation of MetaMuse, a pedagogical agent that aims to foster learner problem-seeking and creative-reflection. The questionnaire approach to evaluation provided us with a useful snapshot of user opinions about MetaMuse. However, the above evaluation of the teaching agent did not give us any insight into the following question: what are the interactive means by which learning agents engage in cooperative problem-seeking? Future work will focus on both answering this question (by undertaking detailed dialogue interaction analysis of part 2 of the evaluation) and on improving the learning support provided by MetaMuse by drawing on the evaluation results discussed above.

References

Auker, P. (1991). Pupil Talk, Musical Learning and Creativity. *British Journal of Music Education,* 8(2), 161-6.

Cook, J. (1994). Agent Reflection in an Intelligent Learning Environment Architecture for Musical Composition. In Smith, M., Smaill, A. and Wiggins, G. (Eds.), *Music Education: An Artificial Intelligence Approach, Edinburgh 1993* (pp. 3-23). London: Springer-Verlag.

Cook, J. (1998). Mentoring, Metacognition and Music: Interaction Analyses and Implications for Intelligent Learning Environments. *International Journal of Artificial Intelligence in Education,* **9**, 45-87.

Johnstone, A. (1996). Techniques of Composition in the British and Irish University Curriculum. *British Journal of Music Education,* 12, 247-272.

Lerdahl, F. (1988). Cognitive constraints on compositional systems. In Sloboda, J. (Ed.), *Generative Processes in Music: The Psychology of Performance, Improvisation, and Composition.* New York, NY: Oxford University Press.

Lipman, M. (1991). *Thinking in Education.* New York: Cambridge University Press.

Acknowledgements

MetaMuse was developed as part of the Cook's Ph.D. Thesis (awarded 1998), which was carried out at The Open University (UK) under the supervision of Michael Baker and Simon Holland. Part 2 of the evaluation of MetaMuse was done with the help of Matt Smith. Thanks to the anonymous reviewers for their comments.

Radical Constructivism and Beyond The Information Given: Emergent Models from a Postgraduate Web-based Course

Shirley Corrent-Agostinho
Ph.D Candidate
Faculty of Education
University of Wollongong
Australia
shirley_agostinho@uow.edu.au

John Hedberg
Professor of Education
Faculty of Education
University of Wollongong
Australia
john_hedberg@uow.edu.au

Abstract: A collective case study examined the change in pedagogy that occurred in a postgraduate Information Technology in Education subject that utilised World Wide Web technology. Two implementation cycles were examined. The model that surfaced from the first case correlates with a Radical Constructivist approach (von Glasersfeld 1995) and the model that emerged from the second case maps with the Beyond The Information Given (BIG) constructivist framework (Perkins 1991). This paper describes the parallels of theory to practice and raises implications for the design of web-based learning environments.

Introduction

This study examined the pedagogical change that occurred in a course that was delivered using network-based technologies. Using a collective case study method (Stake 1997), the researcher (primary author) was a participant observer in a postgraduate course offered by the Graduate School of Education at the University of Wollongong over two years. The research focus was to examine the interactions that occurred amongst the students and the instructor. In addition to participant observation, data was gathered from student and instructor interviews and via a collection of artifacts such as student work, computer-mediated communication transcripts and email messages. The model that emerged from each implementation parallels two theoretical constructivist frameworks. Case One parallels Radical Constructivism (von Glasersfeld 1995) whilst Case Two parallels a Beyond the Information Given (BIG) approach (Perkins 1991).

As part of the initiative by the Faculty of Education to investigate flexible delivery strategies, in 1996 the postgraduate course: *Implementation and Evaluation of Technology-Based Learning* was chosen as a pilot study to explore the use of internet and videoconferencing technologies. The introduction of these technologies enabled students to experience the use of technology whilst learning about its use in an educational context. Two different implementations were undertaken one in each year.

In the first case, there were two geographically separate classes. Eight students met on campus and six students met at another site 80 kilometres away. Both classes were held on the same evening for three hours over a semester of fourteen weeks. Videoconferencing, a subject Web site and computer-mediated communication tools facilitated interaction between the two sites. The instructor physically attended each site on alternate weeks. The researcher physically attended every on-campus class.

The content material was structured so that a new topic was addressed each week. The first five weeks were structured as instructor-led sessions delivered via videoconferencing and computer-mediated communication tools. The remaining nine weeks were structured as student-led sessions. Assessment requirements were based on individual work and consisted of three assignments. The first assignment was a seminar presentation that was to be conducted as a collaborative exercise between two students, one from each site. Seminar presentations began from Week Six of the course. Students had to facilitate a discussion for the entire evening and had to create a web page and provide online activities to engage both sites as one class. A grade was given based on a theoretical paper that accompanied the presentation. The last two assignments were due at the end of the semester. One involved developing a portfolio of resources that each student found relevant in terms of the content of the course and the other involved producing an evaluation report of the implementation of the course as a technology-based learning project or of an educational software package of the students' choice.

The lessons learnt from this case were used to redesign the teaching and learning environment for the subject offering in the following year. For this second case, the subject was implemented using internet technology. There again were two geographically separate classes. Eleven students met on campus and six students met at the remote site. The two classes ran on different evenings for three hours. During the fourteen week semester, students attended eight class meetings, which were scheduled approximately every second week (Weeks 1, 2, 4, 6, 8, 10, 11 and 14), and participated in asynchronous and synchronous online discussions during the non-meeting weeks. A web site facilitated interaction among the students and instructor outside class time. The instructor physically attended every face-to-face meeting. The researcher attended the face-to-face classes held on campus.

Assessment was restructured and comprised four assignments. The first assignment was due in Week Four and involved writing a paper about evaluation theory and its relevance to technology-based learning. A Web page on an agreed topic was to be completed by Week Eight. Students then had to evaluate all the Web pages and produce an evaluation report by Week Eleven. The last assignment involved developing and presenting an evaluation proposal. It was due in the last week (Week Fourteen) and was completed and graded as a group project. These assessable tasks were structured so that the first three tasks could be used as resources for the final group project. Content material was provided to help with the completion of an assessment task. The concept of a Web page replaced the need for content to be presented in a weekly sequence in class time as the content was now available in electronic form and accessible at a time and place convenient to the students.

The instructor incorporated several online activities during the semester. The first online activity involved students working in small groups to discuss asynchronously, the content required for the first assignment. Each group worked on different content and posted a summary of their discussions to the subject web site. The intention was that students could use the summaries produced by the different groups as resources for the first assignment. Other online activities included synchronous and asynchronous discussions regarding particular content.

Constructivism—Its Application in Technology-Based Learning Environments

Jonassen, Mayes & McAleese (1993) argue that "constructivistic learning environments are most effective for an advanced knowledge acquisition stage of learning", which is mostly required and promoted in university education. The underlying premise that purports a constructivist approach is the epistemological belief that knowledge is not an objective reality, that is, exists "outside the mind" but rather, it is internally constructed. "Knowledge is a function of how the individual creates meaning from his or her experiences; it is not a function of what someone else says is true" (Jonassen, Davidson, Collins, Campbell, & Haag 1995, p. 11). What constitutes a constructivist approach to teaching and learning, particularly within a technology-based learning environment? Much of the current educational technology literature is devoted to this issue and several frameworks have been presented (for example: Jonassen et al. 1993; Jonassen et al. 1995, p. 13-14; Duffy & Cunningham 1996, p. 177; Robyler, Edwards & Havriluk 1997, pp. 70-72; Jonassen 1999, pp 2-7, 193-201). From a coalescence of this literature, four generic principles essentially characterise a constructivist learning environment:

1. *Learning is a process of construction.* Learners are provided the opportunity to actively create their own meaning from their current and past experiences and prior knowledge rather than passively learn the instructor's interpretation of the content.
2. *Learning occurs through social negotiation of meaning.* Learners are able to collaborate with peers.
3. *Learning is contextually mediated.* Learners are immersed in authentic contexts.
4. *Reflective thinking is an ultimate goal.* Learners are encouraged to think about their own thinking processes.

The degree in which these generic principles are manipulated has given rise to various interpretations of constructivism ranging from "mild" (Boudourides 1998) or "trivial" (von Glasersfeld 1993 cited in Geelan 1997) constructivism to "radical constructivism" (von Glasersfeld 1995). Perkins (1991, p. 20) states: "Almost all educators and psychologists are constructivists of some stripe these days. But battles rage concerning just how constructive one should be." Phillips (1995, p. 5) claims: "As in all living religions, constructivism has many sects..." Several frameworks for comparing the different forms of constructivism are presented in the literature (see Perkins 1991; Phillips 1995; Geelan 1997; Roblyer et al. 1997; Boudourides 1998). Perkins (1991) differentiates two forms of constructivism: Beyond the Information Given (BIG), and Without the Information Given (WIG). These two forms are based on the amount of intervention provided by the instructor. Phillips (1995) presents a complex comparison framework made up of three dimensions: (1) The individual construction of knowledge versus the construction of human knowledge in general (p. 7); (2) "Humans the creators versus nature the instructor" (p. 7). That is, 'is individual knowledge created actively in the mind or imposed from the outside?'; (3) The active construction process can be described in terms of individual cognition or in terms of social and political process (p. 9). Geelan (1997) provides a synthesis of six different forms of constructivism based on a two-dimensional comparison model: (1) Individual versus social learning, (2) Epistemological belief, that is, objectivism versus relativism. Robyler et al. (1997, pp. 65-70) describes various degrees of constructivism in the form of different learning theories and the amount of intervention provided. For instance, they claim that cognitive flexibility theory is a form of radical constructivism as it suggests little direct instruction. Boudourides (1998) presents various "streams" of constructivism along a continuum from "mild" to "radical". Petraglia (1998), however, presents a different argument with respect to the application, or as he states "misapplication", of constructivism. Petraglia states: "educational technologists have fundamentally misunderstood the challenges posed by constructivism. This is seen in an approach to contextualising learning that I call *preauthentication*" (p. 58). He goes on to explain:

> A problem with the goal of authenticating learning arises when we remember that constructivism argues that the world is not understood independently of our experiences, and that, therefore, any sense of authenticity can be neither predetermined nor preordained... educational technologists have responded to this epistemological dilemma by creating problems and environments that they have determined to be authentic; we might call this practice preauthentication. (p. 58-59)

A synthesis of the different conceptions of constructivism is provided in Figure 1. It is a somewhat simplistic view but merely serves as an illustration to situate the differences in constructivist approaches that surfaced from the collective case study.

Preauthenticated learning environments (Petraglia 1998)	Cognitive Flexibility Theory (Spiro, Feltovich, Jacobson, & Coulson 1991)
Beyond information given (BIG) (Perkins 1991)	Radical constructivism (von Glasersfeld 1995) Without information given (WIG) (Perkins 1991)

More — Amount of intervention provided — Less

(Examples of interventions include: assistance/guidance from instructor; the nature and structure of tasks assigned to students)

Figure 1: Different conceptions of constructivism

Comparing the Two Cases

Interestingly, the model that emerged from each course implementation parallels with the characteristics of constructivism provided at the two extremes in Figure 1: Case One exemplifies a radical constructivist learning environment whilst Case Two is an example of the Beyond the Information Given approach. (See Hedberg & Corrent-Agostinho 1999 for a discussion of the themes that emerged from each case.) Both cases are described in terms of how the four generic constructivist principles identified above were implemented in practice and how the technology was incorporated.

1. Learning is a process of construction

The following description illustrates the difference in emphasis of the knowledge construction process in the two cases. Students in Case One experienced an ill-structured knowledge domain (Spiro et al. 1991) whereas students in Case Two were provided with learning scaffolds via the progressive nature of the assessment tasks.

Case One: Although the course content material was pre-determined, the pilot nature of the course delivery afforded students the opportunity to experience a "real-life" technology-based learning implementation, that is, an ill-structured knowledge domain. Different computer-mediated communication tools were introduced during the course and the entire class (instructor included) was learning about computer-mediated communication by experiencing it. The role that technology played was as much the message as the medium. Students were introduced to the technology to learn about it. As such, the technology was not transparent and integrated seamlessly in the course, it was as much the focus as the content material. The following example of student feedback highlights the significance of such a learning environment.

> The subject was a valuable learning experience despite the technical glitches, periodic support problems and communication difficulties. We learnt as much about implementation of technology-based learning through the failed attempts to innovate as we did through the more traditional presentations and reading. There was a very heavy workload and a real danger of cognitive overload in this course. It challenged us to extend ourselves, perhaps unrealistically in terms of our part-time status and work commitments, but we mostly rose to the occasion.

Students experienced tolerance for ambiguity (Jonassen & Grabowski 1993). They had to manage their own learning experience and had to facilitate their own discussion when the instructor was not physically present. Whilst some students rose to the occasion, as exemplified in student comments such as: "There's one thing about all these hiccups [referring to the use of the technology]. They make you think and you really learn how to cope with things that don't work and strategies to try to make them work." (Evaluation Report); others found the teaching and learning process challenging, for example: "I found the lecturer's style...vague, loose and unstructured. In some tutorials I really had no idea of what was going on, or what was expected of me. I feel I was not alone. I found this style frustrating and annoying." (Evaluation Report)

All assessment was based on individual work and was not used to scaffold the learning process. Specific assessment criteria were not provided. The assignments were open-ended and tailored to the individual. For example, the portfolio was based on individual student relevance. There was no set format for the evaluation report discussed. These two assessments were very individual in nature. It was left to the students to decide how to approach the task.

Case Two: The second implementation was structured so that the assessment tasks drove the learning process. The assessment tasks acted as scaffolds as each task informed the next subsequent task. Student feedback from the end-of-subject questionnaire (N=15) indicated that the majority of students thought the sequence of the assessment tasks was appropriate. There were several students that commented that the first assignment was "too much too soon" (4 students). For example, one student commented: "I felt the first assignment was too early to have formed any views in the subject".

The technology was integrated into the learning process. Computer-mediated communication tools were introduced at the beginning of the subject and students were given the opportunity to learn how to use the tools before online discussions tool place. The technology was used as a vehicle for students to interact with each other. It became more transparent in this case than in Case One.

The themes that surfaced in this case suggest that students experienced a lesser degree of tolerance ambiguity than in Case One. The data suggests the following factors were influential: The scaffolding nature of the assessment tasks, the instructor being physically present with each class during meeting weeks, and more stringently defined assessment criteria than in Case One.

2. Learning occurs through social negotiation of meaning

The nature in which learners were able to discuss content issues with peers differed between the two cases. In Case One, the interaction amongst students was predominantly of a synchronous nature that occurred on a weekly basis. That is, interaction amongst students, both face-to-face and online, occurred mostly during class time. In addition, there was little opportunity for students to reflect and build on content discussions as discrete content "chunks" were discussed each week. In Case Two, the technology was used to encourage both synchronous and asynchronous discussions. The asynchronous online mode afforded students the opportunity to build on the discussion during the course. Also, the nature of the assessment tasks encouraged student collaboration. For example, collaboration was encouraged in the first online task as students discussed content in small groups and each group produced an online summary. Also, the final assignment was structured as group project.

3. Learners are immersed in authentic contexts

The degree of "authenticity" differed between the two implementations. The description below explains how students were afforded with an authentic context in Case One and a pre-authenticated context (Petraglia 1998) in Case Two.

Case One: The "real world" task was the course itself. Due to the pilot nature of the course delivery students experienced problems that were not pre-determined by the instructor. They were also able to evaluate the implementation as part of their assessment. Thus both students and the instructor were immersed in an authentic setting for the entire duration of the course. The following student feedback illustrates the perceived value of this learning context.

> I guess one of my own observations about this course is that most of us spend a great deal of time discussing the technology and its use. This breaks us from the 'formal' side of discussion in the classroom and I think is a statement about the power of what we are doing. I'm not quite sure why this is happening though. I think this in itself is marvellous as we all seem to share the same concerns/thoughts etc....The other interesting observation from my conversation's with others is that everyone seems to be trying really hard to use the technology to its capacity. The last few seminars I think have been markedly different and successful in their own rights....We really seem to be gently pushing the boundaries and experimenting - great stuff!...At the end of the day, I hope that the course and process ends up by being one huge experiment whereby we can reflect on VC, social interaction and learning. Perhaps we can also reflect on what technology really is capable of doing because we've been there. (Email message from student to researcher, Week 9)

Case Two: The instructor imposed more structure in the course via the four assessment tasks and the technology innovation was at a more routine form of use (Hall & Hord 1987). Thus the element of experimentation that students experienced in Case One was not as great. The "real world" context was confined within the assessment tasks particularly in the final group project. This assessment task was deemed an authentic task by the instructor. It was pre-determined before commencement of the course. Such a learning context is claimed by Petraglia (1998) to be preauthenticated.

4. Reflective thinking is an ultimate goal

The degree to which students exercised metacognition differed between the two cases. In Case One, reflective thinking was encouraged via the open-ended nature of the tasks and the recursive nature of the tasks. The evaluation assignment of the course itself enabled students to reflect on their experience during the course.

The student seminars also provided opportunity for reflection as students could refine their implementation strategy after reviewing other seminar strategies. In Case Two, the reflective thinking component was isolated within each task. The instructor encouraged students to reflect on their experience in completing each assignment during the face-to-face class discussions.

Conclusion and Implications

This study has demonstrated two different approaches that fall under the "constructivist" banner and the different emphasis in learning outcomes each approach can generate. The instructor contends that effective learning outcomes were achieved in both cases, however, there was a difference in their emphasis. Case One fostered exploration and afforded students to reflect on their own practice. As such, the learning outcomes were directly attributable to the amount of reflective thinking performed by the students. In Case Two, students were able to compartmentalise their learning into manageable "chunks" that were more clearly identifiable than in Case One and the sense of exploration was diminished.

The use of the technology in both cases from a "mechanical" form of use to a more "routine" form of use illustrates a consistency with the Concerns Based Adoption Model (Hall & Hord 1987). This study, however, highlights an added dimension to the change process advocated by CBAM. Unlike the change process being only confined to the instructor of the innovation, Case One demonstrated that students were also engaged in the change process. The experimental nature of Case One created a community of researchers that explored the nature of their own learning process and how lessons could be transferred in other web-based learning contexts. This particular approach is not often attempted, possibly as the role of the instructor as a co-learner is not comfortable and can be seen as less disciplined. However, the resulting enthusiasm and learning growth of the students in this case demonstrated the potential gains from this approach. An implication for postgraduate education may be that instructors, rather than embarking on a solitary journey of innovation when teaching technology-based content, can invite students to experience the journey, thus producing a community of learners.

The maturity of each student cohort will greatly influence the outcome and the learning experience. The course content and the focus on change as being both a process and the content of the subject provide a powerful focus for learning. Unlike much of the change literature, if the concerns of the instructor are met, the radical view might achieve greater personal movement in the students. It also enables each student to address their own concerns and move from mechanical and routine use of technology in the learning process through to a renewal and reassessment of their own personal expertise to employ the technology as a professional educator.

References

Boudourides, M. A. (1998). Constructivism and education: A shopper's guide. Available URL: http://www/duth.gr/~mboudour/mab/constr.html [Accessed: October 1999]

Geelan, D. R. (1997). Epistemological anarchy and the many forms of constructivism. *Science & Education*, 6, 15-28.

Hall, G. E., & Hord, S. M. (1987). *Change in schools: Facilitating the process*. Albany, NY: State University of New York Press.

Hedberg, J., & Corrent-Agostinho, S. (1999). Creating a postgraduate virtual community: Assessment drives learning. Educational Multimedia, Hypermedia & Telecommunications, 1999, Association for the Advancement of Computing in Education, Seattle, Washington. 1093-1098.

Jonassen, D., Mayes, T., & McAleese, R. (1993). A manifesto for a constructivist approach to technology in higher education. Available URL: http://led.gcal.ac.uk/clti/papers/TMPaper11.html [Accessed March 1999]

Jonassen, D, H., & Grabowski, B. L. (1993). *Handbook of individual differences, learning, and instruction*. Hillsdale, NJ: Lawrence Erlbaum.

Jonassen, D. H., Davidson, M., Collins, C., Campbell, J., & Haag, B. B. (1995). Constructivism and computer-mediated communication in distance education. *The American Journal of Distance Education*, 9(2), 7-26.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective*. Upper Saddle-River, NJ: Prentice-Hall.

Perkins, D. N. (1991). Technology meets constructivism: Do they make a marriage? *Educational Technology*, 31(5), 18-23.

Petraglia, J. (1998). The real world on a short leash: The (mis)application of constructivism to the design of educational technology. *Educational Technology Research and Development*, 46(3), 53-65.

Phillips, D. C. (1995). The good, the bad, and the ugly: The many faces of constructivism. *Educational Researcher*, 24(7), 5-12.

Robyler, M. D., Edwards, J., & Havriluk, M. A. (1997). *Integrating educational technology into teaching*. Upper Saddle-River, NJ: Prentice-Hall.

Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1991). Knowledge representation, content specification, and the development of skill in situation-specific knowledge assembly: Some constructivist issues as they relate to cognitive flexibility theory and hypertext. *Educational Technology*, 31(9), 22-25.

Stake, R. E. (1997). Case study methods in educational research: Seeking sweet water. In R. M. Jaeger (Ed.), *Comtemporary methods for research in education* (2nd ed.) (pp.399-446). Washington, DC: American Educational Research Association.

von Glasersfeld, E. (1995). *Radical constructivism: A way of knowing and learning*. London: Falmer Press

Design Patterns for Web-based Instruction

Lester Cowley
Department of Computer Science and Information Systems
University of Port Elizabeth
P.O. Box 1600, Port Elizabeth, South Africa, 6000
csanlc@upe.ac.za

Janet Wesson
Department of Computer Science and Information Systems
University of Port Elizabeth
P.O. Box 1600, Port Elizabeth, South Africa, 6000
csajlw@upe.ac.za

Abstract: The use of the World Wide Web for education is increasing rapidly, but the usability and utility of instructional Web sites varies greatly. The difficulty experienced by designers in mapping instructional design activities onto instructional systems is a major cause of this. Thus there is a need for ways to make instructional design more accessible to non-instructional designers. Evolving standards in learning technology exacerbate this problem. Using patterns in instructional design may help. This paper reports on work in progress on developing an instructional design pattern language for Web-based learning materials and its planned use in the development of a post-graduate Human-Computer Interaction (HCI) course to be offered via distance education.

Usability Problems of Educational Web Sites

Many researchers and professionals realise that the usability and utility of World Wide Web sites varies greatly (Nielsen 1995). This observation also applies to educational Web sites, many of which are merely electronic page-turners. The use of the World Wide Web (WWW) as one of the delivery systems for asynchronous and semi-synchronous distance education and training is growing at an astonishing rate. Institutions of higher learning, government, business and industry will continue to rely ever more heavily on the WWW for this. Thus it is in the interests of progressive societies that the usability and utility of educational Web sites be improved, particularly those providing formal instruction. By "formal" is meant "in an institutional setting". To improve these two qualities will require using some systematic way of reengineering existing educational Web sites (if this is feasible) and constructing new ones, that goes beyond mere layout aesthetics or page mechanics. What systematic ways of doing this are there? The next section will discuss one possible solution: instructional design.

The Need for Instructional Design

According to Berger and Kam, instructional design as a process is "the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It is the entire process of analysis of learning needs and goals and the development of a delivery system to meet those needs. It includes development of instructional materials and activities; and tryout and evaluation of all instruction and learner activities." (Ryder 1999)

The first task of instructional design is to choose an instructional design model. An instructional design model is an abstract perspective on how learners learn from others, and its choice will determine how the remaining activities of instructional design (described above) are carried out. There are about three dozen models (see the very good Instructional Design Models Web site at (Ryder 1999)). Fortunately, some instructional design models are more popular and well known than others. Two of the most popular models are Constructivism and Instructional Systems Design (ISD). Constructivism views learning as an active, personal construction of meaning about the world by learners and is popular in the educational realm (schools and universities), although not universally so. ISD views learning as a matter of conditioning learners to provide the correct responses to stimuli, and is rooted in behaviourism. It still dominates in the training realm (government, business and industry).

An instructional delivery system presents learning content (instructional materials and activities) to learners, who interact with the content, giving feedback on their interaction. Hopefully the learners will emerge from the experience changed in a positive sense. The delivery system need not be computer-based. Good instructional design is a pre-requisite for producing a good instructional delivery system. But instructional design is more complex than the short list of activities shown above might suggest. It is a specialist field and is difficult to do well, requiring expert knowledge and a considerable investment of time and effort, usually by a team of developers rather than an individual. How can instructional design be made more accessible to those who develop instruction, most of whom are not professional instructional designers? The following section will discuss the concept of pattern languages and how they can be used to assist in the design process.

Patterns and Pattern Languages

Patterns and Why They Are Better

The most important property of modern computer software is the level of support that it provides for the underlying user activities. The interaction between software and users takes place through its user interface (UI), and thus a well-designed UI that properly supports the tasks of users is essential. Considerable empirical research has been done on designing usable UIs (Newman 1995). This research includes general UI design guidelines and domain-specific guidelines for the WWW and general hypermedia (Lowe 1999) (Nielsen 1995). Despite these guidelines, a large number of usability problems still occur (Wesson 1999). This is because design guidelines may be imprecise, have limited applicability and be contradictory.

Patterns may be a better way of designing UIs than guidelines (Tidwell 1999) (Wesson 1999), A pattern is a way of documenting a successful solution to a recurring problem in an application-independent, concrete manner, so that the solution can be applied in many contexts (reused). A pattern is generally derived from experience (by induction through a process called pattern mining, which is both tentative and collaborative) and is not the same as a stylistic rule. Its pre-scientific, humanistic approach runs contrary to the deductive approach of much of Computer Science and Software Engineering. Unlike guidelines, patterns are precise, are applicable in many contexts and harmonise with neighbouring patterns. Patterns can form a framework in which HCI knowledge can be structured, and be a communication tool within HCI and between other disciplines—like instructional design, for example.

A Short History of Patterns

Pattern languages were first proposed by Christopher Alexander et al. in building architecture (Alexander 1979) (Alexander 1987). They have proved useful and popular in object-oriented design (OOD) (Gamma 1995), and in a number of other areas of Software Engineering. Pattern languages as used in Software Engineering are also rooted in the literate programming movement started by Donald Knuth (Thompson 1997). Software Engineering patterns range in granularity from programming language-specific idioms to general design principles. There is an active on-line OOD community, exemplified by the Patterns Home Page (Sane 1999). There is also a small but growing patterns group in the HCI community (see e.g. (Erickson 1999), (Tidwell 1999) and (Wesson 2000)) and among those who model organisational structures.

Structure of Patterns and Pattern Languages

Patterns have a standardised format that is generally discipline-dependent. For example, the classical Alexandrian format for a building architecture pattern consists of a meaningful name for the pattern, examples of contexts in which the pattern is used, a description of the problem which the pattern solves and a listing of the external forces which act to shape a solution. The last two parts of an Alexandrian pattern are a solution that explains what must be done to solve the problem and the context in which one would use the pattern, plus any additional information required. The OOD pattern community uses a different format (Gamma 1995).

A pattern language (Salingeros 19--) is an interconnected group of patterns. A pattern language may be visualised as a graph, made up of nodes (individual patterns) and edges (the functional relationships between patterns). Good pattern languages have the properties of internal consistency and connectivity to other pattern languages at their applicability boundaries. Pattern languages are usually hierarchically structured in that a particular pattern's applicability is limited to a certain level in the hierarchy, supporting larger-scale patterns and being supported by smaller-scale patterns (HCI pattern languages may be an exception (Tidwell 1999)). They provide superior ways of understanding and creating complex systems. The OOD pattern community does not make use of pattern languages, but rather of catalogues, which are lists of useful programming language-specific patterns.

The Case for an Instructional Design Pattern Language

Difficulties in Mapping Instructional Design Models onto Instructional Systems

A search of the Web reveals numerous general tutorials of varying quality on Web page design that deal with layout aesthetics, HTML, DHTML, XML, Java and JavaScript coding or the use of various Web authoring tools (e.g. http://www.taxpolicy.com/tutorial/httutor.htm). Tutorials and on-line documents that focus on practical issues connected with applying instructional design to educational Web sites, or hypermedia modelling (Lowe 1999) for educational Web sites, are far fewer in number. There are many good online resources on instructional design (e.g. (Kennedy 1997)), but the theoretical treatment of models like Cognitive Apprenticeship and Conversation Theory is difficult to translate into Web sites that work, particularly for those who are not instructional designers. What is needed is a way to map instructional design models onto design activities in a practical, straightforward way.

Evolving Instructional Technology Standards

A development which will also increase the need for a practical, straightforward way to perform instructional design tasks is the work being done by the IEEE 1484 Learning Technology Standards Committee (LTSC) on the Learning Technology Systems Architecture (LTSA) (Ryder 1999). This is being done in close collaboration with Educom's Instructional Management System (IMS) Project, the Aviation Industry CBT Committee (AICC), and the US Department of Defense's Advanced Distributed Learning (ADL) project. It includes specifying an architecture/reference model, and learning objects and their metadata.

Although the LTSA and its associated projects seem to have a slight training (ISD) emphasis, there seems little doubt that they will change and expand computer-assisted learning, especially via the Web. One of the changes will be a push towards harnessing the creativity of individuals, academic institutions and businesses in the production of large numbers of learning objects, each of which serves an educational objective (or a few objectives). These will be given away or more likely sold. Educational programmes will be produced by selecting the necessary learning objects and combining them by means of instructional management systems.

As more effort is put into producing instructional materials, the set of learner interactions is likely to become richer, compared to the rather impoverished interaction set generally now possible with the low-bandwidth WWW (server-side ASP pages, and client-side plug-ins, applets and scripts notwithstanding). XML and Java will play an important part in this. One can conceive of the production of families of learning objects that conform to a particular instructional design model, like Andragogy or Computer-Supported Collaborative Learning. As this push gains momentum, the need for instructional design knowledge by learning object developers will become greater, as the draft standards are all pedagogically neutral. In addition, knowledge of how to build highly usable systems that make use of the richer set of learner interactions will become more important.

Thus there is a need for very practical assistance for non-expert developers of Web-based learning materials in these two interwoven areas of instructional design and UI design, and this will increase as the Web (and the Internet) expands and becomes increasingly pervasive. An instructional design pattern language could be of assistance, particularly when one considers that the two major commercial instructional design ("pre-authoring") software tools support ISD only. Such a language could be built into an electronic performance support system for the use of developers.

Related Research

There are a number of projects that are related to the work described in this paper and these may be studied with profit. (Bernstein 1998), (Nanard 1998) and (Lyardet 1998) are examples. The international Pedagogical Patterns Project of Manns et al. (Manns 1999), which focuses on patterns for teaching object technology (a special case of (probably) synchronous, non-distance, non-computer-assisted learning) and the pattern languages for instructional multimedia interface design project of Dimitrova (Dimitrova 1999) are further useful examples. This list is not exhaustive.

Examples of Instructional Design Patterns

At the INTERACT'99 HCI Patterns Workshop, a classification scheme for HCI patterns on the basis of scale was proposed (Borchers 1999). This scheme, in decreasing order of scale, consists of the following levels: Society (beyond systems), Multiple Users, Social Position, System, Application, User Interface Structure (dialog), Components (containers, windows, layout), Primitives (buttons and other simple widgets) and Physical Properties. Instructional design patterns (which are at least partially HCI patterns) map onto the System and Application levels. The greatest rate of change in real-world systems takes place between the System and Components levels, inclusive, and patterns that map onto these levels may become obsolete quite quickly. It is wise to be aware of this possibility for instructional design patterns.

To illustrate how instructional design patterns can assist in mapping models to implementations, two simple instructional design patterns for instructional Web pages follow. These are products of a broader research project that is described in the conclusion to this paper. These patterns were mined by considering two instructional design models, examples of Web-based instructional materials design practice and descriptions of best practice by developers. They deal with *aspects* of the models, not the entire models (there may be an entire pattern language for each model). Since mining patterns is a tentative process, it is customary to call a newly mined pattern a protopattern (Sane 1999) until sufficient empirical evidence through use cases has been accumulated to promote it to the ranks of patterns.

Example 1: Present Initial Knowledge

Present Initial Knowledge, the first protopattern presented, deals with an aspect of ISD: how to present initial knowledge about a topic to a novice learner.
Name: Present Initial Knowledge
Examples: An on-line help screen on how to customise a printed document, step by step. A checklist of activities required when preparing to go to ED-MEDIA 2000.
Context: The learning activity supported is essential for grounding a novice learner in a new learning area.
Problem: How should initial knowledge about a topic be presented to a novice learner?
Forces: A novice learner learning the initial facts, definitions, procedures, etc. of some field must not be distracted by too many choices. The content must be presented in a logical sequence. It must be clear to the novice learner what the purpose of the lesson is, and how to control the display of, and interaction with, the content.
Solution: Create a linear structure made up of one or more relatively short pages/frames, limiting the links to those required for jumping forward and backward between adjacent pages/frames in the linear structure. This structure closely follows the model of conventional, linear text. Structure the content on the pages/frames into logical units that follow a sequence from elementary to more complex. Define all terms used and explain how new objects encountered fit into the overall content. Provide a consistent set of navigation interaction objects on each page/frame. If possible, embed assessment interaction objects in the sequence of pages/frames to allow the learner to practice mastery of the content. It may be desirable to control forward progress to make it conditional on content mastery (e.g. using ASPs or client-side scripts) if a Mastery Learning instructional design model is being used.

The Present Initial Knowledge pattern can be used to evaluate the Web-page shown in Figure 1, which exhibits both strengths and weaknesses. Its strengths are that it is short, its content is logically structured and that it does have some navigation interaction objects. Its weaknesses are that the linearity requirement of forward and backward links is not satisfied, and that terms presented are not defined.

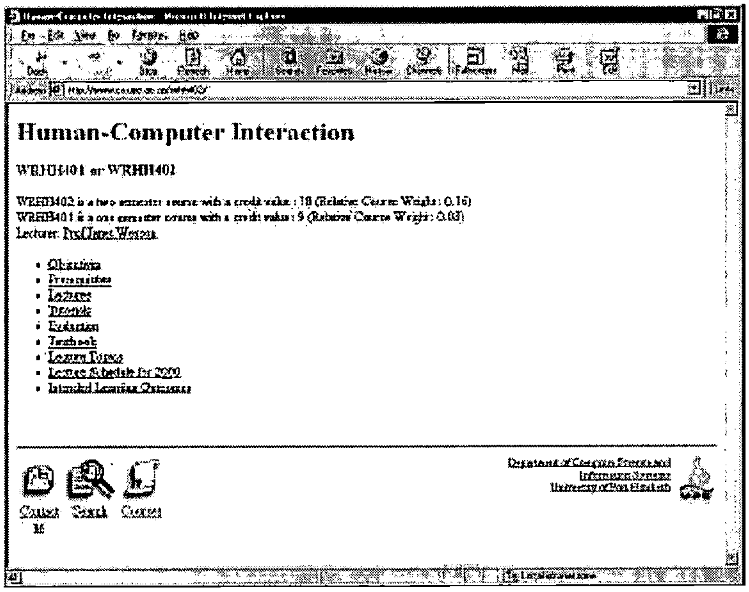


Figure 1: A Web-page to evaluate using the Present Initial Knowledge pattern

Example 2: Fade Out Scaffolding

Fade Out Scaffolding, the second protopattern presented, deals with an aspect of the Cognitive Apprenticeship model. Cognitive Apprenticeship, based on the methods of traditional craft and trade apprenticeships (learning by doing), aims to initiate the novice into a community of expert practice. Scaffolding is support provided while a learner learns to carry out a task. Fading is the progressive reduction of support as the learner become more and more expert at executing the task. This pattern was synthesised from theory and practitioners' exposition of theory; it was not mined from Web-sites.

Name: Fade Out Scaffolding

Examples: A mechanic shows an apprentice how to change a tyre. The apprentice does it herself several times. The mechanic gives a lot of feedback during the first attempt by the apprentice, but as she becomes more proficient, intervenes less and less until at last he can say, "You've got it!"

Context: The learning activity supported by this structure is essential for grounding a novice learner in a new skill, using Cognitive Apprenticeship as a method.

Problem: How should scaffolding provided to the learner be progressively reduced?

Forces: The learning characteristics of the individual novice learner need to be catered for. The skills to be mastered need to be capable of being practised on a Web page (manual skills may be very difficult, but more computational skills are possible). There may be limits on the type of feedback possible.

Solution: Create a linear structure made up of as many pages/frames as required to model the steps or phases of the procedure to be mastered. Limit the links to those required to jump forward and backward between adjacent pages/frames in the linear structure. Place each step or phase in the procedure on a separate page/frame. Provide scaffolding on each page that initially guides the learner in what to do to carry out that step, and gathers data to measure progress with mastery. Keep a learner model whose stored values are determined by learner performance on task. Iterate the learner through the linear sequence. As the learner model reflects improving performance, fade the level and frequency of scaffolding on each page/frame until expert performance is achieved, and then terminate the iteration. Provide a consistent set of navigation interaction objects on each page/frame.

Conclusions and Future Work

The instructional design pattern language proposed in this paper might make it easier for people who are not instructional designers to design educational Web sites of high usability and utility. The investigation of the potential of HCI design patterns for designing technology-supported distance learning programs, particularly those using the Internet, will continue. The project will involve an investigation into the design of several such systems. The goal of this investigation will be to assess the usability of these systems and to identify possible design patterns that have been used. This project also involves an investigation into the general area of HCI design patterns, and specifically those at the Application and Dialogue level that could be applied to the design of distance learning programs. The instructional design pattern language will be used to design a distance learning program for the post-graduate HCI course at the University of Port Elizabeth, that could be incorporated into a virtual classroom environment. The usability of this program will be evaluated in order to validate the pattern language and provide suggestions for improvement.

References

Alexander, C. (1979). *The Timeless Way of Building*: Oxford University Press.

Alexander, C. et al. (1987). *A Pattern Language: Towns, Buildings, Construction*: Oxford University Press.

Bernstein, M. (1998). Patterns of HyperText. *HyperText 98*: Association for Computing Machinery.

Borchers, J., Griffiths, R., Pemberton, L. & Siemon, E. (1999). *Usability Pattern Language: Creating a Community*: undistributed internal draft document.

Dimitrova, M. (1999). Towards a Pattern Language for Instructional Multimedia Interface Design. *INTERACT '99*, IFIP TC.13: IOS Press.

Erickson, T. (1999)[The Interaction Design Patterns Page], [Online], (1999 – last update), Available: http://www.pliant.org/personal/Tom_Erickson/InteractionPatterns.html [1999, October 25].

Gamma, E., Helm, R., Johnson, R. & Vlissides, J. (1995). *Design Patterns: Elements of Reusable Object-Oriented Software*: Addison-Wesley Publishing Company.

Kennedy, D. & McNaught, C. (1997). Design Elements for Interactive Multimedia, *Australian Journal of Educational Technology*, 13(1), 1-22, [Online], Available: http://wwwasu.murdoch.edu.au/ajet/ajet13/wi97p1.html [1999, October 25].

Lowe, D. & Hall, W. (1999). *Hypermedia & the Web: An Engineering Approach*: John Wiley & Sons.

Lyardet, F.D., Rossi, G.H. & Schwabe, D. Using Design Patterns in Educational Multimedia Applications. *ED-MEDIA '98*: Association for the Advancement of Computing in Education, Charlottesville, VA.

Manns, M. et al. (1999). [The Pedagogical Patterns Project], [Online], (1999, July 2 – last update), Available: http://www-lifia.info.unlp.edu.ar/ppp/ [1999, August 12].

Nanard, M., Nanard, J. & Kahn, P. (1998). Pushing Reuse in Hypermedia Design: Golden Rules, Design Patterns and Constructive Templates. *HyperText 98*: Association for Computing Machinery.

Newman, W. and Lamming, M. (1995). *Interactive Systems Design* : Addison Wesley Publishing Company.

Nielsen, J. (1995). *Multimedia and Hypertext: the Internet and Beyond*: AP Professional.

Ryder, M. (1999). [Instructional Design Models], [Online], (1999, October 22 – last update), Available: http://www.cudenver.edu/~mryder/itc_data/idmodels.html [1999, October 25].

Salingeros, N. (19--). [The Structure of Pattern Languages], [Online], (19-- – last update), Available: http://www.math.utsa.edu/sphere/salingar/StructurePattern.html [1999, October 26].

Sane, A. (1999). [Patterns Home Page], [Online], (1999, June 10 – last update), Available: http://hillside.net/patterns/patterns.html [1999, August 5].

Thompson, D. (1997). [The Literate Programming FAQ], [Online], (1997, August 15 –last update), Available: http://shelob.ce.ttu.edu/daves/lpfaq/faq.html [1999, October 26].

Tidwell, J. (1999). [Common Ground: a Pattern Language for Human-Computer Interface Design], [Online], (1999, May 17 – last update), Available: http://www.mit.edu/~jtidwell/ [1999, October 25].

Wesson, J. (1999). Integrating HCI with the Software Development Process. *Proceedings of BitWorld'99*, Cape Town, 30 June-2 July 1999.

Wesson, J.& Cowley, L. (2000) *Selecting Interaction Objects: A Patterns Approach,* to be presented at the CHI'2000 Workshop on Pattern Languages for Interaction Design: Building Momentum, The Hague, The Netherlands, 2-3 April.

The Best Practices Web-Based Tool: Using Technology and Constructivism to Create 4th Grade Instruction that Supports Historical Thinking

Maya L. Creedman
University of California, Los Angeles
Graduate School of Education & Information Studies
Box 95121, Los Angeles, CA 90095
creedman@ucla.edu

Elizabeth Wellman, Ed.D
University of California, Los Angeles
Graduate School of Education & Information Studies
Box 95121, Los Angeles, CA 90095

Abstract: The proposed Best Practices web-based tool is designed to help 4th grade California teachers integrate technology and constructivist learning into existing lessons. The tool guides teachers through the instructional development process to clarify, enhance, and reflect on their instructional practices. Throughout the process, teachers explore and build on specific instructional examples. The resulting instructional lessons use technology and constructivist approaches to engage students in active historical thinking.

Introduction

Technology use in a constructivist learning environment can enhance student learning, specifically, the development of higher order thinking skills. The Best Practices web-based instructional development tool will help teachers develop constructivist learning activities and revise existing instruction while integrating technology and higher order thinking skills simultaneously. Successful technology-integration not only teaches students to use the computer as a learning tool, but can actually improve the quality of instruction by encouraging teachers to apply constructivist principles. Furthermore, higher order thinking skills provide a necessary foundation for learning advanced subject matter.

Many teachers are uncomfortable with using computers for learning and are unsure how to integrate computers into their own lessons successfully. When technology-integration is unsuccessful, it is often because the teacher has not used the computer to enhance learning (Cuban, 1986). The Best Practices tool will provide structured support for 4th grade teachers to integrate technology and constructivism into their existing history lessons to support higher-order thinking. Because the Best Practices tool is designed for history teachers, higher-order thinking skills focus specifically on historical thinking and understanding.

This paper begins with a background on constructivst learning environments, higher order thinking skills and technology as they relate to learning and instruction. Then the challenges facing teachers in developing effective technology-integrated instruction will be explored. Finally, I will explain how the design and development of Best Practices provides this necessary support to teachers.

Constructivist Learning, Higher Order Thinking and Technology

The differences between behavioral and constructivist learning approaches stem from differing definitions of the teaching process (Willis & Mehlinger, 1996). These differing views directly affect the nature of student and teacher roles and the content, context and goals of the learning activities. In traditional instruction students tend to act as recipients of information and the teachers as the deliverers (Brown, 1992). A constructivist learning environment provides more opportunities and motivation for learning through interactive, authentic and student-centered learning activities. In a Constructivist model, both teachers and students act as additional resources for testing and redirecting the student's understandings. In a behavioral setting, activities are likely to be highly structured and geared towards learning a specific set of skills (Willis & Mehlinger, 1996). In a constructivist approach, skills are often developed because the learning activity requires the utilization of those skills.

Constructivist learning engages and supports higher order thinking skills in students. In fact, constructivist pedagogy places more importance on the development of higher-order thinking skills than on specific instructional content (Cadiero-Kaplan, 1999). Common learning goals of constructivist technology-integrated instruction include building on ideas, solving problems and creating research presentations (Cognition and Technology Group at Vanderbilt, 1996). As students build their own knowledge, they analyze, obtain, reconstruct and apply higher order thinking skills. The connection is evident in Honebein's (1996) seven constructivist learning principles. In a constructivist learning environment, students become more responsible for determining the learning process while teachers act as facilitators to support them. In order to support students in being active learners, teachers' roles change from "knowledge givers" to guides or "co-learners" (Resnick, 1996). The focus shifts from "transforming knowledge" to engaging students in acquiring learning skills (Minstrell & Stimpson, 1996). The content, context and goals of constructivist learning activities emphasize multiple perspectives and encourage multiple methods of communication, collaboration and student reflection on the learning process.

Higher order thinking skills specific to the content of history and social studies are well recognized by both National and California State History-Social Science Standards. These historical thinking skills are essential for students to be able to integrate, recount and analyze in the context of time and place, the social, political, scientific, technological, economic and cultural forces that have influenced history (National Center For History in the Schools, 1998). The National History-Social Science standards present five categories of historical thinking – chronological thinking, historical comprehension, historical analysis and interpretation, historical research, and historical issues-analysis and decision making. In other words, instead of simply memorizing information, students should create historical argument and narratives, explain the major events leading to a war or analyze their interrelationship.

In order for students to have the opportunity to develop and use historical thinking skills, they must be exposed to instruction that allows them the opportunity for substantial exploration (Cognition and Technology Group at Vanderbilt, 1996). One approach is to engage the students in authentic history activities (like those in which historians would engage) with historical thinking and strategies support provided (Bain, 1998). Another useful strategy for developing historical thinking skills involves asking students "what if" questions about a presented situation and having them explain their answer (Cognition and Technology Group at Vanderbilt, 1996). For example, history students might be asked what might have happened if the 49ers hadn't discovered gold.

The successful integration of these strategies can be enhanced with technology (Cognition and Technology Group at Vanderbilt, 1996) Recently researchers have begun to explore the benefits that technology and constructivist learning environments bring to each other (Panel on Educational Technology, 1997). It appears that the combination of constructivist learning environments and technology both encourages students to construct their own knowledge and enhances teaching practices (Cadiero-Kaplan, 1999). In addition to supporting authentic and student-centered learning, increasing communication and improving the student's ability to collect and analyze information (Nickerson, 1995; U.S. Government, 1996), technology is specifically useful when it is used to support and model higher order thinking skills for students.

The overall success of technology depends on how it is used (Cognition and Technology Group at Vanderbilt, 1996) and whether it involves any cognitive thinking (Salomon, 1993b, 1991). When technology is used to deliver information to a student, Rogers (1998) suggests that there is little or no increase in learning. If, instead, technology is thoughtfully integrated into the instructional design, curriculum goals, standards and assessment (Kahn, 1997), learning is enhanced "with" computers rather than "from" them (Salomon, 1988). Jonassen and Reeves (1996) determined that technology is most effective when it is integrated into a constructivist environment as a cognitive tool.

Many computer applications currently available in school classrooms can be used as cognitive tools. Applications commonly include communication, spreadsheets database, semantic networks and presentation software -- all of which support student learning processes such as collaborating (the Internet), calculating, organizing and analyzing data (spreadsheets, databases) and representing information (presentation and semantic network software). Telecommunication tools provide students with new opportunities to discuss and collaborate on problem solving (Jonassen & Reeves, 1996). Spreadsheets also support student problem-solving by helping to reorganize and amplify student thinking (Jonassen & Reeves, 1996). Databases enable students to actively manage, categorize, search, and analyze data (Jonassen & Reeves, 1996). Semantic Networks (e.g. Timeliner, Inspiration and Learning Tool) support students' organization and reorganization of information concepts and relationships (Jonassen & Reeves, 1996). Presentation applications allow students to analyze, construct and present knowledge in a nonlinear format (Cognition and Technology Group at Vanderbilt, 1996). Such tools also offer opportunities for students *and* teachers to develop their own instructional software (using authoring software such as HyperStudio), individualize student learning, and encourage team work and self-confidence (Office of Technology Assessment (OTA, 1995).

Teacher Challenges and the Best Practices Solution

Many researchers are beginning to see technology as a catalyst for changing teachers' instructional practices to a more constructivist approach (Cadiero-Kaplan, 1999). The effective use of technology lends itself to student-centered instruction (Clark, 1991; Cognition and Technology Group at Vanderbilt, 1996), which is an important component of constructivist learning environments. Current research suggests that the effective integration of technology requires teachers to adjust instructional practices toward Constructivist models of teaching and learning (Cognition and Technology Group at Vanderbilt, 1996).

Best Practices addresses teachers' instructional challenges by encouraging exploration, providing technology integration and supporting activity development with guiding prompts. The prompts provide a constructivist instructional development model and thus scaffold the development process. Additionally, because content relates to the teacher's existing lessons and instructional standards, Best Practices is also flexible, efficient and relevant to the teacher.

The OTA report (1995) suggests that barriers to technology use include the lack of opportunities to experiment and share experiences, an understanding of how and why to use technology in the curriculum, good models and training and support. Best Practices provides teachers with opportunities to experiment through the technology matrix tool, which provides various technology solutions and activity examples. Sample lesson plans also allow teachers to share and learn from their colleagues' experience. Through guiding prompts and constructivist-based examples, the tool offers teachers a model as well as rationale for integrating technology. Because technology integration focuses on existing lesson plans, it is both efficient and effective. Teachers are more likely to integrate this process into their teaching practice because they experience technology integration as relevant to them and their instructional needs. While Best Practices can't provide in-person training, the tool models and supports teachers' own learning process.

The Best Practices environment is modeled closely on a particular constructivist learning approach -- Problem - Based learning. Problem-Based learning uses constructivist principles to focus student learning around a specific problem. Once the problem is defined, the learner must find a way to solve the problem with support from peers, teachers and/or other resources. Throughout, learners reflect on their solutions and learning process. To be successful, the learner must have support in using and developing their cognitive skills (Savery & Duffy, 1996). Best Practices helps the teacher to identify and solve a specified instructional problem encountered in teaching historical thinking to students.

Best Practices also encourages exploration. Hughes (1998) suggested that such barriers might be overcome by encouraging technology exploration. The OTA report suggests that teachers "need visions of technology's potential, opportunities to apply them, training, just-in-time support and time to experiment". The OTA report found that the most effective technology training for new teachers includes watching videos of actual classroom teaching, practicing with case studies and participating in computer simulations and electronic networks (such as newsgroups and bulletin boards). Experienced teachers responded best to on-line access to new technology ideas, good teacher examples, and on-line contact with colleagues and technology use experts (OTA, 1996). Through exploration and reflection on their own teaching and learning processes, teachers with a more traditional teaching approach can explore learning from a constructivist approach. Because teachers often teach in the same way that they themselves were taught, teachers often need to have the experience of being a student in the same environment that they will create for their own students (Fosnot, 1989).

Because Best Practices will be available on the Internet access it is not limited by geography, time or personnel constraints. This tool could also be used within a group professional development context to help clarify individual instructional goals and view examples. Although Best Practices currently focuses on instruction for 4th grade California history, it can be expanded to include multiple content areas and grade levels. This content and standards specific focus further ensures that the instructional development process is meaningful to the teacher's instructional goals and practices. By revising an existing lesson, a teacher is more likely to develop a lesson he or she will feel comfortable teaching as well as be able to take ownership for the improvements in the lessons.

Best Practices also provides the teacher with support and a framework in which to reflect upon his or her solution and learning process. Using the Technology Matrix at the beginning of the Enhancement Process helps the teacher identify the specific goals (technology-integration and historical thinking engagement) at the beginning of the instructional development process. The teachers have the opportunity to explore technology-integrated activity examples that demonstrate the strengths of different software applications for engaging historical thinking skills. The examples also illustrate how multiple historical thinking skills can be addressed in a single activity.

The Technology Matrix can be used in several ways. Some teachers may want to explore all options – and view activities for all historical thinking skills and software. Other teachers may be interested in viewing the way different activities engage different historical thinking skills for each software program. The Technology Matrix also provides teachers with the opportunity to compare solutions to those of other teachers, broadening their perspective and resources for approaching an instructional problem. The Technology Matrix should help teachers see "how" to integrate technology to meet the content standards (historical thinking skills and content). The Technology Matrix's flexibility allows the *teacher* to choose those areas (historical thinking skills and software applications) that fit his or her needs.

Program Components

Teachers are offered the tools to revise their lessons through a two-stage process: the Clarification Process and the Enhancement Process. In the Clarification stage, teachers identify and clarify the components of their existing lesson. In the Enhancement stage, teachers begin to revise their lesson and develop a technology-integrated activity. Teachers choose from a list of historical thinking skills and software applications. The resulting matrix provides activity ideas as well as teacher examples to match their preferences. From there, teachers develop technology-enhanced activities with the help of guiding prompts. The teacher's responses to these prompts eventually inform the content of the revised lesson.

Clarification Process

With the support from specific prompts, teachers identify and enter the lesson components from their pre-existing lesson -- such as student prior knowledge, goals and objectives, learning activities and assessment -- into a specific format. This format helps teachers to identify the specific elements of their existing lesson and to recognize the implications of those choices. The prompts help engage the teacher in active reflection and response to the instructional development process. The teacher's responses are automatically entered in the final Lesson Plan. These responses provide the teacher with a preliminary instruction plan on which to build and reflect on as they begin the Enhancement process.

Enhancement Process

The Enhancement process is the central focus of Best Practices – this is where the teacher's existing lesson is revised to incorporate constructivist learning and technology in a way that supports historical thinking engagement. The Enhancement Process consists of (1) five sets of prompts that guide teachers toward developing the revised instruction and (2) the Technology Matrix tool , which provides resources to help the teacher respond to the prompts. The teacher begins the enhancement process by using to Tech Matrix tool to match computer software applications and specific historical thinking skills with appropriate instructional activities.

The Tech Matrix tool functions as a first step in the Enhancement process. The Tech Matrix tool allows teachers to choose historical thinking skills that they want to focus on and specific software that they want to use. The tool then creates a matrix offering descriptions and specific teacher examples of activities that meet both criteria. The matrix provides both general and content specific activity examples. Teachers will use these activity examples to begin developing their own technology-integrated activities with the support of development prompts.

The five sets of prompts -- technology integration, historical thinking skills, constructivist learning, assessment and final reflection – provide support and structure as the teachers interacts with the Technology Matrix tool and creates the content for the revised lesson. Each set of prompts supports the integration of a specific instructional goal into the developing activity. These prompts support teachers in integrating technology as a "cognitive tool" that promotes historical thinking skills, integrating constructivist principles and developing an authentic student assessment method for the created lesson. The reflection prompts provide a time for teachers to reflect and revise their lesson as a whole.

The prompts include questions about specific lesson plan components (e.g. instructional goals, activity, and student learning processes) as well as questions to encourage reflection on the teachers' teaching practices. A sample response and detailed description are offered for each prompt. The teachers reflect on their instruction throughout development to maintain or develop an awareness of their own design process as well as their solution. The teachers' responses are automatically entered into the lesson plan at the end of each set of prompts. The teachers can then reflect on their changes and additions as they relate to the lesson as a whole as well as make additional changes. This Enhancement process guides the teachers through basic principles and examples for developing constructivist instruction and provides a final checklist to help teachers identify areas that need further development.

Conclusion

Since it is essential that teacher training programs model appropriate teaching methods, Best Practices integrates three important constructivist characteristics. First, the instructional development is centered around a teacher-determined problem (Technology Matrix). Second, the teacher has a role in determining the process for solving the problem. Third, the environment supports and challenges the teacher's thinking.

References

Bain, R. B. (1998). *Into the Breach: Using Research and Theory to Shape History Instruction.* Paper presented at the Spencer Foundation History Learning Conference. November 6-8, 1998, Pittsburgh, PA.

Brown, A.L. (1992). Design Experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *The Journal of the Learning Sciences, 2 (2),* 141-178.

Cadiero-Kaplan, K. (1999). Integrating Technology: Issues for Traditional and Constructivist Pedagogies. *Journal of Computing in Teacher Education, 15 (2)*, 14-18.

Clark, R. E. (1991). When researchers swim upstream: Reflections on an unpopular argument about learning for media. *Educational Technology, 19(6)*, 2-10.

Cognition and Technology Group at Vanderbilt. (1996). Looking at technology in context: A framework for understanding technology and education research. In D. Berliner & R. Calfee (Eds.), *Handbook of educational psychology.* (pp. 807 - 840). New York, NY: MacMillan.

Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920.* New York, NY: Teachers College Press.

Fosnot, C. T. (1989). *Enquiring teachers, enquiring minds: A constructivist approach for teaching.* New York, NY; Teachers College Press.

Honebein, P. C. (1996). Seven Goals for Design of Constructivist Learning Environments. In B. Wilson (Ed.) *Constructivist learning environments: Case studies in education.* New York, NY; Lawerence Erlbaum Associates.

Hughes, J. (1998, April). *The road behind: How successful, technology-using teachers became successful.* Paper presented at the meeting of the American Educational Research Association, San Diego, CA.

Jonassen, D. H. & Reeves, T. C. (1996). Learning With Technology: Using Computers as Cognitive Tools. In D. Jonassen (Ed.), *Handbook of Research for Educational Communications and Technology* (pp. 693-720). New York, New York: Simon & Schuster Macmillan.

Kahn, J. (1997). Technology-rich teacher education: Meeting the NCATE challenge. *Journal of Computing in Teacher Education, 13 (2)*, 24-29.

Minstrell, J., & Stimpson, V. (1996). A classroom environment for learning: Guiding student's reconstruction of understanding and reasoning. In L. Schauble & R. Glaser (Eds.), *Innovations in learning: New environments for education* (pp. 175 - 203). Mahwah, New Jersey: Lawerence Erlbaum Associates.

National Center for History in the Schools (1998). *National standards for United States history: Exploring the American experience*(Grades 5-12 Expanded Edition). Los Angeles, CA; University of California.

Nickerson, R. (1995). Can technology help teach for understanding? In D. Perkins, J. Schwartz, M. M. West & M. S. Wiske (Eds.), *Software goes to school: Teaching for understanding with new technologies*.(pp. 7 –23). New York, NY; Oxford University Press.

Office of Technology Assessment. (1995). *Teachers and technology: Making the connection* (GPO stock #052-003-01409). Washington D.C.: Government Publishing Office.

Panel on Educational Technology (1997). *The use of technology to strengthen K-12 education in the United States.* Washington, DC [Online]. http://12/21/99/www.whitehouse.gov/WH/EOP/OSTP/NSTC/PCAST/k-12ed.html#2.3.

Resnick, M. (1996). Toward a practice of "constructional design". In L. Schauble & R. Glaser (Eds.), *Innovations in learning: New environments for education* (pp. 161 - 175). Mahwah, New Jersey: Lawerence Erlbaum Associates.

Rogers, A. (1998) *The failure and the promise of technology in education.* Global SchoolNet Foundation. (Online) http://www.gsn.org/teach/articles/promise.html

Salomon, G. (1988). AI in reverse: Computer tools that turn cognitive. *Journal of Educational Computing Research, 4 (2)*, 123-139.

Savery, J.R. & Duffy, T. M.(1996). Problem Based Learning: An Instructional Model and Its Constructivist Framework. In B. Wilson (Ed.). *Constructivist learning environments: Case studies in education.* New York, NY; Lawerence Erlbaum Associates.

U.S. Government. (1996). Section 1: Effects of technology on student achievement. *Report on the Effectiveness of Technology in Schools '95 - '96.* Washington D.C.; Author.

Willis, J.W. & Mehlinger, J. D. (1996). Information Technology and Teacher Education. In J. Sikula, T. Buttery, & E. Guyton (Eds.) *Handbook of research on teacher education : a project of the Association of Teacher Educators* (pp. 978 – 1029) (2nd ed.). New York : Macmillan Library Reference.

Designing an On-Line Campus (OLC) from the Learners' Perspective

Gary Culwick, Academic Development Group, University of Greenwich, UK.
G.Culwick@greenwich.ac.uk

Malcolm Ryan, School of Post Compulsory Education and Training, University of Greenwich, UK
M.Ryan@greenwich.ac.uk

Ann Allen, Student Office, University of Greenwich, UK
A.Allen@greenwich.ac.uk

Abstract: This paper examines the design of an On-Line Campus (OLC) and how it affects the learner. It describes the structure and analyses the thought processes that went into the design of the first OLC at the University of Greenwich. It states the importance of the students' perspectives when designing a virtual learning environment. The discussion is focused on the various elements that comprise the OLC, as well as speculating about future developments.

Background

In 1998 the University of Greenwich began piloting an On-Line Campus (OLC) accessed via the World Wide Web by students (gre-guns2.gre.ac.uk) and via Lotus Notes groupware by staff. Until this time the university had never attempted to co-ordinate teaching via the Internet, instead individual schools with appropriate expertise constructed their own web pages in isolation from other areas of the university. In the early stages, the OLC was used primarily for piloting the school of Post Compulsory Education & Training's Computer Mediated Communication (CMC) related courses on the Internet, which had previously been delivered via Lotus Notes [Ryan, 1997]. Early in 1999 the OLC had progressed to a stage where the interface had been redesigned to facilitate easier access to core areas and more schools and departments were involved.

The Design – everything only 'one-click' away

When constructing the OLC we wanted to mirror the student experience of being on a physical campus, so that any department that existed on one of the university's real campuses would be available to our on-line students. We wanted this virtual environment to be perceived as an extension to the university's physical locations, so we designed it around the metaphor of a real campus (Gould, 1995). This differed from the university's corporate web site philosophy, which was more of an advert - one big web-enabled prospectus.

The advantage of the OLC from the learner's perspective is that it provides a 'one stop shop' for university learning and teaching materials and support. The use of Lotus Notes as the authoring tool and Domino as the web server provided a much greater degree of interactivity than many of the web-based materials found on the corporate site. The OLC was designed to be highly user friendly, particularly for learners studying at a distance, and consisted of mostly interactive, rather than static (dateable), material. Our philosophy of using Information and Communication Technology (ICT) to provide opportunities for interaction was based on our earlier work, using CMC to support adult distant learners engaged in Continuing Professional Development (Lewis et al, 1997; Jordan and Ryan, 1999)

There were threes core rules that we tried to apply when constructing the OLC:

1. **'One click' from useful information**

In our view, so many web sites lose sight of their core function. Our function was, and is, to provide a learning environment where access to information should be quick and easy. We were conscious that many of our students were novice ICT users and when studying at a distance they were likely to have limited access to technical support and be easily discouraged if presented with a complex system. We felt it important that no matter where the student was in their individual school's web pages that they should, with 'one click', be able to access many sources of information. To make this 'one click' approach possible we opted for a frame-based design with a navigation bar running down the left side of the screen, as can be seen in figure 1 (Brookes, 1993; McCormack and Jones, 1997; Latham, 1998).

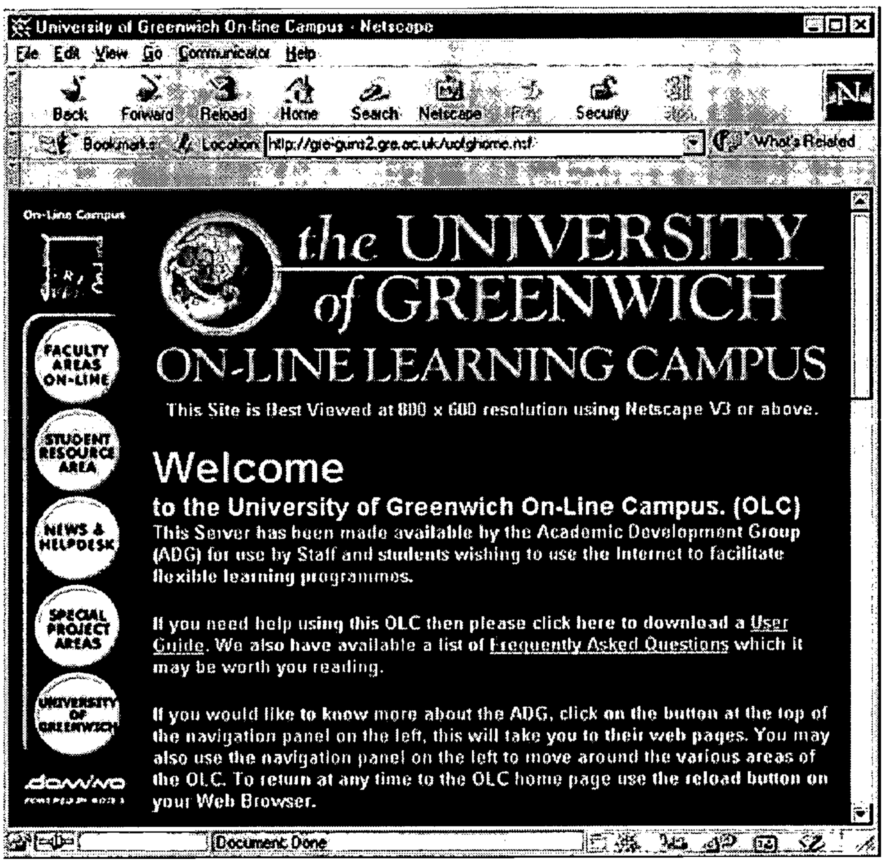


Figure 1: On-Line Campus web site layout with navigation side bar.

This allows our students to work within their course on the right side of the screen and quickly move from one part of the OLC to another to access other resources. For example, if a student were reading a conference entry by a tutor or peer and a book was mentioned, with one click on the Student Resource Area on the navigation bar, they would have access to the university library's search engines to see if the book was in stock. They could then email or submit a form requesting the book be held or sent to them.

2. No prospectus type materials to be included on school pages

Primarily, we wanted the OLC to be a learning and teaching site, so we discouraged the placing of large amounts of course documentation as this would duplicate the information held on the university's corporate site. The problem was that pages could be authored easily using Lotus Notes with no prior knowledge of

HTML. Consequently, staff preferred to use Notes to place information on the OLC as opposed to the corporate web site that was still based around traditional HTML language and Unix command structures.

3. A fully featured environment experience

Often web sites tend to include materials that require plug-ins but with no link to download them. By providing a collection of plug-ins on the OLC this saved time and provided a convenient download site to many of the users, especially in the UK where even local phone calls are chargeable.

The Core Areas

The OLC Navigation bar contains links to core areas of the campus. We kept these to a minimum to make the OLC easy to use and by placing this navigation bar in its own frame, it provided an anchor for the students. Wherever they went (which always occurred in the right hand frame) in the OLC, or even if URL links took them away from the OLC, they would always be able to switch to a different OLC area with one click (Brookes, 1993).

The Faculty Area shows a list of schools and departments, which provide services for the students, this list is updated automatically whenever a new school or department home page is created. The Student Resource Area provides a central place for links that will be helpful to students; at the top of this area is the link to the Student Common Room. We decided there should be a single common room for all students, irrespective of course or school. This is more representative of a real campus where all students mingle in the canteen. The News and Helpdesk is where students can find all the latest information on the OLC as well as any web browser plug-ins\resources that they might require. This area also houses a helpdesk - a bespoke Lotus Notes database that accepts forms submitted by a web browser. Helpdesk personnel can email an answer to the user or compose a technical note that is added automatically to the Frequently Asked Questions (FAQ) list of the helpdesk. The special project area is where new OLC developments are tested prior to launch. Although students may view these, access is restricted to project participants and the final link is to the university's corporate site.

The Student Office (SO), which is part of Central Registry, have worked with the OLC developers from the beginning. This has allowed a great many of the resources that are available for traditional on-site students to be repackaged for OLC users. They have converted many of the print-based, student-centred publications into a web format for the very first time. These include: regulation documents, advice leaflets, information regarding assessment and two important books that all new students receive when they first join the university; a Guide for New Students and a Skills for Learning Handbook.

With the Student Office taking such an active role in the development of the OLC, this has raised awareness throughout the university of the need to treat distance students as equals to their on-site counterparts. This is shown by the SO constructed, student satisfaction survey form, which is only available electronically via the web and makes no distinction between distance and local students

The Educational Elements

From the tutor's or institutional view, the OLC provides an integrated suite of virtual departments including; Library, Media Resources, Student Office and Registry, which gives the distance learner the sense of belonging to a real institution. At the same time it provides a single gateway into school-based materials which remain under the school's control. Because of the non-html nature of the authoring system, even non-technical staff can maintain these pages, and they also benefit from the accumulated good practise being developed in other flexible learning initiatives employing the OLC.

Educational innovation has primarily come from use of the system by the School of Post Compulsory Education and Training who have developed a large area to:

a) support their current traditional courses
b) to develop purely CMC based courses for continuing professional development [Jordan & Ryan, 1999].

With collaboration between the developers and tutors of the OLC it has been possible to add new features to the course areas [McCormack and Jones, 1997]. For instance, at the end of a course all students are required to complete an evaluation form. This is now done electronically and submitted and held within the respective course database. Using Lotus Notes workflow features the course database has the ability to allow the tutor to correlate these evaluation results into percentages for analysis. These can be emailed automatically to appropriate departments in the university for inclusion in a variety of reports.

In 1998 we developed our first validated programme to exploit the potential of the OLC. Designed by the Natural Resource Institute, this is a worldwide, distance master's programme in grain storage management that employs the OLC for tutor support and peer to peer interaction.

The Future

There are many ways we would like to extend the OLC in the future. One would be to include a template database for creating on-line exams with automatic results generation, which could be adapted easily by non-technical staff for any course.

Another would be to integrate more university facilities into the OLC, possibly in an on-line, 'multiplex' lecture theatre. The university's lecture theatres are geographically dispersed across many campuses. If they all had video cameras installed and were connected to computers, this would allow the lecture to be uploaded to the OLC for live transmission or archived for future presentation. The students entering the 'multiplex' would be able to choose which live lecture to attend or go to the archive and view an old lecture, although we have yet to find a way to simulate popcorn on the OLC!

Lastly, to integrate real-time collaboration via Lotus Sametime software (Lotus, 1999), which would allow students to see if their tutor is available on-line to interact with them synchronously, via a Chat based system. This would also allow the tutor to share computer applications with the student. Such a system would also greatly assist the helpdesk by allowing the personnel to demonstrate visually at a distance where the student is having a problem.

Whilst we attempt to introduce innovation into the university's learning and teaching processes via the OLC, we must never forget it must be focused on what students want and we need to be ever mindful of the vast range of technical abilities of these virtual students. We welcome constructive criticism from all our users in our endeavour to make the OLC an even better virtual experience.

References

Brookes, R. (1993) Principles for effective hypermedia design. *Technical Communication*, 40(3), 422-428.

Gould, E. (1995) Empowering the Audience - The Interface as a Communication Medium, *Interactivity Magazine*. September 1995.

Jordan, G. and Ryan, M. Computer conferencing: an effective tool for continuing professional development, *CAL 99 - VIRTUALITY IN EDUCATION*, March 1999, The Institute of Education.

Latham, D. (1998). *Web Based Instructional Design*, Florida State University, http://slis-two.lis.fsu.edu/~design/wbides/

Lewis, T., Gould, M., and Ryan, M. (1997) Computer Conferencing and the Continuing Professional Development of Teachers in the post-16 sector. In Field, J. (Ed), *Electronic Pathways: Adult Learning and the New Communication Technologies*. NIACE.

Lotus (1999) Lotus Sametime - Real-time Collaboration that's Fit for Business. http://www.lotus.com/products/sametime.nsf/prodinfo/B1FD879F0AB9E841852566B1004B7473

McCormack, Colin, and David Jones. *Building a Web-Based Education System*. Book and CD-ROM ed. Somerset, NJ: John Wiley and Sons, 1997.

Ryan, M. (1997) Exploiting groupware reveals an enhanced distance paradigm in Muldner, T. and Reeves, T (Eds.) in *ED-MEDIA and ED-TELECOM 97 Proceedings*. Calgary, Canada, June 1997. AACE, Virginia. p1829

Synchronous and Asynchronous Discussion: What Are the Differences in Student Participation?

Gayle Davidson-Shivers
gdavidso@jaguar1.usouthal.edu
Lin Muilenberg
Linm@zebranet
&
Erica Tanner
Cltanner@bellsouth.net
Department of Behavioral Studies and Educational Technology
University of South Alabama
Mobile, AL 36688 USA

Abstract

The purpose of the study was to examine how students (n = 14) participated in a web-based graduate course discussions. The focus of this examination was to analyze the interactions that occurred during synchronous (chat) and asynchronous (listserv) modes of discussions using a coding scheme developed by the researchers. During a one week period, students were randomly assigned to either a small group chat or threaded discussion. The next week, the two small groups switched forms of discussion and were given another topic question to discuss. The study is qualitative in nature in order to find out whether of the students' participation were substantive (that is, directly related to the topic) or non-substantive (messages were not directly related to the content) in both types of discussions and these were compared by type of comment and quantified. In addition, the students were surveyed about their computer and Internet experience and skills as well as their attitudes toward the course content, its organization and delivery. Results indicated that overall students' discussions included all 8 types of substantive and non-substantive. However, the participants when in the chat showed greater numbers of responding and reacting statements (substantive types) in both weeks than when participating in the threaded discussion. Based on the survey results, some students found it difficult to follow the dialogue in the chat, but overall they enjoy this type of interaction. The students also enjoyed the threaded discussion, especially for its convenience.

Introduction

Although various forms of Distance Education have been in existence for a long time, the advent of the Internet and the World Wide Web (WWW) has brought changes to teaching and learning at the university level. A number of universities and colleges are adding or converting traditional courses and programs to web-based instruction (WBI) or online learning environments. These WBI courses require not only a different design and delivery of the instruction, but also a different form of engagement on the part of students with the course materials, other students, and the instructor. These learning environments require not only active, but interactive participation (Davidson-Shivers & Rasmussen, 1998 & 1999). Interactive learning includes an interchange of ideas with all participants; that is, the students and instructor exchange ideas in a flexible and dynamic environment (Rasmussen & Northrup, 1999).

This interchange of ideas may occur through a synchronous mode, which occurs at the same time but from different locations, or through an asynchronous mode, in that students and the instructor communicate to each other at differing times. The computer-mediated communication (CMC) literature documents the dynamics of online discussions by various forms of communication patterns, processes, and purposes (William & Merideth, 1996; Piburn & Middleton, 1998; Wojahn; 1994; Jeong, 1996; McCormick & McCormick, 1992; McConnell, 1997 Sherry, 1999; Hara, Bonk, & Angel (in press)). The CMC literature and the literature on Web-based instruction (WBI) identifies various online delivery formats (e-mail, listserv, chats, conferences, etc.) and how they might be used for discussions (Khan, 1997; Shotsberger, 1997; Driscoll, 1998). Developers of online learning environments often suggest that asynchronous communication may have advantages over synchronous.

For instance, Driscoll states that asynchronous methods allow students more time for reflection than do synchronous delivery formats; with one example shows only 20% of a web-based course to be in the synchronous format. In addition, Jeong argues that "most [not all] findings hail the use of asynchronous communication" but this author also "notes the absence of the evaluation of synchronous communication and their effects" (p. 51). His own findings suggest that synchronous online chats have an advantage of promoting highly interactive discussions with a disadvantage for the group to digress from the topic to another (p.62). However, there are mixed results based on the CMC research and there is a lack of evaluation on synchronous discussion, it seemed viable to compare and contrast how students participate in both types of discussions.

Methods

Subjects

Participants in the study were graduate students (n = 14) in a required course for their degree programs of study from a southeastern regional university in the USA. Approximately two-thirds of the students were female. Based on the survey results, the majority of students reported that they had computer experience with some having less experience with the Internet and WWW. Participation in the discussions was a course requirement. Confidentiality of information was maintained by having surveys collected and coded by someone other than the instructor and the analysis of the discussions occurred after final grades were posted.

Course content, organization, and requirements.

The course was an introductory course on trends and issues in instructional design. The course was organized by weekly topics with assignments and questions being posted to its website. Two or three questions were given with directions on how to post (either chat or threaded discussion) answers and replies. Students had a week to respond to any listserv qucstion(s) and were also required to reply at least twice to other students' responses during the week. Typically one question was scheduled for an hour and a half chat during the week. Chats were either large group (whole class) or small groups (half of the class per chat session). Students were also assigned particular readings as preparation for discussing the weekly topic. They were also encouraged to draw on their own experiences, knowledge and skills. Both threaded discussion and chat could be copied and all of the chats were distributed to all members of the class. After the fifth week of the term, students were assigned as discussion leaders to facilitate the weekly discussions in both chats and threaded discussions with guidance from the instructor. The instructor participated directly in the online chats; however, less so when another student was the discussion leader. With the threaded discussions, she added her comments to a summary at the end of the week rather than commenting during the week.

Procedures

The following procedures occurred for gathering the data.

- Using a Likert-type questionnaire, students were surveyed three times during the term in order to evaluate students' reactions and attitudes toward the course. The survey also gathered information about the computer experiences and skills. Data was kept confidential by having someone other than the course instructor collect and code each set of questionnaires.
- For one question posted during the thirteenth and fourteenth week of the term, the students were randomly assigned to two groups. Half the students discussed the question (it was the third question posted for each week) using the online chat and the remaining students used the threaded discussion. The process was repeated the following week with a new topic and question, and the two groups switched discussion modes.
- Transcripts of the discussions for those two weeks were then coded using a coding scheme developed by the researchers based on the work of Piburn and Middleton (1998) and Williams and Meredith (1996). See Table 1 for the coding scheme. The coding and analyses of the discussions did not occur until after the final course grades were posted.
- The researchers were trained to use the coding scheme and then coded each discussion transcript independently. The transcripts were coded by each completed statement/thought made rather than

using a line-by-line method. Complete sentences, incomplete sentences, and short phrases were considered as a statement if a new or different thought was presented within them. Incomplete sentences or short phrases were often used within the chat due to the speed and interactive nature of this format.

C The researchers met together to reach agreement on each line coded. If any discrepancies were encountered their codings, the three researchers discussed the statement and then came to consensus. At that time, the researchers added another code type, supportive statements; it became number 9.

Table 1
Types of Discussion Participation Coding Scheme

SUBSTANTIVE: messages that relate to the discussion content or topic.

Code 1. Structuring – Statements which initiate a discussion and focus attention on the topic of the discussion. These statements are often made by the discussion leader or instructor (i.e. "Today we are going to discuss . . ." or "This week's discussion will focus on . . .").

2. Soliciting—Any content-related question, command or request which attempts to solicit a response or draw attention to something (i.e. "What do you think the author meant by . . .?" or "Give us some support for that assertion.").

3. Responding—A statement in direct response to a solicitation (i.e. answers to questions, commands, or requests). Generally these are the first response to a question by a given individual.

4. Reacting—A reaction to either a structuring statement, to another person's comments, but not a direct response to the question. (i.e. "Your earlier statement got me to thinking about . . ." or "I agree/disagree with Bob because . . .").

NONSUBSTANTIVE: messages that do not relate to the discussion topic or content.

5. Procedural—Scheduling information, announcements, logistics, listserv membership procedures, etc.

6. Technical—Computer-related questions, content, suggestions of how to do something, not related to the topic directly.

7. Chatting—Personal statements, jokes, introductions, greetings, etc.

8. Uncodable—Statements that consist of too little information or unreadable to be coded meaningfully.

9. Supportive—Statements that although similar to chatting, there is an underlying positive reinforcement to the comment! (i.e. "Good idea!" or "Excellent work!"). *Note:* This type was added when the researchers met for consensus of their coding of the transcripts.

Source: Davidson-Shivers, Muilenberg, & Tanner, 1999. Adapted from Piburn & Middleton (1998) and Williams & Meredith (1996).

Data Sources

Survey

Data were gathered by a questionnaire distributed three times to the group. The survey asked students to report their capabilities using technology, web-based technology in particular, experience with the discipline, and other demographic data. They were also asked to critique the course as it progressed through the term in terms of technical difficulties, interest in topics, preferences to types of activities, instructional strategies used, and amount of work that this course in this format involved.

Coded Transcripts

Two threaded discussions and two chats were coded for types of participation that students made during online discussion. The coding scheme used two main categories of substantive, messages that related directly to the content or topic at hand and non-substantive, messages that did not relate to the discussion topic or content. The 4 subcategories for substantive were structuring, soliciting, responding, and reacting; the 5 subcategories for non-substantive were procedural, technical, chatting, supportive statements, and uncodable. Every statement or sentence was coded using one of these 9 subcategories. (See above Table 1.)

Discussion of Results

The analysis showed that participants' comments were made in all substantive and non-substantive categories in the chats and the listservs, except that there were no uncodable (albeit, unreadable by the researchers) in the threaded discussions and several in the chat transcripts. In addition, whether in a chat or threaded discussion for either week, students overall provided more substantive statements either by responding to a question or reacting to another's statements or comments than any of the other seven categories. By mere observation of the length of the responses by participants in a threaded discussion, it would seem that they would contain more substantive remarks than those in a chat discussion, especially since statements in the chat tended to be shorter in length and were often interrupted by others' comments. However, the chat discussions showed greater numbers of *responding* and *reacting* statements in both weeks over the substantive statements made in the threaded discussions. There were also greater amounts of non-substantive statements in the categories of chatting and supportive comments during the chats than in the threaded discussions. Overall there were a greater number of interchanges and interaction when participating in a chat than when involved in the threaded discussions. Thus, it appears that for these two weeks of a given course, the chat discussions were dynamic with a lot of interactive and interchanges among the participants.

The supportive data suggests that students liked both modes of delivery every time they were surveyed. In their comments, they stated that the chat discussions were sometimes difficult to follow, but still enjoyed them. One student commented that they liked small group chats over large group ones. They enjoyed the convenience of the threaded discussion.

When reporting their computer experience level, most stated that they had experience using computers, although some stated that they had little experience using the Internet and WWW. It was noted that with the second survey, the reported level of computer experience was lowered slightly. But it returned to the same level as reported in the first by the end of the course (and in the third survey). The reported 'dip' in computer experience may be due, in part, to technical difficulties of online services. And once these were overcome, students may have regained their confidence in their computer abilities.

The importance in this study is *not* so much as to determine 'what group won", but rather to determine which form of discussion is preferred and which is most appropriate for the types of actions and interactions that students need to perform in order to be successful in such a learning community. It is also important to realize that these graduate students, for different reasons, enjoyed both forms of discussion. The use of chats provided a direct and interactive environment in which they reacted and responded to the topic at hand, chitchatted, and made supportive comments to each other. It involved a high degree of interchange and was a dynamic environment, although sometimes difficult for some students' to follow the train(s) of thought. In contrast, threaded discussions provide an opportunity for students to provide reflective, thoughtful responses to posed questions, judging by the length and wording of any given single response. They were also able to provide insightful reactions to others' opinions and ideas presented perhaps because a threaded discussion's timeframe (of a week) allowed for that. Students enjoyed the chat because of the convenience factor. Both discussion modes—synchronous and asynchronous—have merit and may be used within online courses. They clearly can be used for different purposes and provide different, but useful, means for students to engage in learning. It is suggested that additional research into the use of chats and threaded discussions be conducted.

References

Davidson-Shivers, G.V. & Rasmussen, K.L. (1999). Designing Instruction for WWW: A Model. Proceedings for the Ed-Media 1999, World Conference on Educational Multimedia, Hypermedia & Telecommunications. Seattle, WA, USA, June 19-24, 1999.

Davidson-Shivers, G.V. & Rasmussen, K.L. (1998) Collaborative Instruction on the Web: Students learning Together. Proceedings for the WebNet98 World Conference, Orlando, FL.

Driscoll, M. (1998). *Web-Based Training.* San Francisco, CA: Jossey-Bass Publishers

Hara, N., Bonk, C.J., & Angeli, C. (In press). Content analysis of online discussion in an applied educational psychology course. *Instructional Science. Also appears on*

Jeong, A. (1996). The structure of group discussions in online chats. *Journal of Visual Literacy,* 16(1), 51-63.

Khan, B.H. (1997). *Web-based Instruction.* Englewoods Cliff, NJ: Educational Technology Publications.

McConnell, D. (1997). Interaction patterns of mixed sex groups in educational computer conferences. Part I –Empirical Findings. *Gender and Education,* 9(3), 345-363.

McCormick, N.B. & McCormick, J.W. (1992). Computer friends and foe: Content of undergraduates' electronic mail. *Computers in Human Behavior,* 8, 379-405.

Piburn, M.D. & Middleton, J.A. (1998). Patterns of faculty and student conversation in listserv and traditional journals in a program for preservice mathematics and science teachers. *Journal of Research on Computing in Education* 31(1), 62-77.

Rasmussen, K.L. & Northrup, P.T. (1999, February). Interactivity and the Web: Making and Maintaining Contact. Paper presented at the Annual Conference of the Association for Educational and Communication Technology, Houston, TX.

Sherry, L. (1999, April). The nature and purpose of online discourse: A brief synthesis of current research as related to the WEB Project. ITFORUM Paper #33. Also to appear in *The International Journal of Educational Telecommunications.*

Shotsberger, P.G. (1997) Emerging roles for instructors and learners in the web-based instruction classroom. In B.H. Khan, (Ed.), *Web-Based Instruction.* Englewood Cliffs, NJ: Educational Technology Publications.

Williams, H.L. & Merideth, E. M. (1996). On-line communication patterns of novice internet users. *Computers in the Schools,* 12(3), 21-31.

Wojahn, P.G. (1994). Computer-mediated communications: The great equalizer between men and women. *Technical Communications,* 41(4), 747-52.

The Adaptation and Use of a WWW-Based Course Management System within Two Different Types of Faculties at the University of Twente

Wim De Boer and Betty Collis
Faculty of Educational Science and Technology
University of Twente
Enschede, The Netherlands
w.f.deboer@edte.utwente.nl, collis@edte.utwente.nl

Abstract: At the Faculty of Educational Science and Technology, University of Twente, in The Netherlands, the entire faculty is involved not only in the use of a new WWW-based course-management system (called TeleTOP) but more fundamentally in a new educational approach. In addition we are working with other faculties to support the same progression. How are we doing this? In this article, the TeleTOP Method and implementation model are (http://teletop.edte.utwente.nl) are described and the similarities and differences between the implementation, the adaptation, and the use of the TeleTOP course support environment in the Faculty of Educational Science and the Faculty of Telematics (computer science and networks) are analyzed.

Introduction: TeleTOP at the University of Twente

The University of Twente in The Netherlands has a national and international reputation in the field of telematics, the European name for the branch of computer science involving the combination of information and communication technologies (in particular, related to the Internet and the World Wide Web (WWW)). A focus is the application of telematics applications to the teaching and learning process, what we call "tele-learning". In our definition, tele-learning does not necessarily imply distance education but instead emphasizes the increased flexibility that can come to the teaching and learning process through the combination of the new possibilities offered by the WWW and new ways of teaching and learning. The most ambitious of the tele-learning initiatives at the University of Twente is the TeleTOP project in the Faculty of Educational Science and Technology. Our core ideas are extending the levels of activity and engagement of our students and extending the impact and influence of our good instructors (Collis, 1998).

The decision made by the Faculty of Educational Science and Technology in 1997 was to involve all courses in a re-design process, both pedagogically and including use of WWW tools and environments. This involves the challenge of working with a wide variety of courses and instructors. In the academic year 1997-98 we re-designed all the first-year courses, in 1998-99 all the second-year courses, and by approximately the end of the year 2000 all other courses (for more information, see http://teletop.edte.utwente.nl, through which a number of courses can be visited for inspection and many publications and presentations are available).

To support this new approach, we needed a technical platform and an implementaiton model that would fit a variety of different kinds of courses and instructors. We identified a core set of requirements for the WWW-based course-management system that we would need (Tielemans & Collis, 1999). In our analysis, no existing system met our requirements, so we capitalized on our own experience and in 1997 built our own system, based upon a Lotus Notes database. (This system is described in detail elsewhere; Collis & DeBoer, 1998; Tielemans & Collis, 1999). However, no matter how elegant a system is, instructors must use it, an administration must choose to support its use and thus must make resources available, the technical infrastructure already in the faculty must handle it, and soft- and hardware must be available. Thus an implementation model is necessary that integrates a variety of considerations and change entities.

After the first year and a half of implementing the WWW in our own faculty, we began in January of 1999 to respond to other faculties who also wanted to make use of our system and method. We chose as the next faculty to change its way of teaching and learning a faculty within our university with different types of courses, students, and instructors compared to our own faculty. This was the Faculty of Telematics, a technical faculty with many engineering and mathematics courses. The adaptation proceeded smoothly and we have now moved to the rest of the faculties in our own university as well as faculties in other universities. In this article, we describe the TeleTOP Implementation Model which underlies all this work. The Model indicates, based on literature and experiences, the change entities and areas which are of importance when an institution is going to implement the WWW in education in a wide-scale way. We also describe the transfer experiences with the Telematics Faculty.

The TeleTOP Implementation Model, Version 1

In an earlier study (see DeBoer & Collis, 1999) an implementation model of the change process was defined with the interrelationships among three phases of a time dimension, five change areas, and 12 change entities (see Figure 1).

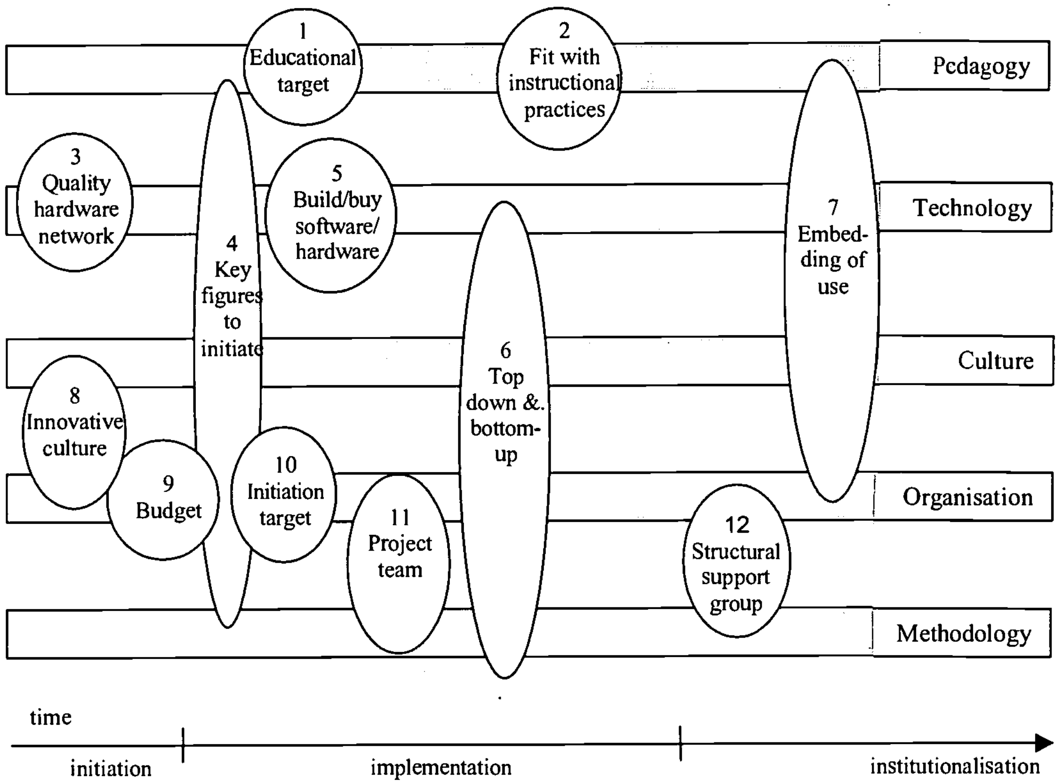


Figure 1: The TeleTOP Implementation Model, Version 1

The Model is a direct reflection of the experiences within the Faculty of Educational science and Technology since 1997. Some aspects of the innovation have already reached the institutionalization phase (for example, all students and most faculty routinely going to their start pages generated by the TeleTOP system on a daily basis) while new aspects are being initiated (such as the capturing of instructor and student presentations on digital video for the reuse of segments of these presentations through course WWW environments as video-on-demand for a variety of learning purposes). The sizes of the circles and ovals reflect complexity in terms of the number of change areas involved. The importance of key figures in the initiation phase, including all of the members of the faculty administration, had an early impact on all change areas in the TeleTOP situation.

Experiences at the Faculty of Telematics

In January 1999 it was decided that the new Telematics Faculty at the University of Twente should also set up a WWW-based course-support environment as was done at the Faculty of Educational Science and Technology. A project group (including the first author) was set up which would be responsible for the technical and instructional implementation of TeleTOP in this new faculty. A key question was if the educational culture and approach in one faculty, as visualized by the TeleTOP Implementation Model (Figure 1) could map onto another faculty. The project group consisted of two TeleTOP team members and two members of the Telematics Faculty. The Telematics members became primarily responsible for the implementation, while the transfer of the TeleTOP method and course-management system was the responsibility of the TeleTOP team members.

Figure 2 gives an impression of how the TeleTOP team planned the steps for the transfer and adaptation of TeleTOP to another faculty (a process repeated in March-June 1999 for a faculty in another university). Figure 2 can be seen as an operational version of the TeleTOP Implementation Model shown in Figure 1.

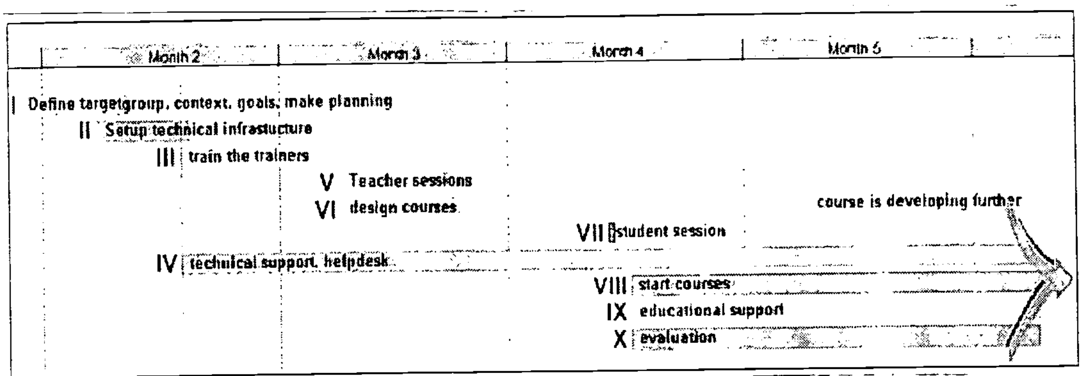


Figure 2: Steps for adapting the TeleTOP Implementation Model and methodology at the Telematics faculty

The actual implementation steps visualized in Figure 2 will be summarized in the following section (Table 1). Comments will be given as to what was intended in the steps, and what actually occurred in the transfer process (see also Fisser, Kamp & Slot, 1999).

Table 1: The change entities used in the TeleTOP Implementation model, in terms of the experiences of the Telematics Faculty

Entities	**Degree of fit**	**Comments**
1. Educational target	+/-	This is corresponding with: ***I. Defining the target group, context, goals and making a plan.*** In the Telematics Faculty situation, while most of these activities occurred, the goal of this innovation was not made explicitly clear to all involved. The Telematics faculty coordinator planned a start-up session with all who were involved at the start of the project, and indicated that the initiative was very important with regards to providing more flexibility for the students. There was not a real educational target; more focussed on flexibility towards students and the image of the new faculty.
2. Fit with instructional practices	+	The instructors indicated that they had to change their ways of teaching, but this was within reasonable boundaries. …
3. Quality hardware network	++	This is corresponding with: ***II. Setup the technical infrastructure***. The operational model shown in Figure 2 indicates that the technical infrastructure for the WWW-based course-management system should be set up in Months 2 and 3. In the case of the Telematics Faculty, this was no problem. There was already a sophisticated technical infrastructure in place in the faculty, with an excellent network, and multi-media computers for all students and staff.
4. Key figures to initiate	++	The key figure to initiate the educational change was the faculty administrator. In this case a top-down approach initiated the process; some instructors already had used the WWW for their courses, but had to change to the new system.
5. Build/buy software/ hardware	++	This is corresponding with: ***II. Setup the technical infrastructure***. The only thing needed to be set-up was a Lotus Notes Domino server, and to guide the faculty Web masters in learning some new skills for maintaining it. The faculty invested a considerable sum of money to get the right hard- and software. They chose to buy/license the software from TeleTOP; not build it themselves, because it was available and had proven itself in practice.
6. Top down &. bottom-up	++	As already mentioned in #4 (Key figures to initiate) the administrator of the faculty followed a top-down approach introducing the change. The way instructors were encouraged to explore the possibilities of the system and were able to use it so they would maximally benefit from the system could be seen as bottom-up.
7. Embedding of use	+/-	As the initiation phase started in March 1999, the faculty is not at the point where embedding of use should start. This should happen in the future (within 1-2 years).
8. Innovative culture	+	An innovative culture should make it easier for an educational change. The faculty is still very young, so a characterization is difficult to give.
9. Budget	++	The commitment of the faculty management was evident, because extra money and resources were made available. The planning should indicate when the course-

		management system should be operational for use. The faculty was willing to invest in human resources (support groups) and hard- and software. The instructors however did not get payment for their extra time investments.
10. Initiation target	+	The initiation target in this case was the fact that the new faculty was just ready to start. This was a good time to set up new courses with the course-management system.
11. Project team	++	This is corresponding with: ***III. Technical support, Helpdesk***. The new supporters, already experienced in giving support, where educated in using the new software. The educational supporter also learned to work with the supportive educational tools, getting hands-on experiences. The project team played an important role in the implementation of the educational change. ***V & VI. Instructor sessions & Designing the course A*** series of sessions for the instructors were set up. The topics dealt with within the sessions were technical as well as instructional. After the first session, during which members of the administration introduced their plans, a technical session followed. The course-management system was demonstrated and instructors had the chance to try it out themselves. Two weeks later a personal session was arranged. In an one-hour interview examples of how the WWW could be used in support of technical courses. Every other week a two-hour hands-on sessions was held. Instructors used their own course-management environments, to try things out, and to exchange ideas. Most instructors attended this meetings, and thought they were worthwhile. The instructors used their time getting skilled in the using the course-management system at the same time as they were designing their own courses. Most work was done a few weeks before the starting date of a course. ***VII. Student session***. The use of a course support-management system which is fully based on the WWW and does not make use of additional programs other than regular e-mail proved to be a very user-friendly system for the students. Students learned the basics of the system and were able to work with the system within one short session. All students got a simple manual. They learned more about additional features of the environments as they used them during their courses. ***VIII & IX. Start the courses & Educational support***. The courses could start after the student session, and after the student had gotten access to the course-management environment. The use of the WWW made it possible to have interaction within the environment, and the possibility to let the environment 'grow' during the time the course was held. During the time that the courses were in operation, educational support was available to the instructors, as well as technical support (see Step IV). Most instructors however were capable of managing their own environments.
12. Structural support group	?	It is not clear yet how and who will be supporting the instructors in the future. This is of great importance for the successful institutionalization of the change.

Thus, as summarized in Table 1, the TeleTOP Implementation Model did seem to reasonably describe the experiences of the Telematics Faculty in initiating and implementing the use of a WWW-based course-management system.

Differences in the use of a WWW-Based Course Management

For almost two years, courses have been using the TeleTOP system at the faculty of Educational Science and Technology. The Faculty of Telematics has used the system for half a year. At both faculties an evaluation was carried out to look at the use of the systems. It is interesting to look at differences in use between the two faculties, of which one is more technical (Telematics) and one of which is a social science (Educational Science and Technology). Are there differences in the use of the TeleTOP system and what factors influence these differences? In particular, both groups of instructors have found a WWW-based matrix (which we call a roster) as an organizing structure for course content and activities to be particularly useful. Figure 3 shows the options that were chosen by the instructors of samples of 26 courses of Educational Science and Technology and 10 instructors of the Faculty of Telematics.

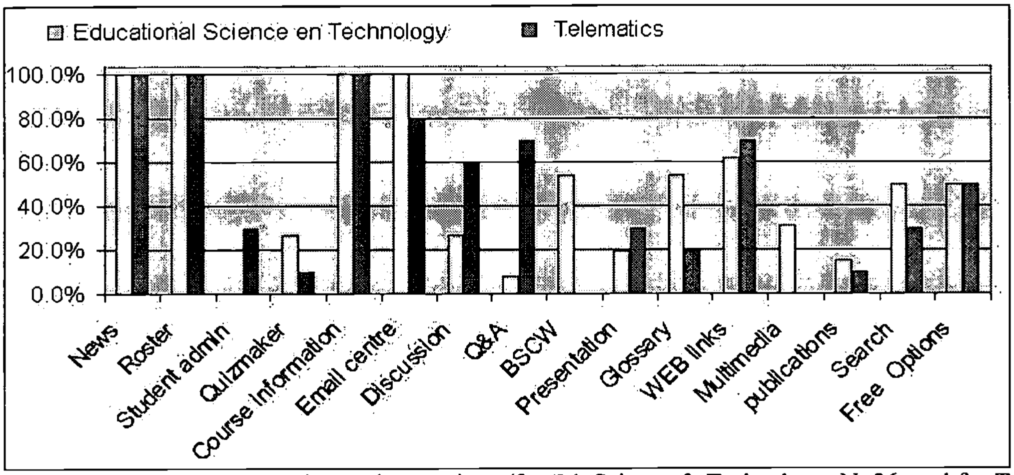


Figure 3: Percentages of instructors using various options (for Ed. Science & Technology, N=26, and for Telematics, N= 10).

Central in the course environments is the roster of a course, integrating study materials, contact-session notes, assignments, communication, and feedback. Figure 4 shows the roster of Telelearning, a course of the faculty of Educational Science and Technology. The roster in the TeleLearning course gives an overview of the assignments and meetings of the course. The course was organised around contact sessions. Instead of lectures, the students present could interact with each other in a variety of ways, and students not present would join in, within the next 48 hours, via the course WWW site. For students not able to be involved for reasons of work or distance as part of the real-time group during any of the sessions, participation in the group session was also expected, but asynchronously and via the WWW. Figure 5 shows the roster of Switching and Control Systems, a course given at the Faculty of Telematics. In this course, students were reasonable for presenting more than half the lectures. Students formed groups and chose a topic, about which they presented material to their fellow students and to the instructors. All material was placed in the session row of the roster of that particular week. The first part of the lecture session was the actual lecture, the second part was intended for questions and discussions. Also after the sessions the discussion would go on in the discussion area of the site. The site was therefore intended as a real support site, to be used for information, materials and communication.

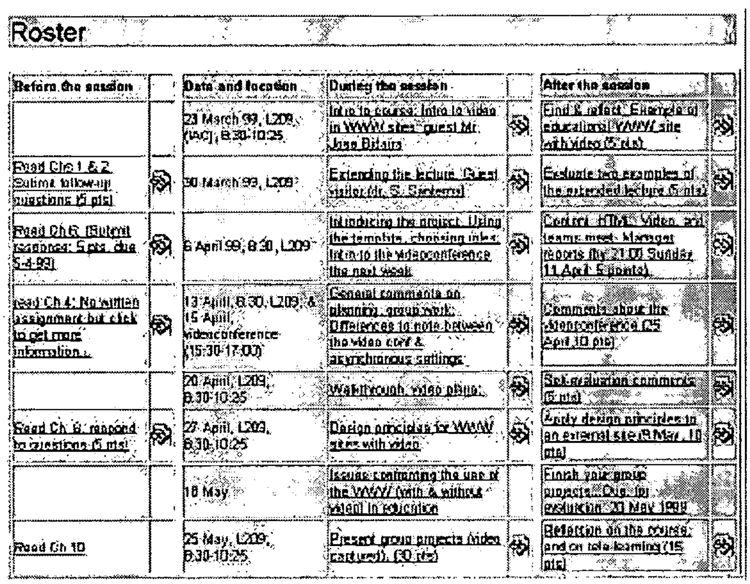
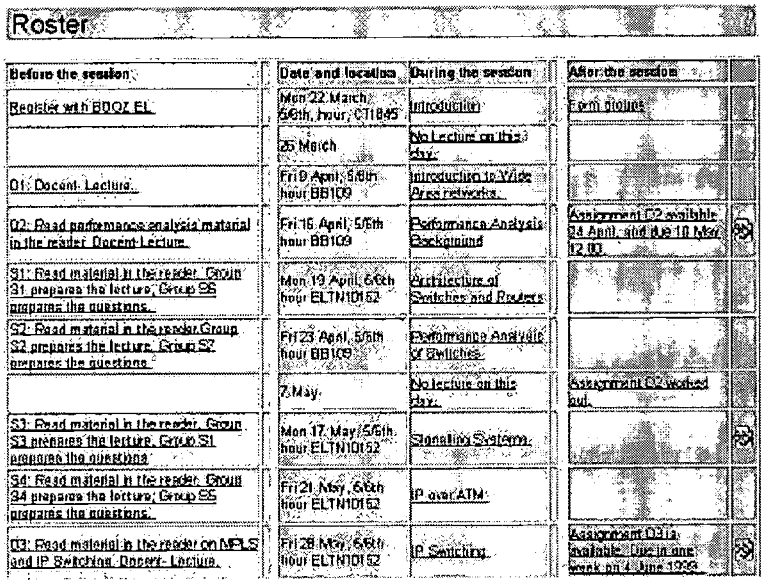


Figure 4: The roster of *Telelearning*.

BEST COPY AVAILABLE



Roster

Before the session	Date and location	During the session	After the session
Register with BOOZ EL	Mon 22 March, 5/6th, hour, CT1845	Introduction	Form groups
	25 March	No Lecture on this day.	
01: Docent- Lecture.	Fri 9 April, 5/6th hour BB109	Introduction to Wide Area networks.	
02: Read performance analysis material in the reader. Docent-Lecture.	Fri 16 April, 5/6th hour BB109	Performance Analysis Background	Assignment 02 available 24 April, and due 10 May 12.00
S1: Read material in the reader. Group S1 prepares the lecture; Group S6 prepares the questions.	Mon 19 April, 6/6th hour ELTN10152	Architecture of Switches and Routers	
S2: Read material in the reader. Group S2 prepares the lecture. Group S7 prepares the questions.	Fri 23 April, 5/6th hour BB109	Performance Analysis of Switches.	
	7 May.	No lecture on this day.	Assignment 02 worked out.
S3: Read material in the reader. Group S3 prepares the lecture. Group S1 prepares the questions.	Mon 17 May, 5/6th hour ELTN10152	Signaling Systems.	
S4: Read material in the reader. Group S4 prepares the lecture; Group S5 prepares the questions.	Fri 21 May, 6/6th hour ELTN10152	IP over ATM	
03: Read material in the reader on MPLS and IP Switching. Docent- Lecture.	Fri 28 May, 6/6th hour ELTN10152	IP Switching.	Assignment 03 is available. Due in one week on 4 June 1999

Figure 5: The roster of Switching and Control Systems

Differences in use?

Looking at Figure 3 and taking into account the two examples of the use of the roster shown in Figures 4 and 5, it can be concluded that the differences in use of the system between the two faculties are not very large. It seems that the Faculty of Telematics focuses a little more on communication via the support environment, and Educational Science & Technology focuses more on collaborative work through the support environment. Both faculties are still in the implementation phase, and have a long way to go until full institutionalization. It is therefore interesting to follow the faculties and see where they will be at in one or two years. Maybe the differences will fade away or maybe they will increase?

References

Collis, B. (1998). *New wine and old bottles?* Tele-learning, telematics, and the University of Twente. In F. Verdejo, & G. Davies, (Eds.), The virtual campus: Trends for higher education and training (pp. 3-17). London: Chapman & Hall.

Collis, B., & De Boer, W. F. (1998). *Rapid prototyping as a faculty-wide activity: An innovative approach to the redesign of courses and instructional methods at the University of Twente*, Educational Media International (EMI), 35(2), 117-121.

De Boer, W. F. & Collis, B. (1999). *Implementation and Adaptation Experiences with a WWW-Based Course Management System.* Computers & Schools (in press)

Fisser, P. Kamp, I. Van de, & Slot, C. (1999). *Evaluation of TeleTOP at the Faculty of Telematics*. University of Twente, The Netherlands

Tielemans, G., & Collis, B. (1999). *Strategic requirements for a system to generate and support WWW-based environments for a faculty.* Proceedings of Ed-Media '99 Seattle, World Conference on Educational Multimedia (pp 346-351). Charlottesville, USA. ISBN 1-880094-35-5.

Designing Adaptable Learning Environments for the Web: A Case Study

Ileana de la Teja
LICEF Research Centre, Télé-université
Montreal, Quebec, Canada
idelatej@teluq.uquebec.ca

Andrée Longpré
alongpre@teluq.uquebec.ca

Gilbert Paquette
gpaquett@teluq.uquebec.ca

Abstract: As the capabilities of information technologies increase, the success of developing learning environments adaptable to individual learner's needs and preferences depends more on design planning than on technical features. This paper focuses on a design method grounded in knowledge modelling, evincing its use in the design of a flexible learning environment for the Web, aimed at three different target audiences. It is proposed that modelling techniques can be used to represent the generic parts as well as the specific activities of each one of the target audiences from four different perspectives: contents, pedagogical strategy, learning materials and delivery platform.

Introduction

In the past decade, the potential of learning environments adapted to the learners has been put forward by studies interested in user centred design (Nikolova and Collis, circa 1997; Larin, 1997; Hannafin et al, 1992). Recent technological advances in the Web have increased that interest because it offers a promising option to deliver such environments, thanks to the capacity to combine the advantages of different media, to handle large amounts of interconnected information and to facilitate social interactions by linking people throughout the world (Knowles, 1996). Before making this potential concrete, however, there remains an array of challenges for instructional designers since design methods addressing environments adapted to learners are still sparse and/or haven't been empirically tested (Pulkkinen, 1997 and Larin 1997).

This paper reports an experience using MISA, a courseware engineering method, in the design of a Web course aiming to meet the needs and characteristics of three different target audiences. It first describes the issues addressed by MISA. In particular, it discusses how a modelling approach has been used in the representation of four different axes (content, pedagogical strategy, learning materials presentation and delivery infrastructure). Then, it explains how this method has been adapted to represent the generic parts (shared by the three target audiences) as well as their specific conditions.

1. The Method: MISA

For more than seven years, a multidisciplinary team at LICEF Research Centre has engaged in the development of tools to assist the designers of telelearning environments. The expertise from various fields has resulted in the development of a courseware engineering method named MISA (French acronym for Learning Systems Engineering Method). MISA proposes an approach to learning systems design based on 4 axes that are created individually but are closely related. The multidimensional structure of each axis is represented through a knowledge modelling technique (Paquette et al, 1998). A software called MOT is used to graphically describe different types of knowledge and their links (Léonard and Lalonde, 1997).

Empirical evidence of the effectiveness of MISA is elicited by the successful application of its principles in different courses designed to be delivered in telematic contexts. MISA doesn't presuppose a particular pedagogical orientation or a specific technology; it is learner centred and considers eventual differences between target audiences according to their profile. The attributes of the target audiences determine the basis upon which the modelling of axes is to be done. To identify these attributes, MISA offers a set of electronic forms including sections to describe each target audience. Currently, MISA considers different target audiences as belonging to one single organisation. This may be seen as a constraint in the design of learning systems involving several organisations in which each one of them brings their own set of target audiences. In order to analyse this limit, MISA has been used in the design of a Web course aimed at three different organisations, corresponding to three professional associations: accountants, managers and notaries. The next sections describe the process of examining this issue.

2. Target Audience Profile

The first phase of MISA's pedagogical engineering process addresses the learner's profile. Since MISA considers different target audiences as belonging to the same organisation, each professional association (PA) has been taken into account as an organisation on its own. In so doing, it was possible to get a general characterisation of each PA as well as to identify the profile of their own different target audiences. Among the distinguishing attributes were the number of participants, language, availability, learning preferences and attitudes.

The information gathered from the three PAs culminated in a generic profile of the target audiences. Generic attributes were the academic level (a university degree) and similar computer literacy. All of them were familiar with Web navigation. The characteristics of specific target audiences were drawn and compiled in families pertaining to a single generic trunk with branches both specific and generic. The target audience profile would define the orientation of the four models described below.

3. Subject Matter Model

The modelling of the subject matter has been done in the second phase of the engineering process. The challenge was to create a unique model that could be adapted to each of the professional associations. A procedural model was chosen in order to accommodate the general objective of the course: to use information technologies (IT) to improve the effectiveness of professionals in their tasks. Figure 1 shows the first level of the subject matter model.

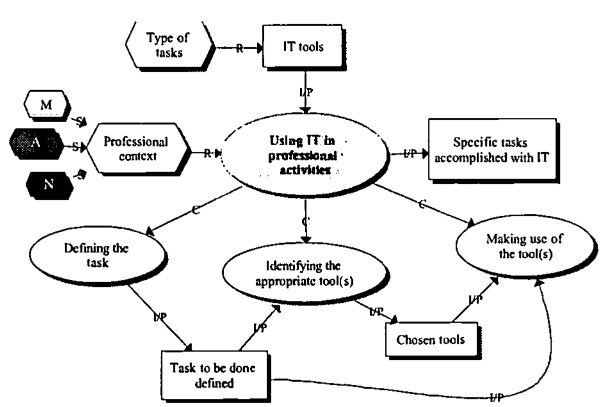


Figure 1. Subject matter model

In this model, the main knowledge, "Using IT in professional activities", is a process (grey oval) having as input the knowledge unit "IT tools" which, in turn is determined by the type of task to be done. The general process starts by defining the task to be accomplished and is followed by the identification of the appropriate tool to be employed.

Since this generic model had to represent the specificity of each target audience, different means were used. First, a ruling principle was applied to the main knowledge unit. The hexagon "Professional Context" indicates that the leading process varies according to the context in which ITs are to be used. In this case the context is given by the professional associations (A=Accountants; M=Managers; N=Notaries).

Secondly, a learning skill has been associated with each knowledge unit according to the requirements of different target audiences. For example, the learning skills "Memorise", "Analyse" and "Transfer" could be joined to the knowledge unit "IT tools" to respectively illustrate the needs of each professional association.

Finally, the creation of sub-models enabled us to represent a knowledge unit as seen from different perspectives. The knowledge "Type of tasks", in figure 1, has been further divided into five knowledge units corresponding to the five sorts of tasks identified as important in the subject matter model: self-management, information, production, collaboration and assistance. These tasks were created as a sub-model inside the hexagon "Type of tasks".

For each professional association, a series of tasks embodying their professional practice were selected. A comprehensive analysis of the specific tasks led to the classification of families of tasks named "common tasks" that were shared by at least two target audiences. The common tasks were integrated into the generic task branches of the model and were separated into new sub-models to represent the specific tasks.

4. Pedagogical Model

The third pedagogical engineering phase suggests the description of the activities available to the learners as well as to the instructors (if any) through a pedagogical model. This model indicates how the activities are organised and which learning materials and tools are necessary to accomplish them.

The pedagogical model is nurtured by the subject matter model and is oriented by the target audience profile depicted in the first phase of the engineering process. Since the specific aspects to be considered in a learning environment can be numerous, the diversity of pedagogical possibilities in a learning environment adapted to learners can be difficult to represent.

To facilitate this kind of modelling the activities were combined to form groups named "learning units". The purpose was to discern different alternatives according to the two main learning preferences of the target audiences: guided learning or autonomous learning. The model offers different possibilities to the learners through seven learning units (LU). All LUs are generic, excepted for LU5, which was conceived to answer some specific needs of one target audience: the manager's professional association (M).

The first learning unit (LU1) introduces the general concepts regarding IT and enables the learner to get a glimpse of the different decisions s/he can take, among others, to select the content to learn and the pedagogical path to follow. The pedagogical model is not linear and after completing LU1, the learner can choose any other LU. To assist the learner in her/his choice, LU2 offers activities to help her/him identify her/his profile whereas LU3 contains activities to help in the planning of her/his learning process.

If a learner's preference is for autonomous learning, s/he can accomplish the tasks in LU4, which are exploratory in nature. LU4 covers the same subject matter as LUs 5, 6 and 7, but the learner can decide on the content to be learned and can progress according to her/his own pace. Assistance of tutors, pairs and advisors is always available.

When a learner's preference is for guided learning s/he can choose the content to learn from LU6 or LU7. Whereas LU6 aims to improve the effectiveness of a professional when doing a research task on the Web, the LU5 intends to enhance effectiveness in communication and collaborative tasks.

As stated before, the pedagogical model is generic; its specificity is emphasised in the activities of each LU through 1) the principles applied to the learning materials and 2) the sub-models in pedagogical scenarios representing distinctive characteristics.

The pedagogical scenarios contain the activities of a LU describing the interventions of learners and the tutors (if any). Figure 2 shows the representation of the learners' activities of LU 6.

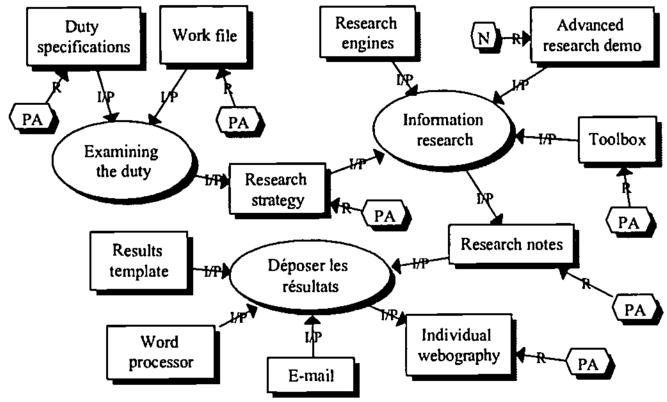


Figure 2. Learning scenario of LU6

In this model, principles (hexagons) designating the target publics have been used to refer to the nature (generic or specific) of the inputs and products of the activities. The principle PA indicates that the material exists in three versions, (one per professional association). "N" implies that the element applies only to notaries. The absence of a hexagon indicates that the element is generic, i.e. is the same for the three target audiences.

5. Media modelling

The media model has been constructed during phase 4 of the MISA method and according to the orientation principles proposed in phase 2. These principles had stated the types of learning materials, the selected media support, their size or duration properties, and their actual status: existing, to be adapted or to be built from scratch.

For each learning material, its media model describes its main components. For example, Web pages, video sequences or book chapters are, each in turn, subdivided into smaller components, down to the media element which will correspond to a text, an image, an audio or a video file called "content objects". These media components and elements are structured together by transition links and regulated by principles (norms to guide their presentation).

Each learning material is associated with one or more target populations. Some of the materials are generic, intended to be used by every target population even outside a specific course, for example, the "User Guide of the Virtual Learning Environment". Others are specific to a target population such as the case studies "Will in Trust" for the notaries, "Exporting marble products" for the managers or "The Verdi inc." for the accountants; while others are specific to the course but common to all target populations, such as "Tools for Efficient Communication".

In the media model, learning materials and their components are organised around a metaphor, in this case an exposition hall on information and communication technology. Such a metaphor makes it easy to separate the generic, common and specific components, while keeping them related in a consistent way. The metaphor also gives a concrete meaning to the pedagogical scenarios through an analogy with a familiar situation.

In our case, the exhibition hall contains booths corresponding to the generic tasks in the pedagogical scenarios: Self management: the "Welcome Kiosk" (Learning Units 1, 2 and 3); Exploring tools: the "Smart Explorer" (LU 5); Information search: the "Successful Prospector" (LU 6); Production: the "Efficient Communicator" (LU 7); Collaboration and assistance: the "Bistro", the "Auditorium" and the "Idearium" are all sections of the exhibition in which contacts, exchange of ideas and assistance can be requested or given (LU 5).

On that basis, a media model of the website could be built as a MOT graph representing media components and elements as concepts (rectangular boxes), transition links as procedures (oval boxes) and norms as principles (hexagonal boxes). Figure 3 presents the main model, together with the corresponding main Web page of the exposition hall. In the model, the transition links a, b, c, d, e and f, lead to pages where other components correspond to activities and resources that will be accessible in the future website.

Based on the orientation principles and each target population profile, we have first built a generic model (mainly independent from the subject matter but relevant to the metaphor). Then, in a second step, we have identified the specific media components addressed to each target population, and also the common components and their media elements.

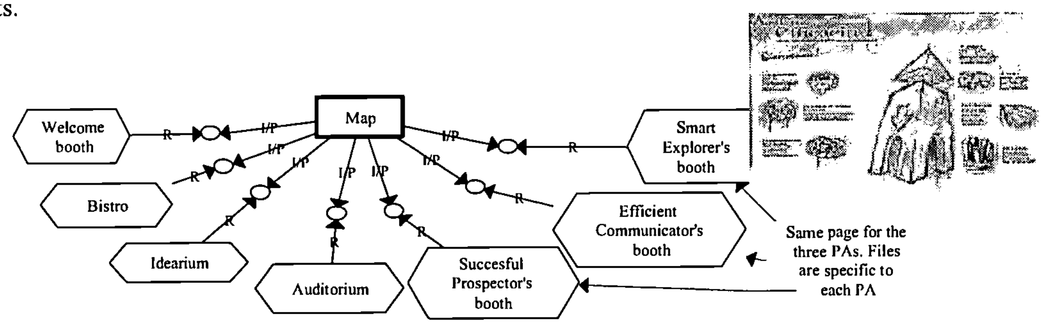


Figure 3. Media model and corresponding Web page

The main media model of figure 3 shows how we have grouped the generic aspect related to the metaphor, for example the booths. It shows the common components linked to the course content, for example "Principles of communication" in the Efficient Communicator's booth. Each booth has transitions towards specific files, such as the assignments for learning activities using situational descriptions such as "Mediation familial" (for notaries) or "Planification stratégique" (for managers).

Important constraints have influenced this media model. We wanted to have a single interface for every target population in order to minimise the development costs, while still ensuring that each target population would have access to tools and learning materials appropriate to them. To achieve this, the generic and common components have been integrated in the main model, while the specific components have been represented in sub-models of the media model and their corresponding Web pages.

Finally, in a third step, to insure consistency between this media model and the knowledge model, each main component of the media model has been associated with a sub-model of the knowledge model that had been developed in phases 2 and 3. This is particularly important for some material components such as the self-diagnosis grid, which requires the learner to answer questions about his or her actual skills, followed by a piece of advice from the system on the next activities to tackle.

6. Delivery modelling

Also in phase 4, a delivery model has been developed in tandem with the media model, based on the orientation principles stated in phase 2 and revised in phase 3. The principles had identified the technological infrastructure (networks and tools) and the services (for example, of a training manager) required for the delivery of the course. The delivery model is another specialised MOT graph based on the relations between users requiring services to access the learning materials, tools and telecommunication services.

In our case, there were many challenges. We had to provide Web-based training including asynchronous as well as synchronous activities. We were to build a single website for three professional associations, each having their specific needs to reach learners distributed at home or at work within a large territory in Quebec, using various communication services that would require the participation of many service providers.

The Explora virtual learning centre model and system (Paquette, 1997; Girard et al, 1999) has been a good way to fulfil all these conditions. This system is now in full operation at Télé-université and in other organisations. The Explora system supports learners and the other actors in their interactions. Each actor has a specific environment enabling him/her to manage his/her activities, consult and produce information, engage in collaboration and receive assistance from different sources. Some of these resources are linked to the specific website, such as the one intended here for professional associations, to provide user tracking, reports on progress and counselling.

Using the Explora system, we were able to provide an efficient telelearning environment to each of the three target populations, using either broadband communication from Bell Canada for ADSL lines and from Vidéotron for cable-modem lines, as well as narrower ISDN lines more available to some of the participants.

7. Results and Discussion

The four models developed in this project have been useful to structure the main dimensions of a telelearning environment, producing a course design that proved to be an efficient way to communicate with the development team, and also to prepare the delivery of a Web-based course and its technological environment.

Graphical modelling, as proposed by the MISA method, has been a good way to represent the course content as related knowledge and skills, the learning scenarios with their activities and resources, the structure of the website based on a metaphor, as well as the delivery infrastructure and services. The graphical representation of these elements has helped the design team to produce a consistent blueprint of the system in all its dimensions, while considering the many alternatives possible to fulfil the learner's training needs. It has been helpful in decision making on how to support different target populations, types of learning materials and delivery infrastructure components, within the same website.

Two limitations have been identified. First, the many models, generic and specific, each with their sub-models, even with a well developed and useful representation tool like MOT, have proved a bit cumbersome. Second, instructional engineering is a complex iterative process that requires constant updating of the models. Revising one model entails modification in the others, so the designer has to be helped in his or her tracking efforts for possible inconsistency between models.

To overcome these barriers, the LICEF Research Centre will deliver a more powerful knowledge editor, which is an extension of the actual MOT software, based on a effort started in spring 1997. This software has new capabilities to link different models together so that the designers more easily identify incompatibilities. Also, some help functions are integrated to support team collaboration, as well as variant scenarios or media models addressed to different target populations.

A further effort was started in the summer of 1999, to built ADISA, a Web based performance support system for designers that will cover all the 30 main tasks and processes of the MISA method. ADISA will integrate seamlessly the actual and the future MOT modelling tool, together with forms describing the main objects such as knowledge units, learning activities and resources, media components or delivery services. ADISA will enable designers, possibly working at distant locations, to work together on-line or off-line to design telelearning environments.

References

Girard J., Paquette G., A. Miara and K. Lundgren. (1999). *Intelligent Assistance for Web-based TeleLearning.* In S.Lajoie and M. Vivet (Eds), AI in Education – Open Learning Environments, IOS Press.

Hannafin, M.J., Craig, H., Land, S., and Hill, J. (1994). *Learning in Open-Ended Environments: Assumptions, Methods and Implications.* Educational Technology. 34(8).

Knowles, A. (1996). *Instructional Media: The Internet Possibility.* Literature Review Research Paper EIPT 6333, University of Oklahoma. Available on-line: http://www.ou.edu/class/eipt6143/annehome/ou6333.htm

Larin, G, (1997) *Adaptive Learning Environments.* Available on-line: http://www.stemnet.nf.ca/~elmurphy/emurphy/ale.html

Léonard, M. and Lalonde, D. (1997) Logiciel MOT. Manuel de l'utilisateur. V. 1,0. LICEF, Télé-université, Montreal.

Nikolova, I. and Collis, B. (circa 1997); *Flexible Learning and Design of Instruction.* Available on-line: http://193.68.242.15/~iliana/TDO/TDO97/CRS_MATERIAL/PEG_PAPER.HTM

Paquette, G. (1997). *Virtual Learning Centers for XXIst Century Organizations.* In F. Verdejo and G. Davies (eds.), The Virtual Campus, Champman & Hall, London. pp. 18-34.

Paquette, G (1998). *Engineering Interactions in a Telelearning System.* Proceedings of TeleTeaching'98, IFIP World Conference, Vienna-Budapest.

Paquette, G., Crevier, F., and Aubin, C. (1998) *Méthode d'ingénierie d'un système d'apprentissage (MISA).* LICEF, Télé-université, Montreal.

Pulkkinen, J. and Niemi, E. (1997). *Open Learning Environment on the Web.* ICDE conference 1997. Pen State University. USA

Acknowledgements

We wish to thank the three professional associations involved in this project: la Chambre de notaires du Québec, l'Ordre des administrateurs agréés, and l'Ordre des comptables agréés du Québec, and also the CEFRIO who has been a facilitator before and throughout this project. Thanks also go to Lise Damphousse, Hamadou Saliah, Juli Aubin, Louis Guérette, Guilaine Binette, Alexis Miara and Frédéric Bergeron of LICEF Research Centre for their participation in the development of the learning environment. Finally, we wish to thank TL-NCE and OLT, two Canadian organisations that have partly funded this project.

E-STUDY: THE DESIGN OF AN INTERNATIONAL ONLINE KNOWLEDGE COMMUNITY

Sjoerd de Vries
Faculty of Educational Science and Technology
Communication Science
Netherlands
vries@edte.utwente.nl

Dimiter Bogdanov
Bulgarian Academy of Sciences
Institute of Computer and Communications Systems
bogdanoc@iccs.acad.bg

Maurice van Egeraat
Comi BV
Netherlands
maurice@holomediasystems.nl

Paul Bloemen
Faculty of Educational Science and Technology
Communication Science
Netherlands
bloemen@edte.utwente.nl

Lonneke Roossink
Faculty of Educational Science and Technology
Communication Science
Netherlands
roossink@edte.utwente.nl

Abstract: The design of an online knowledge community is described. A online knowledge community serves as the socio-technical infrastructure for tele-learning. The E-Study Europe project is taken as an example of the design and development of an international online knowledge community in an university setting.

Introduction

Developments in technology, society and new pedagogies have changed the education last years (Tempelaars, Jager & de Vries, 1999). New technologies offer a wide variety of instructional, information and communication functionality. With the development of new technologies a whole new range of possibilities become available.

The educational concept we apply is the online knowledge community. In the E-Study Europe project a knowledge community is being developed to foster tele-learning activities in Eastern Europe. To enable tele-learning there is a need for a socio-technical infrastructure. A socio-technical infrastructure refers to a hardware and software infrastructure embedded into an organizational infrastructure. The main question of this paper is how a international online knowledge community can be designed.

Online knowledge communities

We see an online knowledge community as a group of like minded people who band together for frequent interaction by means of (an) online gathering place(s), where they share knowledge and

work together onto a specific knowledge domain through communication and knowledge services, because it is mutually beneficial. Online implies the (technical) infrastructure that is used to unite the group of people and to enable them to share their interests. The key elements of an online knowledge community are the members, the shared interests, and the instrumentality. The members can be described by role models. We distinct for instance: the organization, the expert, the master, the external and the apprentice role model. The shared interests can be described by the mission of a community.
Knowledge sharing and knowledge creation activities in a community require thoughtful and careful design. Two educational views are used for the design of a socio-technical infrastructure for a knowledge community:

- *constructivist view of learning*. This view implies that knowledge is not seen as an accumulated body of empirically verified facts, but rather is derived directly from observation and experimentation. In this view, it is assumed that knowledge is something that is constructed by people. Learning concerns the individual construction of knowledge as schemata, concepts, attributes, links, forms, etc.
- *cognitive apprenticeship approach*. In this approach, a master and apprentice work together on tasks in order to enable the apprentice to become a master. The purpose of Cognitive Apprenticeship is to transfer conceptual and problem-solving knowledge in an integrated and connected way (Collins, Brown & Newman, 1986).

Based on these educational viewpoints a technological design encompassing the technical configuration as well as more social requirements like the functionalities, services and resources available is needed. From this point of view, four design requirements for the technical system can be formulated:

Technical design requirements:
- The system has to be functional. The technical system should include all the functionalities users want from the information system and it should support the user while working with it.
- The system structure should be efficient. The design of the system should provide appropriate information to the user and should support the navigation through the system.

Social design requirements:
- The system has to be usable. Usability means the extent in which an user can work with the system easily and the amount of system support the user gets.
- Users should acknowledge that the system is valuable to work with, because of effective and efficient system use.

The technical and social requirements are presented in Table 1.

Design requirements for an online knowledge community

Technical requirements	Social requirements

Functional system Flexibility • Provide opportunities that members don't have to be physically present to participate in online knowledge communities. • Provide continuous communication so members could log on the community whenever it suited their schedules and where ever they are • Provide member functionalities to execute needed (learning) tasks and activities (based on function and task analysis)	Useful system Support • Provide a shared, understood goal to members of the community to learn about. • Embed learning / knowledge creation in social experience. Provide spaces and communication and collaboration opportunities that all could share. • Present opportunities for support: for modelling, coaching, scaffolding, fading, articulation, reflection, and exploration. • Provide both public and private feedback support.
Efficient structure Information-richness • Present needed information to perform tasks and store and maintain information in objects in a knowledge base. • Provides links to other useful (Web) resources and make selective use of outsiders for complementary insights and information. • Provide formal and informal environments. Let members of all kinds benefit from having a broader audience, see other's work and dialogue about ideas and insights. • Provide navigation tools that are easy to use.	User acceptance Interactivity • Establish clear lines of responsibility and functionalities for the different role members in the community. • Use contexts that reflect the way the knowledge and skills will be useful in real life to make the knowledge realistic and relevant and meet practical needs and development. • Support mediation between the members and provide mutual respect, tolerance and trust. The members must continually reinforce the collaborative premise of the community. • Foster a sense of collaborative learning and knowledge creation by including learning scenarios.

Table 1: Technical and social design requirements for an online knowledge community.

The requirements in Table 1 provide a framework for the design of an online knowledge community in the E-Study Europe project.

The E-Study project

The main goal of the E-Study Europe project is the development of a tele-educational infrastructure for life long learning purposes concerning the design of ICT-applications for organizational communication purposes as a mean for setting up a knowledge community. The project aims at the implementation of an European socio-technical infrastructure for enabling tele-learning in CCE that makes it possible for students from the CCE to set up and follow personalized curricula based on available certificated online courses.

The project comprises seven partners from four different countries (The Netherlands, Bulgaria, Poland and Germany). Every partner has a specific role or responsibility in this two-year project, for example being the project coordinator, scientific coordinator, course developer or design expert. In the first year of the project the knowledge community was designed and preparations were made for the technical infrastructure (computer network). At this moment courses to be used in the knowledge community are developed.

In the E-Study Europe project, the concept e-study is used (Vries, 1998). The e-study concept refers to a socio-technical infrastructure for life long learning. To enable life long learning there is a need for a socio-technical infrastructure, that is, a hardware and software infrastructure embedded into an institutional infrastructure. To describe such an infrastructure, the concepts Interactive Study Environments, Interactive Study Systems and online Study Services are used. These concepts are illustrated in Figure 1.

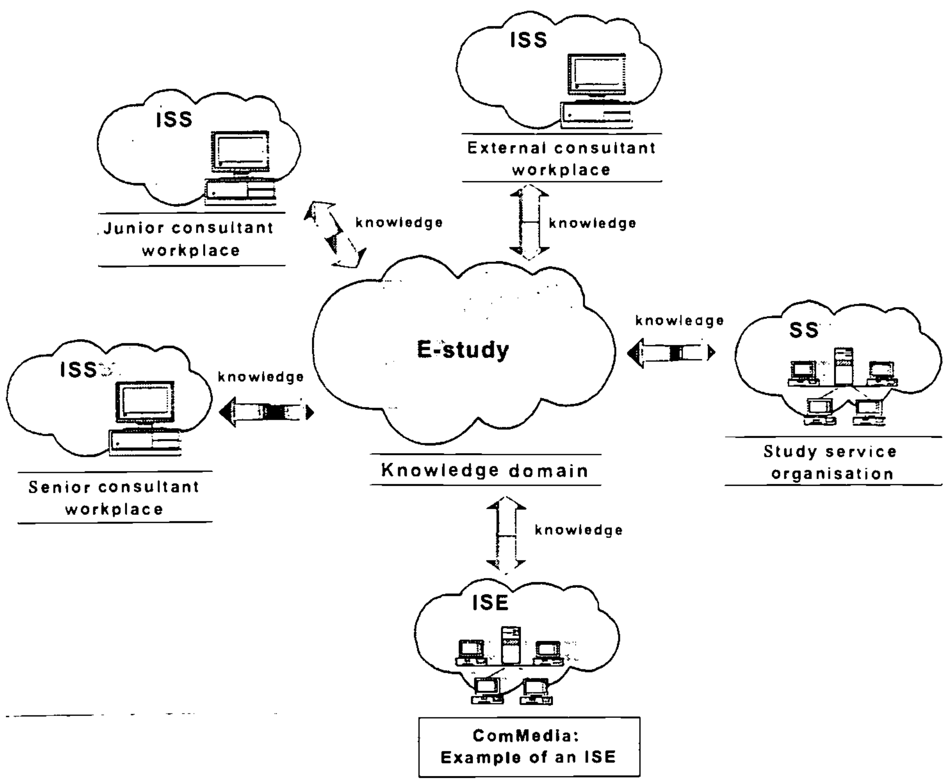


Figure 1: Example of a socio-technical infrastructure based on the E-study concept.

An Interactive Study System (ISS) can be seen as a software system consisting of study task views, study tools, information resources, and if needed additional materials. The main goal of an ISS is to enable an interactive study process between a user of the system and other users and/or between the user(s) and educational resources.

To give the needed support to teachers, there is a need for Interactive Study Environments (ISE's). An ISE is a software system for the preparation, application, and evaluation of ISS's. Such an environment consists of the following basic components: preparation, application, and evaluation tools and Interactive Study System Components. The main goal of an ISE is to improve the effectiveness, efficiency and attractiveness of the (re-) design, use and evaluation of ISS's.

In the E-Study concept teachers and learners will be supported by means of a wide range of communication and information services, summarised in the concept online Study Services. For instance, educational publishers as 'content owners' may act as a Study Service Provider. They provide teachers and learners, who apply study books of the involved Educational Publisher with services linked to the study books. In the e-study concept ISS's, ISE's and study services are interrelated.

In the E-study community the mission is 'the acquisition, creation, management, sharing, and incorporating of knowledge about the design of media applications for educational and communicational use'.

The infrastructure of a knowledge community refers to the ict-applications which form a meeting place for the members. This meeting place enables them to accomplish their mission. Application of modern ICT in education requires high performance backbones for data transmission. In Figure 2 the telecommunication model used in the E-Study Europe project is displayed.

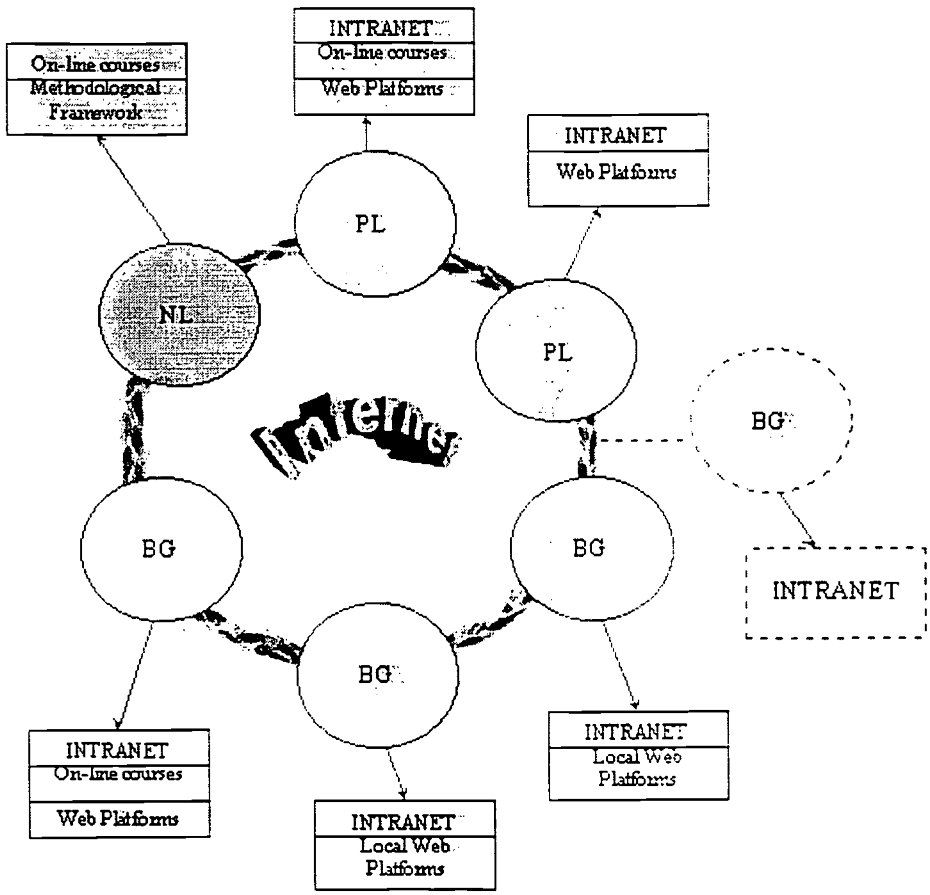


Figure 2: E-Study communication model

The presented telecommunication model enables a broad international propagation of the projects's result and make easier utilization and dissemination at European level. On the other hand, at local level the high-speed requiring technologies could be run on a local network.

Designing the E-study community

In the E-Study Project an Interactive Study System is seen as a study service platform for students and teachers. A study service or a closely related set of study services is made accessible by a workspace. A workspace is defined as a framework which consists of a set of views and interactions (with other users and/or the study environment) needed to make use of services. A view in this context is a set of knowledge objects dynamically created by a specific query on either the Knowledge Object database or the Person/Group database.

In E-Study we distinguish three basic types of workspaces: Personal Workspaces, Community Workspaces and Knowledge Workspaces. Personal Workspaces contain all views and interactions related to the personal housekeeping of the community member. Examples are the personal mail/agenda or portfolio. Communication Workspaces contain all views and interactions related to the co-operation and communication processes between the community member and the other members. Examples are group management, project management and/or communication tools. Knowledge Workspaces contain all views and interactions related to the creation and management of knowledge objects. We distinguish three types of knowledge objects: knowledge items, knowledge collections and knowledge sequences. Knowledge items are media products containing distinct messages. Examples are documents (like a MS Word file, a Quicktime movie or a Webpage) or links to external websites or ftp-sites (URLs). Knowledge collections are unstructured collections of knowledge items or other (sub) knowledge collections. An example is a collection of knowledge items about a certain topic.

Knowledge sequences are structured knowledge collections where a certain (non-)linear path exist between its components. An example is a course which is sequenced by a time schedule. By maintaining metadata, created knowledge objects can be reused and shared among members of the local knowledge community or members of other knowledge communities.

Based on these basic workspaces, customized workspaces can be constructed for certain types of interactions and views. In E-Study we distinguish a Guest Workspace (based on the Personal Workspace) and several workspaces based on the Knowledge Workspace: Tutorial, Support, Design, Archive and Explorative workspaces. In some cases, combinations of these workspaces are possible.

Workspaces contain a set of views and interactions. We distinguish the following views (and related interactions) in E-study: 'What's new?' View, Identity View, Agenda View, Portfolio / Showcase View, Records View, Personal Education Plan View, Notations View, Groups View, Knowledge Object View, Overview of relevant tools, Communication tools, Collaboration tools.

By using workspaces as a framework to organize views, interactions and tools, study environments gain a more dynamic and adaptive way to accommodate several types of learning in the knowledge community.

Further developments

The development of the knowledge community is still under way. The next step in the E-Study project will be the development of courses to be used within the developed knowledge community. The courses planned to be set up have to contribute to a trans-national on line curriculum on "Design and use of Interactive Media for Corporate Communication". Two trials are going to be carried out to identify the viability of the concept used in the E-Study project, the effectiveness/efficiency of applied tools, services and approaches.

References

Collins, Brown & Newman (1986). *Cognitive apprenticeship: teaching the craft of reading, writing and mathematics : technical report.* Cambridge, MA : BBN. Laboratories Inc.

Tempelaars, P., Jager, A., & de Vries, S.A. Kennismanagement in het hoger onderwijs. In: Van Duivenboden, H. & Lips, M. (1999). *Kennismanagement in de publieke sector.*

Vries, S.A. de (1998). *E-study: A way to flexible and Interactive Education.* Informatik Forum 12(1), 33-38.

Prototype Tools for Programming

Fadi P. Deek
New Jersey Institute of Technology
Computer and Information Science Department
Newark, NJ 07102
fadi@cis.njit.edu

James A. McHugh
New Jersey Institute of Technology
Computer and Information Science Department
Newark, NJ 07102
mchugh@cis.njit.edu

Abstract: We describe a prototype environment for programming. The Specification Oriented Language in Visual Environment for Instruction Translation (SOLVEIT), is designed to address the novice programmer's problem solving and programming skills by providing a collection of tools that students can use in formulating the problem, planning, designing, testing, and delivering the solution.

The SOLVEIT Prototype

SOLVEIT is a prototype of an integrated environment to support students through all problem solving stages, including formulating the problem, planning and designing a solution, testing and delivering that solution. Students who use SOLVEIT not only learn programming but also gain experience in problem solving by using strategies and tools that help them understand the problem, develop a plan for solving the problem, and then produce the design needed to implement the solution. The SOLVEIT system is based on an underlying process for problem solving and program development (Deek 1997), together with the tools needed to support that process. This work is based on the premise that the programming language itself is only one of the necessary skills in writing programs and that there is a complementary relationship between efforts to develop environments and tools to support problem solving and programming, and research into understanding the fundamental cognitive skills and effects of learning programming (Weinberg 1971; Shneiderman 1980; Mayer 1988; Hoc, Green, Samurcay, & Gilmore 1990; Lemut, du Boulay, & Dettori 1993; Deek, Kimmel & McHugh 1998; Deek & McHugh 1998).

The Process

The conceptual framework underlying the SOLVEIT environment joins the problem solving method with the tasks of program development into a common model for problem solving and program development. Each stage of this model relies on specific activities to integrate and support the tasks of both problem solving and program development (Deek 1997). Specifically, the framework articulates the details of the activities required to support: formulating the problem, identifying a plan for solving the problem, specifying a solution design, translating the solution specification into programming language code, testing and delivering the results. Thus, the framework explicitly unifies problem solving/program development into one methodology.

The Tools

The SOLVEIT environment complements existing tools of traditional programming environments (syntax editors, compilers, linkers, loaders, code libraries, debugging utilities, tracers and code watchers), with additional tools to support the process of problem solving in problem formulation, planning, designing and delivering the solution; translating and testing are facilitated through existing programming environment tools.

Tools are available for specific stages of the process and are used to perform the various tasks of problem solving and program development. There are shared tools, such as project notebook, recorder, reference database, and algorithmic toolbox, that can be used in most of the stages. Compiling and debugging tools are pre-existing utilities that are already available in traditional programming environments. The SOLVEIT environment's architecture establishes relationships among the different tools and components that support the activities within the stages of the problem solving and program development process, that is, the architecture realizes or embodies the methodology. The tools for formulation and planning stages were fully developed, i.e. operational prototypes, but the tools for the remaining components of the system we only simulations. The students used these simulated components to mimic the activities of those stages. *Figure* 1 provides an overview of the functionality of this prototype system.

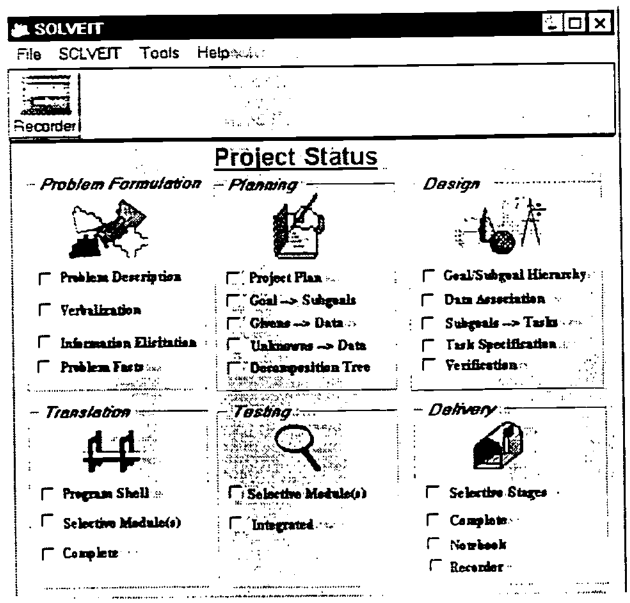


Figure 1: An overview of the SOLVEIT prototype

Tools for Problem Formulation

Three tools are used for problem formulation: (1) the problem description editor; (2) the verbalization tool; and (3) the information elicitation tool. *The problem description editor* is invoked from within the problem formulation stage to enter and save the problem statement into the system. If the problem is already in electronic form, the file can be opened and read into the editor. The problem description text is stored in the multiple-view reference database.

The verbalization tool is active in all stages of SOLVEIT, but is invoked automatically in problem formulation after the problem description is saved. Questions are presented to the student while the problem statement is still visible in the editor. The student can answer the questions or can skip the entire verbalization session. These questions will provoke the student to re-examine the problem statement which remains displayed throughout the interaction session. The results of this verbalization session are saved, along with subsequent verbalization sessions, by the recorder and are available to the student during the entire problem solving process. A complete transcript is created as part of project deliverables. The verbalization questioning in SOLVEIT is general, but can be adapted to fit a specific class of problems. In addition to questioning, users have access to a project notebook/graphics editor in order to draw and make notes as necessary. The interaction transcript is stored in the project notebook/graphics editor.

The information elicitation tool is invoked from within the problem formulation stage. It is used to extract and organize relevant information, found within the problem description, in a structure suited to perform the transformations of subsequent stages and to carry out the tasks that will lead to the solution. This technique of information elicitation will transform the problem description from its text format into a database of problem facts. Using the information elicitation tool, the student returns to the typed problem and extracts the goal, givens, unknowns, conditions and constraints. All gathered information is stored in the multiple-view reference database and is accessible from within other stages of SOLVEIT.

Tools for Solution Planning

In conjunction with the tools used for problem formulation, there are three tools used for solution planning: (1) the plan definition editor, (2) the goal decomposition tool, and (3) the data description tool. *The plan definition editor* is invoked from within the planning stage. The student uses this simple text editor to describe various alternatives and the steps required for solving the problem, but it does not impose a specific solution or a rigid sequence on the student. This initial plan will help coordinate student's thoughts and actions in solving the problem. The plan is written to the project notebook/graphics editor.

The goal decomposition tool is invoked from within the planning stage, allowing the student to begin transforming the goal identified in the information elicitation phase into subgoals that need to be completed to solve the problem. The student refines the goal into a collection of subgoals and associates two attributes with each subgoal: an identification name and a description. A goal can have multiple subgoals and subgoals themselves may be decomposed into smaller subgoals. A decomposition tree and information about all the subgoals are stored in the multiple-view reference database.

The data description tool is invoked from within the planning stage to transform the givens and unknowns identified in the information elicitation phase into data representation. Givens are the problem's input-data or constants. Unknowns are output-data or intermediate data elements. Using the editor, the student associates a series of attributes with givens and unknowns: name, description, origin/source, type and structure. A data description table is stored in the multiple-view reference database.

Tools for Solution Design

Three tools are used for solution design: (1) the module organization tool, (2) the module communication tool, and (3) the module logic specification editor. *The module organization tool* is invoked from within the design stage. It is used to establish the hierarchy of the subgoals, using a structure chart approach, already refined in previous stages and now contained in the reference database. There is an implied left to right organization and top to bottom hierarchy of subgoals. To reorganize or change the hierarchy, subgoals can be repositioned vertically and horizontally. New subgoals can be added, and others can be removed or merged. Information about the organization/hierarchy of subgoals in the structure chart is also maintained in the reference database and can be viewed in a convenient manner.

The module communication tool is invoked from within the design stage. It is used to establish the data flow relationship between modules. Communication between modules is formed using information gathered during the planning and design stages, now stored in the reference database. Additional data may be defined and added to the database as needed. Data elements can be associated with specific modules as a sender or receiver of that element. The result is a data dictionary table, also stored in the reference database, that includes the data element names, type, description, the associated goal/subgoal and the direction of the data flow.

The module logic specification editor is invoked from within the design stage. It is used once the organization and refinement of the structure chart and data flow have been completed. This tool enables the student to develop module logic for each box of the structure chart. Module logic is constructed using an algorithmic constructs toolbox. A program shell, based on the structure chart, is displayed in a "table of contents" form to facilitate module logic development.

The "table of contents" gives the name of the main module and all other program modules along with the data flow and the direction of each. Each module and associated entry in the "table of contents" is hypertext sensitive and when selected it invokes the module logic development window.

A SOLVEIT algorithmic constructs toolbox, which is used to describe the logic for each module, contains templates for a SOLVEIT-specific algorithmic language consisting of basic data types, control structures, a simple list structure and modular abstraction. Syntax templates are selected and copied into the student's workspace.

The module logic is saved in the reference database as a text file using the SOLVEIT algorithmic language. General-purpose routines that are developed in this stage may be stored into a library of functions for reuse in other problems. Similarly, any modules developed and saved in earlier problem solving sessions that are appropriate for other situations may be integrated and reused. The algorithmic logic created in the specification editor, stored in the reference database, can not be compiled directly. It must be copied into the syntax editor of the target-programming environment (i.e. Pascal, C, and C++) and the student uses it as the basis for code translation from algorithmic logic into language syntax.

The next two stages of translation and testing are performed within the programming environment.

Tools for Solution Delivery

The file management tool is invoked from within the delivery stage. It is used to organize and produce the complete solution package consisting of the outcome of each stage and, if desired, the content of the reference database and project notebook/graphics editor. The result is a fully documented program maintained in an organized manner and can be printed or saved on a disk. In addition to the specialized tools in each stage of the process, SOLVEIT provides a host of environment-wide tools that may be invoked from within any stage of SOLVEIT.

The Project notebook/graphics editor is a text and graphics editor used as a scratch pad by the student. The student is prompted to invoke the editor during the problem formulation stage, but can also be invoked at any time during the problem solving process. Text and graphics capabilities are available for the student to make notes and to draw.

The recorder monitors the student's activities within SOLVEIT and acts as an event-capture log. It allows the student and teacher to replay the activities of a problem solving session at a later time. Each time the student enters a stage within SOLVEIT, the event is recorded, and the task performed is also recorded. Upon exiting, a snapshot of the reference database is copied to the recorder. Activities logs are listed in the sequence they occurred. The recorder content cannot be edited. *The multiple-view reference database* contains the result of all data transformation within SOLVEIT, beginning with entering problem description through the development of the algorithmic solution. The database organizes this information and makes it available to the student at different stages of the problem solving process. *The algorithmic constructs toolbox* is a logic template database represented as icons and is accessible from within the design stage to specify modules' logic.

In summary, the process of the SOLVEIT environment, the tools supporting this process and the existing tools of a traditional programming environment are combined to form an integrated environment for problem solving and program development.

Conclusions

Students' difficulties with learning basic programming go beyond the scope of language syntax because programming is an activity that demands the development of problem solving skills. Command of language syntax must be acquired, but in conjunction with problem solving skills and analysis and design methodologies. With the development of composite methodological/software environments like SOLVEIT that supports teaching students programming, the role of language syntax in the overall process of programming instruction will be redefined in a manner that gives appropriate weight to both language issues and problem solving.

Acknowledgements

The authors wish to thank Richard Ordowich, an NJIT Computer and Information Science student for his role in the implementation of the initial SOLVEIT prototype.

References

Deek, F.P. (1997). *An Integrated Environment for Problem Solving and Program Development*, Unpublished Ph.D. Dissertation, New Jersey Institute of Technology.

Deek, F.P, Kimmel H. & McHugh J.A. (1998). "Pedagogical changes in the delivery of the first course in computer science: problem solving then programming", *Journal of Engineering Education*, 87 (3), pp. 313-320.

Deek, F.P. & McHugh J.A., (1998), "A survey and critical review of tools for learning programming", *Journal of Computer Science Education*, 8 (2), pp. 130-178.

Hoc, J.-M., Green T.R.G., Samurcay R., & Gilmore D.J. (Eds.), (1990). *Psychology of Programming*, London: Academic Press.

Lemut, E., du Boulay B., & Dettori G. (Eds.), (1993). *Cognitive Models and Intelligent Environments for Learning programming*, Berlin: Springer-Verlag.

Mayer, R.E. (1988). Introduction to research on teaching and learning computer programming, in R.E. Mayer (Ed.), *Teaching and Learning Computer Programming*, pp. 1-12, Hillsdale, New Jersey: Lawrence Erlbaum.

Shneiderman, B. (1980). *Software Psychology: Human Factors in Computer and Information Systems*, Boston, Massachusetts: Little, Brown and Company.

Weinberg, G.M. (1971). *The Psychology of Computer Programming*, New York: Van Nostrand Reinhold.

Authoring Educational Hypermedia Using a Semantic Network

D.J. Mullier, M.B. Dixon
Faculty of Information and Engineering Systems
Leeds Metropolitan University
England
[d.mullier][m.dixon]@lmu.ac.uk

Abstract: Authoring hypermedia is a difficult process and any deficiencies in the authoring process are likely to be reflected in the student's educational experience. This paper is concerned with providing the author with a framework and process so as to reduce the possibility of producing a poorly structured domain. The discussion is centred on practical experiences with an educational hypermedia system produced at Leeds Metropolitan University that helps the author to structure the domain by the use of a semantic network that is used to represent the essential structure of the domain. Since it is an educational system tutorial nodes are used within the hypermedia to provide the student with tasks to reinforce their learning. The location and use of these tutorial nodes is discussed, in that they may be used as landmarks to help orientate a student.

Introduction

It has been argued by Pereira et al (1991) that all hypermedia systems should have a semantic network (or similar structure) defined within them to aid both the author and the end user. Jonassen and Wang (1993) have further suggested that structures such as semantic networks provide the student with structural information that aids them in the retention of hypermedia material. Further studies have shown that complex information and arguments can be represented in semantic network-like web like structures, termed mind-maps or concept maps and that the use of such structures can aid the author of the structure to remember the information stored within them (McAleese 1998, Holmes 1999). Given this, this paper discusses the implications and the process of defining a semantic network.

In order to explore the issue of authoring an educational hypermedia domain, and other issues described in Mullier et al (1998) and Mullier (1999), a prototype educational hypermedia system, called "Hypernet", has been developed at Leeds Metropolitan University. The remainder of the discussion uses Hypernet as an example of an educational hypermedia system, but the discussion is not restricted to Hypernet itself.

Domain Types

The exemplar domain designed for the conception and implementation of Hypernet was an astronomy domain. This domain was chosen for the reason that it is highly structured and hierarchical, making it ideal for application to this system, since it allows the rapid design of a semantic network. However, the goal of the project as a whole is to devise a paradigm that is as generic in approach as possible, so that it can be applicable to a multitude of domains. In practice, however, it is likely to be the case that some domains are easier to describe as a semantic structure than others. This is because some domains do not exhibit an obvious and generally accepted structure. This could result in a new hypermedia problem similar to "Linkitis" (Conklin 1987), in that if an author is unsure how a domain may be structured then they may be tempted to force a structure on the domain that may not necessarily exist or be helpful. This may result in the student becoming confused and hence render the domain difficult to navigate, exacerbating the lost in hyperspace problem. It is not an ideal situation, however, to allow the students to identify the shortcomings of a domain's design. It is suggested, therefore, that it is the author's responsibility to ensure that the domain is designed correctly before it is exposed to students. It is accepted that this is not a trivial task however.

The authoring process is a complex one and has often been overlooked by hypermedia designers (Theng and Thimbleby 1998, Conklin 1987). It is, however, fundamental to the student's learning needs that the domain is authored to a sufficient standard (Jonassen and Wang 1993). This is especially true for "fixed-link" systems (systems that do not provide dynamic links). In fixed-link systems it is vital that the author provides the correct links for every possible user of that hypermedia system. Bell (1995) argues that people are not good at writing in a non-linear fashion, therefore hypertext (hypermedia) documents tend to become linear and do not model the true (semantic) structure of the domain itself. By producing hypermedia systems that require a semantic network forces the domain author to consider the structure of the domain and hence is far more likely to result in a domain that provides an adequate structure for the student to navigate. Further, if dynamic links are employed the student is provided with links that more closely meet their requirements and so reduces their cognitive loading.

Defining A Domain

Here Hypernet is used as an example hypermedia tutoring system. The process of defining a domain for use in Hypernet involves the following steps:

- Structuring the domain into a semantic network (defining its structure) by providing typed links between class nodes (class nodes may also be used as hypermedia nodes).

- Forming a semantic hypermedia domain by attaching instance nodes to the class nodes (instance nodes may be used as hypermedia nodes).

- Storing suitable exercises within tutorial nodes, which are connected to the semantic hypermedia.

For a standard hypermedia system it would usually be the case that none of the above stages would be employed, since the majority of hypermedia systems remain unstructured (Dillon and Gabbard 1998). Instead, the author determines for every node in the domain how it connects to all of the other nodes, typically an extremely complex task. However, the application of the semantic network encourages the domain author to organise the domain in a more logical fashion. The final stage is unique to a computer based learning system, as opposed to a general browsing hypermedia system. Since it is difficult for a student to learn in an undirected environment (Jonassen and Wang 1993) it is appropriate for the domain author to require the student to accomplish some task, at least until they have become proficient enough in the domain to be allowed to browse freely.

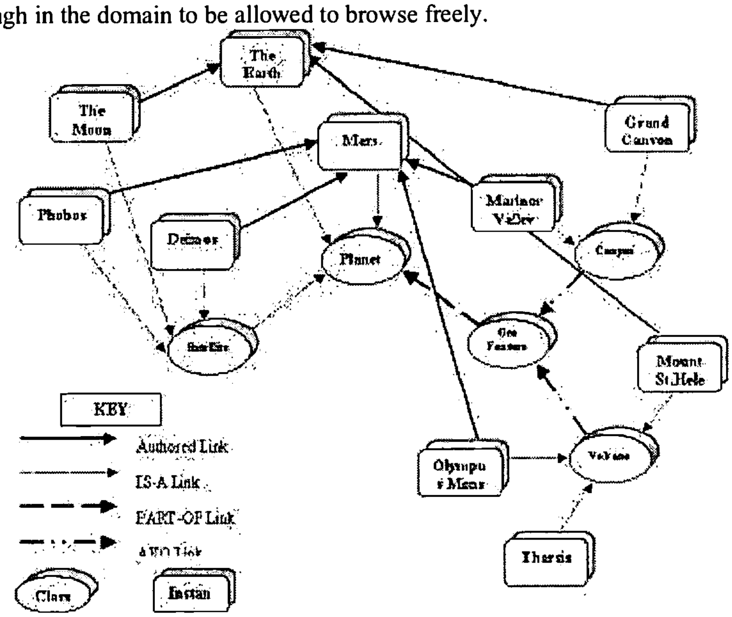


Figure 1 An Example Domain

The Semantic Network

A semantic network can be defined as a graphical representation relating concepts and information et al Beynon-Davies 1994). A concept in a semantic network is defined as a node and labelled arcs (links) define the relationships between concepts. The example semantic network, shown in figure 1, describes part of a simple astronomical solar system domain. The oval nodes represent class nodes and form the overall structure of the domain. The square nodes represent the instance nodes that are subsequently attached to the class nodes. Each class node is therefore used as an anchoring point for instance nodes. Therefore every instance node in the hypermedia is connected directly to the class structure of the semantic network. For example, the instance node "Earth" is attached to the class node "Planet", thus all "Planets" are logically collected around the "Planet" class node. Each instance and class node is visible to the student as a hypermedia node. It is therefore of potential use to the student and author to utilise the class nodes for presenting higher-level information that relates to the nodes connected to it. For example, the instance nodes "Earth", "Mars" and "Jupiter" are attached to the class node "Planet". The instance nodes contain information that relates purely to the node itself (the "Earth" node contains information about the Earth). The class node "Planet" may therefore hold information, useful to the student, about the higher level "Planet" node (which may not have been present without the need for the semantic network) and may provide information as to why each node attached to it, should be attached to it. In many hypermedia systems the only way to discover this fact is to traverse a link that exists between the two and rely upon the domain author providing the information within both nodes that each is a volcano. If the student is forced to undergo this procedure in order to discover the relationship between two nodes then they are further exposed to the "risks" of navigation in a complex information structure. The semantic network however reduces the danger of the cognitive loading problem and navigation problem associated with the hypermedia paradigm, by providing a student with contextual information and by forcing the author to structure the domain more logically (Pereira et al 1991, Jonassen and Wang 1993).

Link Types

This standardised set of link types, described fully in (Beynon-Davies et al 1994) are defined below as:

ISA – relates an object to a class, i.e. it defines an instance of a class. For example "Mars" ISA "Planet", "Mars" being the instance of the class "Planet". This link is unidirectional in that properties are inherited in one direction only. For example the "Mars" node inherits all properties from the "Planet" node by virtue of this link (such properties or attributes may include the fact that a Planet orbits the Sun, thus Mars orbits the Sun). However "Planet" does not inherit properties from "Mars". The IS-A relationship usually represents information towards the top of a hierarchy and therefore represents more general information (Tudhope and Taylor 1997).

AKO (a-kind-of) – relates a class to another class, or may define a subset. This link type demonstrates the relationship between classes. This type is fundamental in connecting a class nodes together to form one semantic network. For example "Planet" AKO "Solar System Body", meaning that a "Planet" is a kind of "Solar System Body" and that a "Planet" inherits all properties of the class "Solar System Body". Tudhope and Taylor (1997) have referred to the AKO link as "narrower-than", since it represents information at the bottom of a hierarchy, which is usually more detailed or narrower in scope.

PARTOF (part-of) – represents how an object is composed of other objects, or inherits only part of the parent class. This link type demonstrates how a class may be associated with component parts. For example, "Geographical Feature" PARTOF "Planet". The part-of link implies that there is a relationship between instances of classes connected via a part-of link.

HASA (has-a) – relates an object to a property or attribute. This is not used to represent structural information (it is not used as a link type). Instead it may be used to represent knowledge within a class. For example, a "Planet has-a Diameter". This may be used to ensure that an object conforms to a class exactly (i.e. the author is aided in deciding if a node belongs to a particular class by virtue of it having the same attributes). As noted by Beynon-Davies et al (1994), this link type also aids queries in that a search may search for exact matches, such as "Planets with diameters greater than 100".

The above link types allow the structure of a domain to be represented. However, further link types may be required to represent course material. For example, it may be necessary to represent dependencies, if one concept must be learned before another, or to represent counter arguments. Extra link types such as "dependent-on" could be used by hypermedia systems to determine whether a node is relevant to a particular student. If a student has not visited the node at one end of the link then the node at the other end is not relevant and may be hidden or greyed out in accordance with the hiding method discussed in Brusilovsky (1996). The "dependent-on" link can therefore be used to represent course information, where it is common to lead a student through topics that are dependent upon each other.

Further link types may include "example-of", "counter-example-of", "supported-by" and "disputed-by". Link types such as these provide a greater depth of information about a particular node. Therefore it may be necessary to separate a node into several nodes representing various levels of detail. It is arguable that some node types such as "counter-example-of" may not be beneficial to lower-level students, since they may contain contradictory or otherwise confusing information, therefore there may be a case to make such links available to only the higher level students. Further, in the area of concept mapping, which can be said to share some common attributes with hypermedia, there can be any number of author (of the concept map) definable link-types (McAleese 1998). In essence it does not matter whether the domain author uses a predefined set of link types or whether they use their own. Other researchers have attempted to produce automatic links differently, depending upon the link types that connect two remote nodes. Tudhope and Taylor (1997) calculate automatic links by giving a stronger relationship between nodes connected by AKO relationships than IS-A relationships. The reason for this is that relationships at the bottom of hierarchies, represented by AKO relationships, are thought to be more closely related than those at the top, represented by IS-A relationships (Tudhope and Taylor 1997). The use of different strengths of relationships has not been explored as part of this research project, although it may prove to be beneficial as part of further work. Further, it may be possible to combine the information potentially available from the student's browsing pattern to dynamically alter the strength of the link types, in that if a user is determined, by virtue of their browsing pattern, to be interested in general information then the strength of the IS-A link type could be increased and vice versa.

Adding Nodes to the Domain

Once a semantic network has been defined for the domain in terms of class nodes, then instance nodes may be added to it. The author must decide to which class a new node belongs, a class being represented by a class node (connected to other class nodes via ISA and/or AKO link types). If there is no such class node, then the semantic network has not been sufficiently defined for the domain or the new node does not belong to the domain. This is an important restriction, since there may be more than one author for the domain. It is possible that a domain may be initially defined by an author, but extra nodes are added to it subsequently, perhaps after students have begun using the hypermedia. The addition of the semantic network is an aid to all such authors, since it has the potential to help them to decide if a node should belong to the domain. An author who is unsure as to the legitimacy of a node's relationship with the domain, may succumb to the "Linkitis" problem, i.e. if unsure then link. The semantic structure aids such an author by providing them with a structure into which the node must fit. It is possible that the responsibility for deciding whether a node should be added to the domain lies with the original semantic network author, since it could be stated that if a node cannot be typed to an existing semantic network node, then it should not belong to the domain. This could be achieved by allowing only certain classes of author to modify or otherwise add to the semantic network. Thus, the integrity of the domain is protected to a far higher degree than would be the case with a hypermedia system without a semantic network.

Once a node has been correctly typed, it is connected to the semantic network. This immediately connects the new node to all the other nodes in the hypermedia system, via paths of varying lengths, thus the author need not specify any other direct links. It is likely however, that an author wishes to add a series of related nodes. For example, the author may wish to add the node "Pluto" to the domain. This could involve the addition of several new nodes, namely the node "Pluto" representing the planet itself and "Charon", representing Pluto's only satellite. The author therefore types "Pluto" is-a "Planet" and "Charon" is-a "Satellite". Once "Charon" has been correctly typed, the author is required to connect it to a host "Planet", since this is an explicit requirement of the "Satellite" type (a reasonable requirement since satellites do not exist in isolation). The original author of the semantic network encodes this requirement within the semantic node itself.

The semantic network is therefore a structure that connects the entire domain together. It is vital that the author connects the class nodes together in an accurate fashion. As discussed above, it may not be clear cut decision whether to connect a node to a particular class node or not. The author may have to make a decision about connecting two class nodes together when the relationship between them is not a definite one. The author should detail this relationship within the class node so that any future author is clear about the defined relationship. It may not always be the case that such a one to one relationship can be defined, i.e. an instance node may not fit exactly into the semantic structure of the domain, but may still be valuable to the student studying the domain. In this situation the author should provide a suitable "non specific" semantic node. For example, the domain author may wish to add information about probe missions to various planets. The author may decide that it is not appropriate to add the semantic node "Probe Missions" as a-kind-of "Planet". However, it may be appropriate to have information about the Voyager missions to Jupiter, with the "Jupiter" instance node. The author could therefore define the semantic node "Related Material" as part-of "Planet". It is important that this facility is used sparingly, otherwise the benefits of structuring the domain could be lost.

Defining Tutorial Nodes

Tutorial nodes are employed by Hypernet as a means to aid the student's retention of the domain contents. Jonassen and Wang (1993) suggest that information is retained by providing a context into which the information fits, thus aiding the student in determining where the information fits within their own knowledge representation structures (schema). In Hypernet this is aided by providing the students with tasks to complete, via the tutorial nodes. Tutorial nodes may take the form of a simple question and answer session, or they may involve a more complex task that requires that the student to visit several nodes. Such tasks may require the student to traverse the hypermedia looking for various pieces of information. Requiring the student to find and examine the relationship between concepts may also aid their retention of structural knowledge of the domain (Jonassen and Wang 1993). It is therefore paramount that tutorial nodes are designed and placed within the hypermedia in order to render this transfer of knowledge as efficient as possible.

The tutorial nodes are designed to remove the danger of passivity from the system, i.e. the student is not always left to wander through a hypermedia system, without a task or guidance, especially if they are a novice of the domain. It could be argued that a human teacher could present the student with a learning task before they are exposed to the hypermedia system. However, this would require the human teacher to supply the student with a complete task that would detail requirements for the student, as they become more proficient with the domain. Alternatively, it would require that the human teacher is constantly present, in order to gauge when the student requires a new more advanced task. The latter situation is not always possible, since the human teacher is an expensive resource and the need for ITSs has been drivcn by this fact (Woods and Warren 1995). The former situation is also not desirable, since providing the novice student with expert level tasks (for their future use), may be providing the student with a level of complexity that is not beneficial to them (Ridgeway 1989, Kinshuk and Patel 1997).

Tutorial Nodes are embedded within the hypermedia, although they do not strictly form part of the semantic network, in that they do not represent the structure of the domain. A tutorial node may be triggered by a simple rule, defined by the domain author. For example: "*Activate Tutorial Node 1 when the student enters the system*". The student is therefore given a task to complete as soon as they enter the system. It is advised that such a task should concentrate on providing the student with information about how to use the hypermedia tutoring system itself and not necessarily be related to the domain, since initially, a user who is new to a system expends most of their "cognitive power" learning how to use a new system .

Linear and Non-Linear Tutorial Nodes

Tutorial nodes may exist in "linear hyperspace" and "non-linear hyperspace". They may be designed to be encountered one after the other, guiding the student through the hypermedia (linear hyperspace). Alternatively, they may be activated by a student following their own interests into a particular area of the hypermedia (non-linear hyperspace). Linear hyperspace is similar to Trigg's (1988) idea of paths authored into a hypermedia system. Trigg's system, "TexNet", allows the author to specify default paths for the student to follow, in order to reduce the chances of them becoming lost. Such a method has been criticised by Jonassen and Wang (1993), for providing the student with a path that they may "blindly" follow, i.e. they are encouraged not to search the hyperspace. The same criticism cannot however be levelled at the linear hyperspace tutorial nodes (LTN) employed by Hypernet, since they are not providing a node to node path. Instead the LTNs are providing the student with useful landmarks with which to orientate themselves, in that the student can navigate from one LTN to the next. They may therefore travel through the hypermedia in freedom, between such tutorial nodes. These nodes are suitable for novice students, since they are guided (as opposed to forcefully directed) by the tutorial nodes.

The non-linear hyperspace tutorial nodes are intended for more advanced students, since they do not provide the guidance that the LTNs provide. This is because the NLTNs do not appear in a predefined sequence. Instead, it is a matter of when the student uncovers them. They therefore do not offer the same landmark qualities as their linear counterparts. Such nodes are therefore more suited to students of higher levels, since the student may randomly encounter them and are not lead from one to the next.

The LTNs may be useful for lower level students and the NLTNs for higher level students. It may be desirable in some instances to use the two types of tutorial nodes interchangeably; for example, using LTNs for an expert level student who has entered an unvisited section of the domain. It may also be desirable for the author to target certain tutorial nodes at certain levels of students, or to have slightly different tutorials, for each student level, present within the same tutorial node. Figure 9.3.1.A (shown previously) shows two NLTNs, labelled "Planet Tutorial" and "Volcano Tutorial". These nodes are invoked when the node to which they are connected to via an "Invoked-by" link is selected. For example, the "Volcano Tutorial" is invoked when the "Volcano" class node is visited.

Conclusion

Experiences with Hypernet suggest that the use of a semantic network does indeed help the author to represent their knowledge in a formalised way, suitable for expression as a hypermedia domain. Whether this domain representation is more of less useful to the student is open to educational debate, however, the literature concerning the use of semantic networks would strongly indicate that it is (Tudhope and Taylor 1997, Pereira et al 1991, Jonassen and Wang (1993).

References

Bell G, 1995, Knowledge Modelling and Adaptive Hypertext. In **Proceedings of the University of Nottingham Psychology Department, Post Graduate Conference**, 1995. Available from www.psyc.nott.ac.uk/~grb/papers

Beynon-Davies P, Tudhope D, Taylor D, Jones C, 1994, A Semantic Approach to Knowledge-Based Hypermedia Systems. In **Information and Software Technology,** 36(6), pp 323-329

Brusilovsky P 1996, Adaptive Hypermedia: an Attempt to Analyze and Generalize. In **Multimedia, Hypermedia and Virtual Reality, Lecture Notes in Computer Science, Vol 1077**, pp 288-304, Springer-Verlag.

Conklin J 1987, Hypertext: An Introduction and Survey. In **IEEE Computer,** September 1987, pp 17-41.

Dillon A, 1990 Designing the human computer interface to hypermedia applications. In **Hypermedia for Learning,** D.Jonassen (ed), pp 57-65. Springer-Verlag.

Holmes B, 1999, Beyond Words, In **The New Scientist,** No.2194, July 10, 1999, pp 32-37, Reed Business Information.

Jonassen D H, Wang S, 1993, Acquiring Structural Knowledge from Semantically Structured Hypertext. In **Journal of Computer-Based Instruction**; Vol 20 No. 1 pp 1-8, 1993.

Kinshuk, Patel A, 1997, A Conceptual Framework for Internet based Intelligent Tutoring Systems. In **Knowledge Transfer** (Volume II), pp 117-124, Behrooz A (ed); Pace, London.

McAleese R, 1998 The Knowledge Arena as an Extension to the Concept Map: Reflection in Action; In **Interactive Learning Environments,** Vol. 6, No. x. (Available from www.icbi.hw.ac.uk/~ray.

Mullier D J, Hobbs D J, Moore D J, A Hybrid Semantic/Connectionist Approach to Adaptivity in Educational Hypermedia Systems. In **Proceedings of ED-MEDIA'99,** Seattle, WA. 1999

Mullier D J, 1999, The Application of Neural Network and Fuzzy-Logic Techniques to Educational Hypermedia. PhD thesis. Available from www.lmu.ac.uk/ies/comp/staff/dmullier/thesis/thesis.html

Pereira D C, de Oliveira A, Vaz J C G, 1991, Hypermedia and ITS. In **Intelligent Systems in Education.** Micarelli, Belastra (eds), pp 207-223.

Theng Y, Thimbleby H, 1998, Addressing Design and Usability Issues in Hypertext and on the World Wide Web by Re-Examining the "Lost in Hyperspace" Problem. In **Journal of Universal Computer Science,** vol. 4, no. 11, pp 839-855.

Trigg R, 1988, Guided Tours and Tabletops. In **Tools for Communicating in a Hypertext Environment,** ACM Trans. on Office Information Systems, Vol 6, No 4, Oct 1988, pp398-414.

Tudhope D, Taylor C, 1997, Navigation via Similarity: Automatic Linking Based on Semantic Closeness. In **Information Processing & Management,** Vol. 33, No. 2, pp 233-247.

Woods P, Warren J, 1995, Rapid Prototyping of an Intelligent Tutoring System, In Proceedings of the Australian Society for Computers in Learning in Tertiary Education Conference 1995 (ASCILITE'95).

Leading Your Faculty Down the Information Highway

Thomas J. Donahue
University of St. Thomas
1505 West 28th Street
Minneapolis, MN 55408
tdonahue@alsi.net

Abstract:
Many colleges, universities and businesses recognize the rewards of teaching on the Internet. As each organization rushes toward cyberspace, they bump into a variety of potholes that cause resistance and discouragement among the faculty. Sometimes poor administrative strategy leads faculty members to abandon a technology that may become the most effective tool in the history of education. This session emphasizes methods of successfully introducing faculty to teaching in virtual classrooms, and points out strategies to be avoided.

Interactive media and web-based instruction have repeatedly proven themselves to be effective and efficient tools for classroom support and distance learning. Compared to traditional modes of instruction, students learn the same amount of material in half the time or less with equal or better understanding and equal or better retention when using interactive learning materials. To use these new instructional tools, colleges and universities need the technological infrastructure and a profound cultural change within the institution. If funding is available, the technological infrastructure is relatively easily achieved.

The greater challenge is achieving the necessary cultural change. Simply putting traditional materials on the Internet doesn't work. Using this tool requires a new teaching/learning paradigm. Faculty must alter their teaching methods and styles to teach successfully in cyberspace. Student preconceptions of education will need to change to accommodate this non-traditional moderated mode of learning.

Effective change is not mandated, but adopted because of obvious benefits to the users. A top down approach is likely to meet resistance, but a bottom up approach can generate enthusiasm. In the early stages of the move to virtual classroom use, top down standardization and policy-making inhibit progress. If administrators support grassroots faculty and student use of the Internet the school will avoid stifling the initiative of individual faculty members.

The initiative is likely to go nowhere if the faculty senate, administration, union, and dozens of committees pool their ignorance and discuss *ad nausium* issues they do not fully comprehend. During the early years administration should simply support voluntary initiatives of early adapters. Otherwise peer pressure among faculty members to maintain the status quo is likely to subvert use of technology in the classroom. If the administration does encourage specific software, it should be the simplest to learn and use available. Once the majority of the faculty has adopted Internet tools and understands how the virtual classroom works, the peer pressure supports adoption of this new technology rather than the status quo.

Once the majority of faculty is knowledgeable about use of the Internet to teach and learn, discussions are informed, and better decisions will be made. Standardization and policy-making will be easier and more appropriate, because most faculty members will be familiar with the technology and issues and will have learned what works and what doesn't. Since the WWW Consortium already promotes HTML communication standards, it is relatively easy to switch from one software package to another. Switching from one virtual classroom program to another is analogous to switching from driving a car with automatic transmission to a semi-truck.

Faculty training is the key to success. The technology should be as simple and transparent as possible. The important issues here are about learning, not about technology. Many faculty members are attracted to experiences that promote teaching and learning but tend to avoid experiences emphasizing technology.

Time commitment, compensation and recognition are key elements in the adoption.

Most Colleges and Universities recognize the rewards of teaching on the Internet if it is implemented properly. As each organization rushes toward cyberspace, they bump into a variety of potholes that cause resistance, discouragement, and sometimes abandonment of what may become the most effective technology in the history of education.

This workshop will examine the potholes (false assumptions) every institution should avoid, and examine strategies (fastlanes) that lead toward successful implementation of the virtual classroom and Internet supported and Internet based programs. Some of these will include:

Pothole: Implementation should be organized and standardized from the top down.
Fastlane: In higher education, the top down approach frequently generates resistance - the bottom up approach generates enthusiasm.

Pothole: The greatest obstacle is the technology.
Fastlane: The greatest obstacle is social inertia of the institution.

Pothole: Learning in cyberspace is just teaching repackaged.
Fastlane: Learning in cyberspace requires a fundamental paradigm shift on the part of students and teachers.

Pothole: e-Mail is a great way to managc distance learning.
Fastlane: e-Mail has its place, but using e-mail as the primary technology to manage distance learning is nearly equivalent to tutoring each student individually.

Pothole: Unions, Administration, and Faculty Senate should get involved early, because otherwise their interests may be hurt.
Fastlane: Arguing about theories that no one has put into practice or really understands prevents progress.

Pothole: This endeavor is about technology.
Fastlane: This endeavor is about learning.

Pothole: Faculty training is best done by techies, and implementation of the virtual campus can be done by staff.
Fastlane: Faculty training should be done by faculty. Faculty must play the leadership role in decision making about the technology after experimenting with various systems. The role of the techie is to serve faculty needs and help faculty promote student learning.

Pothole: Relationships with students will degrade when teaching in cyberspace.
Fastlane: Relationships improve, as the lecturer becomes a coach, mentor and guide.

Pothole: Relationships between students and with teachers are not as important in cyberteaching.
Fastlane: Relationships in the virtual classroom are more important to learning than in the traditional classroom. Steps must be taken to build cooperative relationships.

Pothole: Create a rich didactic site with lots of information no matter how much time it takes.
Fastlane: Use a minimalist approach and the Socratic method.

Pothole: Use all the information available on the Internet.
Fastlane: Pace and organize material so students don't become overwhelmed with information.

The potholes (false assumptions) and fastlanes (successful strategies) will be discussed in this presentation.

Appendix: Quotes and Notes

Analysis of Effectiveness and Costs of IVD Instruction in Defense Training and Education, summarized of over 600 research studies of interactive training programs. This metastudy, done by the Department of Defense Analysis (1801 Beauregard Street, Alexandria, VA 22311-1772), concluded: Compared to traditional modes of instruction, students learn the same amount of material in half the time or less with equal or better understanding and equal or better retention when using interactive learning materials. To see or contribute to a summary of research studies dealing with the effectiveness of interactive multimedia and the Internet follow the hyperlinks to the Interactive Virtual Classroom Discussion from http://www.alsi.net.

Some aspects of the new paradigm for online learning are discussed in *Using the Internet and CD--ROM for Classroom Support* at http://www.alsi.net/WEBLEARNING.htm

Distance learners found faculty to be more accessible than in the typical classes. All types of learning styles can be successfully taught using distance education technologies. Threlkeld, R., & Brzoska, K. (1994). Research in distance education. In B. Willis (Ed.), Distance education: Strategies and tools (pp. 41-66). Englewood Cliff, NJ: Educational Technology Publication.

To be effective distance educators, faculty should participate in a training program designed specifically to meet their needs (Threlkeld & Brzoska, 1994, p. 58).

Clark, R.E. (1991) maintains that instructional strategies, and not the medium, are the key to effective learning. Unfortunately, technology and production considerations rather than teaching-learning theory or the instructional development process are often the driving force behind distance education programs.

Clark, R.E. (1991). When researchers swim upstream: Reflections on an unpopular argument about learning from media. Educational Technology Research and Development, Feb. 1991, 34-40.

Jerald G. Schutte of California State University, Northridge did a comparative study of two statistic classes, and reported: "Quantitative results demonstrated the virtual class scored an average of 20% higher than the traditional class on both examinations. Further, post-test results indicate the virtual class had significantly higher perceived peer contact, and time spent on class work, but a perception of more flexibility, understanding of the material and greater affect toward math, at semester end, than did the traditional class." Virtual Teaching in Higher Education: The New Intellectual Superhighway or Just Another Traffic Jam? (http://www.csun.edu/sociology/virexp.htm)

In *Dancing with The Devil*, Duderstadt maintains that education used to be "just in case". It is now "just in time" in corporate America, and in the future it is likely to be "just for you".

Relationships between students and between students and faculty are important to the learning process. Does use of technology degrade the relationship? Does talking on the phone degrade the relationship? Prejudices fall away online, and relationships focus on ideas. Students become more intimate rather than more distant when they learn online. Professor Joe Schramer, Teacher of the Year at the University of St. Thomas said, "I had over 70 comments posted by students in my virtual class last night. In my traditional classroom, I'd be lucky to have 70 student comments in an entire semester."

Problem: Students can become overwhelmed with information. How do you pace an online class? How do you help the students choose among the activities and information?

Thomas J. Donahue teaches communication technology at the University of St. Thomas in Minnesota. He is also President of Active Learning Systems, Inc. His full resume is online at www.alsi.net/content/index.htm. ALSI helps colleges and universities create a strategic plan for using technology and trains faculty to teach using the Internet.

ExploraGraph: A Flexible and Adaptive Interface to Support Distance Learning

Aude Dufresne
Department of Communication, University of Montreal
C.P. 6128, Succ. Centre-Ville,
Montréal, QC Canada H3C 3J7
dufresne@com.umontreal.ca

Gilbert Paquette
LICEF Research Centre, Télé-université
4750, rue Henri-Julien
Montréal, QC H2T 3E4
gpaquett@licef.teluq.uquebec.ca

Abstract: The ExploraGraph interface was designed to facilitate interaction in the context of distant learning. It was developed as an alternative to simple web interaction, in order to increase flexibility, visibility, and structure in the learning environment. It may be used as a front end to existing courses on the web. The ExploraGraph Navigator makes it possible to navigate through conceptual graphs with automatic arrangement of elements, zoom and "fish eye" effects. Each nodc of the graph may have a description attached to it and may give direct access to an application, a document or an Internet site. Graphic structures may thus be used to represent the organization of tools, activities, concepts or documents. The Navigator offers each user a tool to specify his goals and the system can support him, using multiple modalities: Hypertext, graphical cues (Lee & Lehman, 1993), Ms Agents avatars, voice, visual demonstrations and force feedback guiding.

Introduction

LICEF is developing, in the context of the Canadian TeleLearning Network of Centres of Excellence, a distance education environment on the web. The Center for Virtual Learning developed at LICEF offers not only hypermedia content on the web, but different tools for conferencing, planning meetings, videoconferencing, presenting scenarios and knowledge, etc. The modeling of users in activity has illustrated the difficulties they experience in learning the efficient use of such a complex environment, first as they learn it at the training session, and then on their own when they are at distance. To offer contextual help to learners, we have designed a supportive interface that will adapt to each user, unfolding gradually as s/he acquires expertise and offering adaptive support using different modalities.

The ExploraGraph interface was designed to facilitate interaction in the distance learning context. After studying learners in various distance learning situations, it became evident that existing interfaces could be improved to better support the interaction and the learning process. Learners have to navigate between pages of web documents, search engines and text instruction. They must use various communication tools and organize their activities with little support. As DiSessa (1986) explains, they encounter thc "utility barrier", not knowing how the system should be used and how to modify their activities to better use it. They find it difficult to transpose their activities in multiple environments. The ExploraGraph interface was developed as an alternative to simple web interaction, in order to increase flexibility, visibility, and structure in the learning environment. Inspired by the Explora interface developed at LICEF (Paquette et al., 1996), we tried to develop a more dynamic and flexible interface for the learner to access the Center for Virtual Learning. The learner navigates in graphic conceptual structures of tasks, knowledge elements and documents, that give him a schematic idea of what is to be learned and what s/he has to do. Automatic arrangement of elements, zoom and "fish eye" effects are used to increase visibility as each users manipulates the graphs. Each node of the graph may have a description attached to it and may give direct access to an application, a document or an Internet site.

The Importance of Adaptive Interfaces

The need to integrate adaptive interfaces in the domain of learning environments has become an important field of research (Dufresne, 1997; de La Passardiere et Dufresne, 1992; Brusilovsky, 1997), especially as it appears to play an important role in reducing navigation disorientation and encouraging exhaustive learning in hypertext systems, particularly in web learning applications. Adaptation may take many forms, modifying content and/link access and annotations.

One of the main limitations to adaptive interfaces is the amount of information obtained by the system on user activity and knowledge. In order for adaptive interfaces to increase the salience of some elements, the next best to be learned, it is necessary to define what is the proposed structure for learning, what has been seen, but also, what does the user want to learn next. If the structure of the content is encyclopedic and easy to chunk, then direct manipulation may be used, giving access to graph representing the structure of concepts to be learned. An overlay model of knowledge may then be extracted from the trace of the user's navigation: What information has he read? For how long? How long ago? In such a context, adaptive links annotation can suffice to support the user's navigation and encourage him to complete his navigation and understanding.

However, some pedagogy and learning theories insist that it is better that learning take place in a more active, situated and collaborative setting. In this context, content has to be organized in a more complex way and this complicates the possible support to navigation. According to the MISA model (Paquette, Aubin, & Crevier (1997), learning activities are organized around many structures, including : knowledge structure, scenarios of activities and documents structure. In this context, there may be many paths to access knowledge and the user needs some coaching and adaptation at a more general level to better assimilate content. For this meta-level of support to be implemented, the system must use strategic information on both content structure and the user's higher level of activity . The present project proposes a model and generic prototype to facilitate navigation and adaptive support, based on the intentions of the user and on the structure of his activities.

We were among the first to experiment with links annotation (Dufresne, Jolin, & Senteni, 1990), where visited links are hierarchically modified as the user finishes visiting the information within them. In the context of distance education, our interest was more proactive, in order to attract the user's attention to tasks or contents that were more pertinent at one point in time. We were interested in the pacing of the meta-level of information attached to a content to be learned, in order to follow the evolution of user expertise and to support learner .

System Structure

The architecture of the ExploraGraph (Dufresne, Cosmova., LeTran, & Ramstein, 1999) system is partly local and partly shared: it is an integration of commercial Office applications and applications we developed in Visual Basic using an Access database. Figure 1 show the architecture of the system and of the interaction, with the different input and output paths used in system adaptation.

The system main features are the dynamic arrangement of graphical structures, the Control Panel that allows each user to specify his/her intentions and to delegate actions, and the system's various modalities of support.

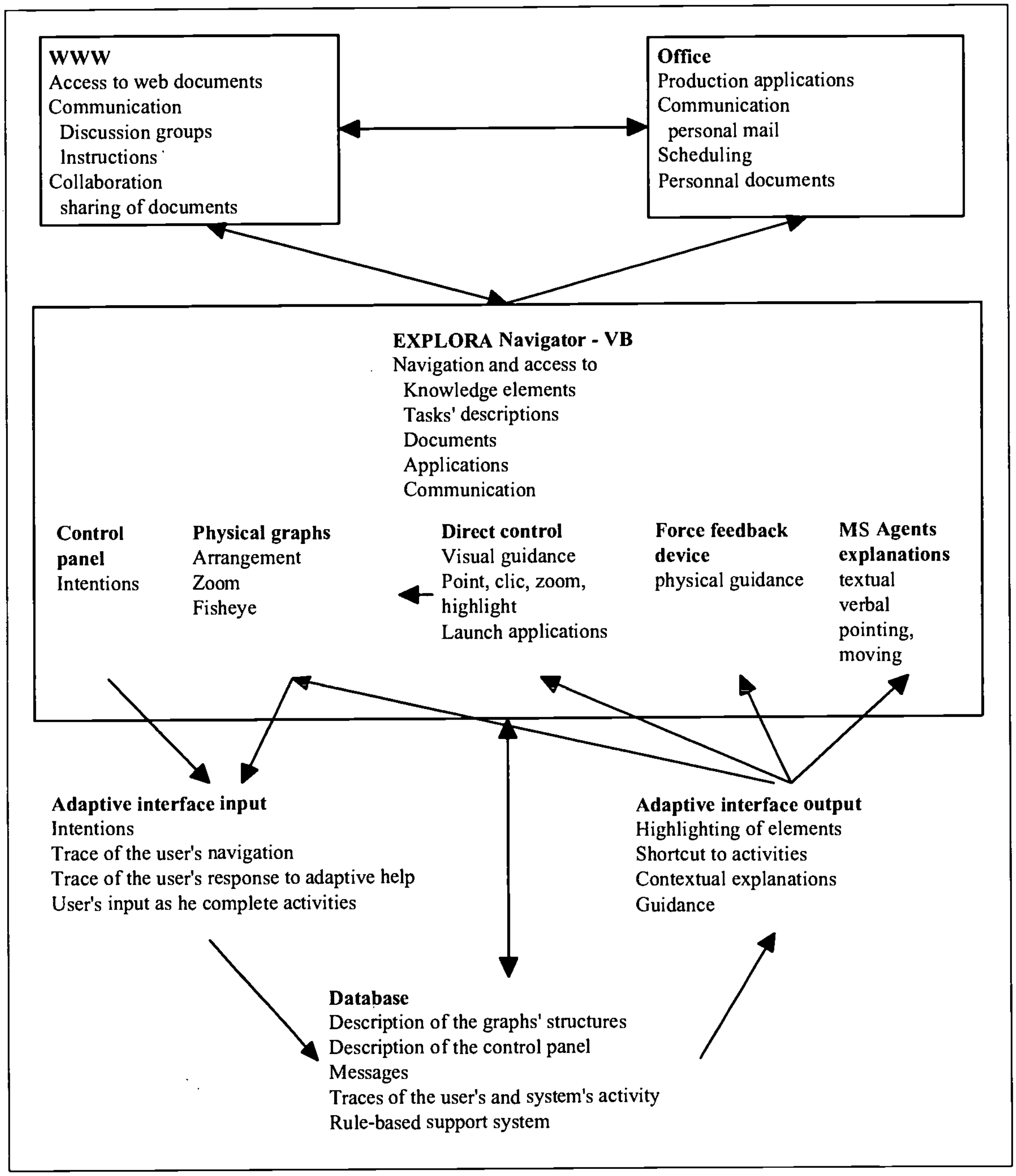


Figure 1. Multimodal adaptive support in the ExploraGraph interface.

Navigation: A Metaphor that Helps You "Stretch Your Mind"

The ExploraGraph Navigator was designed to facilitate the visualization of graphical structures. A physical model of nodes (mass and repulsion), links (elasticity) and of the general organization (gravity and friction) is used to simulate the relations between sets of elements. As concepts are added (editor mode) or as they are traversed (navigation mode), nodes rearrange themselves in order to maximize visibility and contextual relation to what is at the focus of interest. Zoom and "fisheye" effects make it possible for the user to pop out and concentrate on an area of the graph knowledge or task representation. Such relative accentuation may also be driven by the system adaptive functions, which may use it to highlight areas of the information to be explored; this corresponds to concept of map adaptation (Brusilovsky, 1997).

The ExploraGraph Navigator makes use of a generic representation of types of nodes and types of links that may be changed to represent structures of tasks, concepts, tools or documents.

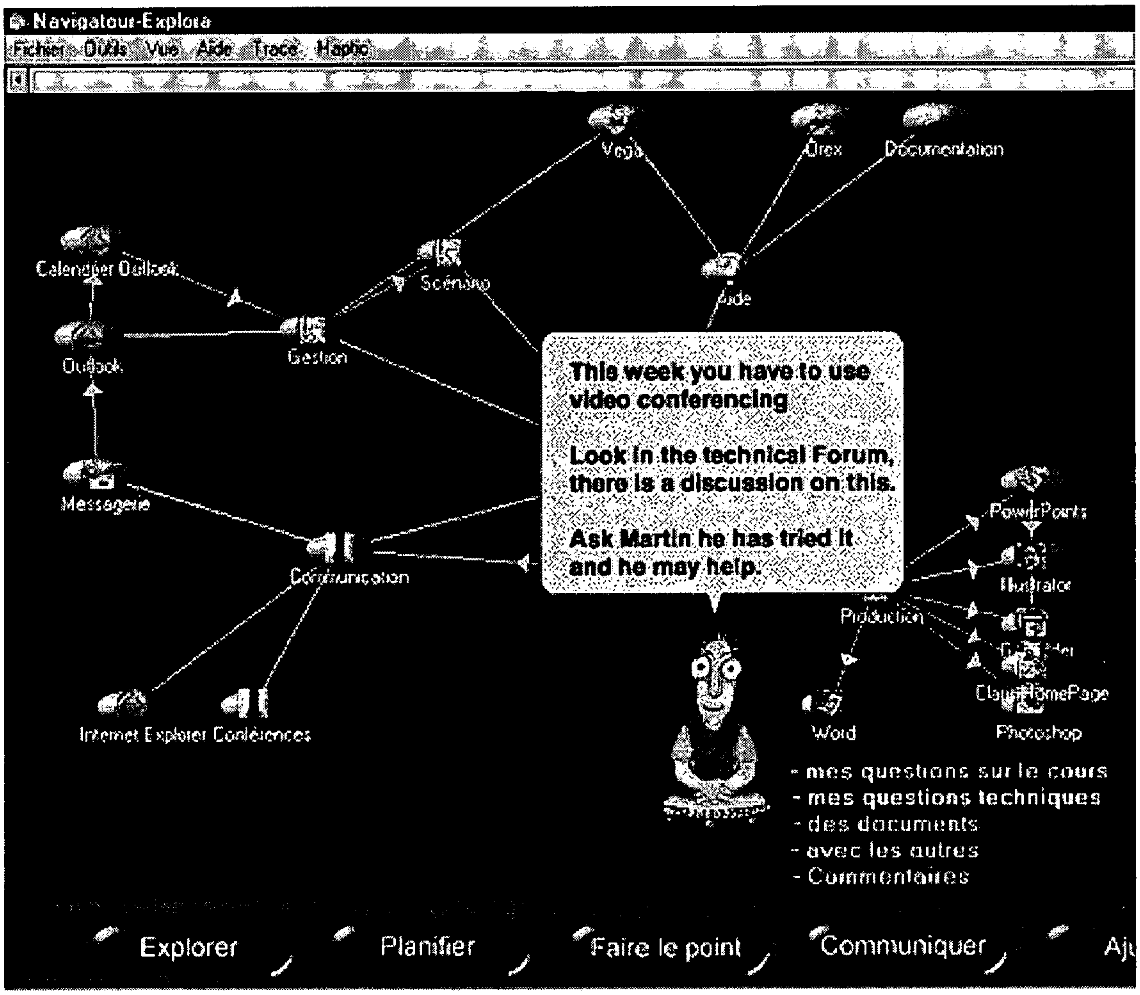


Figure 2 ExploraGraph Navigator showing the graphical structure, the Control Panel and the avatars' contextual help.

In figure 2 the User have chosen the goal "Communicate a technical question".
Depending on the task model, the Avatar may suggest a specific technical problem and propose help related to it. He may zoom on the right discussion Forum and eventually launch it with appropriate help depending on previous interaction with the user. Eventually, looking at others user's model he will suggest someone to ask for help.

Activities: Let the User Choose What S/He Wants to Do.

In fact, the context of distance learning is one where the system is not at the center of the interaction: the teacher and the other learners are also there, so the system is seen more as a tool then as the only field of interaction. As such, the system cannot assume the full direction of the activity: it must be transparent to the user goals and activity and cannot be too unpredictable. In this context, what the user needs is not as much a feedback on his/her progression in the content but a guide as to how s/he may use them to achieve the proposed learning objectives. The adaptive interface should coach the learner, according to the schedule, and to learner progression and context. It must then cue the learner to links between tasks and documents, between tasks and the structure of concepts, between tasks and his/her utilization of tools, methods and external resources like discussion forums.

For the interface to adapt its support to the user's higher level of activity, a **Control Panel** is incorporated in the Navigator, where he may choose a general intention: Explore, Plan, Revise his own progression, Adjust the system (each with various options). Choosing a goal may trigger a set of actions in the system, opening multiple applications, choosing a specific navigation environment. The Control Panel also enriches the user's model, making it possible to adapt system support, which may propose different contextual explanations or guidance for each goal, depending on task schedule and on user profile.

Support with Multiple Modalities

The system may propose different types of adaptive support, taking into account the potential of each modality to guide the user. Support could take the form of:

- Graphical highlight and links annotation, which give a general idea of the structure and which are more passive and less intrusive than more formal guiding and demonstration.
- Avatars animations which are used for graphical demonstrations (attention seeking, pointing, etc.) , but also for non-verbal communication and motivational purpose.
- Avatars audio voices, which serve to attract attention and are more easily combined with visual demonstrations than text.
- Visual guiding to present to the user procedures and actions which s/he may use to realize his/her chosen intentions
- Force feedback guiding, which, combined with visual demonstration, obtains more attention, takes less cognitive concentration, facilitates memorization (Arcand, 1995) and ensures that the user follows the demonstration to the end.

Avatars were introduced in the environment partly "to fulfill the need for social context" when no other learners are on-line (Kearley, 1993 in Pentti, 1998; Rickel & Johnson, 1999; Grégoire, Zettlemoyer & Lester, 1999) and to serve as the interface to the advisory system.

Some adaptation of the support will eventually be under user control. But for the user in the fire of action, adapting the interface might be a tedious and bothersome task, so we intend to integrate adaptive functions that will integrate both global and individual users' feedback on the help system, in order to adjust future help both in general and individually. Such a mixed adaptive learning environment appears to be important in guaranteeing adaptation of systems to longer learning situations. A mixed adaptive environment appears to be the best way for the environments to be really adapted to the user's longer learning situations and to his evolving wishes (Brusilovsky 1996).

References

Arcand, J.-F. (1995). An Artificial Neural Network for the Ergonomic Evaluation of a Human-Computer Interface , Intern. Conf on Tools with Artificial Intelligence, IEEE, New Orleans, Louisiana (pp. 606-608).

Browne, D., & Totterdell, P. (1990). Adaptive User Interfaces. London: Academic Press, 227p.

Brusilovsky, P. (1996). Methods and Techniques of Adaptive Hypermedia, User Modeling and User-Adapted Interaction, 6, 87-129.

Brusilovsky, P. (1997). Efficient Techniques for Adaptive Hypermedia. Intelligent hypertext: Advanced techniques for the World Wide Web. Lect. Notes in Computer Science, 1326, 12-30.

DiSessa, A.A. (1986). Notes on the future of programming: Breaking the utility barrier. In D.A. Norman (Ed.), User Centered System Design: New Perspectives on Human-Computer Interaction Hillsdale, N.J.: S.W. Draper Lawrence Erlbaum Associates, pp. 125 -152.

De La Passardière, B., & Dufresne, A. (1992). Adaptative Navigational Tools for Educational Hypermedia. In I. Tomek (Ed.), Computer Assisted Learning. Berlin, New York: Springer-Verlag, pp. 555-567.

Dufresne, A., Jolin, N., & Senteni, A. (1990). Hypertext documents for the learning of procedures. In R. M. Aleese, & C.Green (Ed.), Hypertext: State of the Art (pp. 96-104). New York: Ablex.

Dufresne, A. (1997). From adaptable to adaptive interface for distance education , Workshop on Intelligent Educational Systems on the World Wide Web, AIED'97, Kobe, Japan (pp. 94-98).

Dufresne, A., Cosmova, V., LeTran, T., & Ramstein, C. (1999). EXPLORA: An interface to support the learner with dynamic graphs and multimodal goal driven explanations, AIED'99, IOS Press, Maine, pp. 660- 662.

Elkerton, J., & Williges, R.C. (1989). Dialogue Design for Intelligent Interfaces. In P.A. Hancock, & M.H. Chignell (Ed.), Intelligent Interfaces: Theory, Research and Design, Amsterdam: North Holland, pp. 213-264.

Grégoire, J.P., Zettlemoyer, L.S., & Lester, J.C. (1999). Detecting and Correcting Misconceptions with Lifelike Avatars in a 3D Learning Environments, AIED'99, IOS Press, Le Mans, France, pp. 587- 593.

Lee, Y.B., & Lehman, J.D. (1993). Instructional Cueing in Hypermedia: A Study with Active and Passive learners. Journal of Educational Multimedia and Hypermedia, 2(1), 25-37.

Paquette, G., Aubin, C., & Crevier, F. (1997). Design and Implementation of Interactive TeleLearning Scenarios , ICDE'97 (International Council for Distance Education), Penn State University, USA.

Paquette, G., Ricciardi-Rigault, C., Paquin, C., Liégeois, S., & Bleicher, E. (1996). Developing the Virtual Campus Environment, ED-Media International Conference, Boston.

Pentti, H., & Timo, N. (1998). The Comptence of Learning Companion Agents, International Journal of Artificial Intelligence iin Education, 9, in press.

Rickel, J., & Johnson, W.L. (1999). Virtual Humans for Team Training in Virtual Reality, AIED'99, IOS Press, Le Mans, France, pp. 578-585.

Acknowledgement

This research was funded within the TeleLearning Network of Centres of Excellence, Canada. The application of ExploraGraph was funded by the Office of Learning Technologies, Department of Human Ressources, Canada.

A Model of Successful Technology Integration in a School System: Plano's Curriculum Integration Project

Yoram Eshet
Department of Education, Tel Hai College
Tel Hai, Israel
eshet@netvision.net.il

Joel Klemes
The Open University of Israel
Tel Aviv, Israel 61392
joelkl@oumail.openu.ac.il

Lyn Henderson
School of Education, James Cook University
Townsville, Australia 4811
Lynette.Henderson@jcu.ac.au

Sara Jalali
Independent multimedia producer
Carrollton, Texas, USA, 75007
jalali@mindspring.com

Abstract: The technology-based Curriculum Integration project in the Plano Independent School District is presented as a model for successful implementation of large-scale technology integration projects. The project addressed relevant components: teachers, students, curriculum, learning theories and materials, technological infrastructure, and school architecture. It was found that systemic change in the learning culture among district teachers and students resulted from a convergence of forces. These forces included changes in teaching methods, the curriculum, and the physical learning environment, as well as the planning, development, and implementation of the project as a collaborative effort between Plano educators and various professionals within an educational software company.

Introduction

In the last decade, there has been an increasing number of publications reporting the minor impact that, despite substantial investments, the integration of technology in schools has on the teaching culture, the school environment, and the students' attitude to learning (e.g., Bryson & de Castell 1998). In addition, teachers report dissatisfaction with the applicability of off-the-shelf multimedia products to their curriculum. For example, in a survey conducted in United States in 1999, 59% of teachers who use software for instruction report that is it "somewhat" or "very" difficult to find software to meet their classroom needs (Resnick 1999). However, it is not only appropriate software that is the issue. Successful technology implementation into schools requires a holistic approach that addresses all relevant issues, including design of custom curricular materials, learning theory, pedagogy, staff development, technology infrastructure, management, finance, and school architecture.

The technology-based Plano Independent School District (PISD) Curriculum Integration Project is an excellent example of such holistic implementation. The large-scale systemic project was implemented in the PISD between 1993-1998, involving approximately 40 elementary schools and 60,000 K-5 students. Two of its unique features were that teachers played a leading role in collaboration with an education computer company to design an interdisciplinary curriculum with custom learning materials based on a constructivist approach to teaching and learning as well as recommended the classroom's architecture and technology infrastructure.

The paper reports the Plano Curriculum Integration Project to highlight necessary ingredients for a successful wide-scale integration of technology in a school system.

Launching the Plano Project

The decision to launch a systemic curricular change in 1993 was based on the recognition that the PISD school system "suffered" from problems such as those listed in Table 1 as well as an understanding that introducing technology, without addressing other educational and architectural issues, would not be enough. Therefore, the project was designed to address the factors in Table 1; these are subsequently discussed in the paper. The PISD contracted Edunetics, a multimedia production company, to help it redesign its curriculum, inservice the teachers in the area of computer technology, and develop educational computer software that would serve as a crucial component of the new integrated curriculum. In addition, PISD established the Curriculum Development Center in which a team of 30 to 40 selected K-5 teachers, supervised by PISD curriculum coordinators, cooperatively developed the new thematic curriculum with the pedagogical, content, and instructional technology design experts in Edunetics (Otto 1997).

Pre Technology-Based System	Technology-based System Changes
Traditional discipline-based curriculum that adopted mostly behaviorist pedagogy.	A conceptual redesign to a technology-based, thematically integrated curriculum that adopted cognitive and constructivist pedagogy.
Infrequent and minimal involvement of teachers in curriculum design.	Teacher ownership in redesigning the curriculum and developing the learning materials.
Limited use of technology in schools due to scarcity of computers and an inadequate technological infrastructure.	An appropriate technological infrastructure plan that included 8 computers and a printer per classroom, ethernet connectivity, and Internet access.
Very limited use of software, partly due to its lack of suitability to the curriculum.	Custom learning material development, both computer-based and other types of materials.
Classrooms were designed for traditional chalk-and-talk style of teaching.	Interior classroom and school redesign to promote an open teaching style, use of technology, teamwork, and group discussion.
Lack of finance.	Debenture bonds.

Table 1: Decision Factors Influencing Curriculum, Teacher Involvement, and Architectural Change

Curriculum redesign

Plano Independent School District's pre-1993 segregated curriculum (Table 2) was designed to follow the curriculum standards in the various disciplines (cf. Bybee & McInerney 1995; Texley & Wild 1996). A major task of the project was to convert this curriculum into a thematic one (Table 3), without giving up the disciplinary depth of content. It was argued that thematic learning enables the student to perceive curricular topics in a broader and more interconnected way (Jacobs 1989, 1997; Kovalik & Olson 1994; Marzano 1992).

	Kindergarten	**Grade 1**	**Grade 2**
LIFE SCIENCE	• Looking at plants • Looking at animals • Homes for living things • My body grows	• Animal body parts • Grouping plants • Where plants live • Living/ non-living things • My body grows • Staying healthy	• Grouping animals • Ancient living things
EARTH SCIENCE	• Exploring space • Exploring earth • Watching the weather • Weather changes	• Looking at the sky • Earth seen from space	• The sun • Fossils & Dinosaurs • Air and water • Looking at weather

Table 2: A section of the pre-Plano Curriculum Project K-2 discipline-segregated curriculum

In a thematic curriculum, the learning objectives are organized in themes, or "big ideas," and not necessarily in segregated disciplines, as in most traditional curricula. Thus the first stage in designing the new curriculum was to identify six major themes (Overarching Concepts) under which the entire new curriculum was organized: Communication, Continuity and Change, Interactions, Diversity, Systems, and Balance and Stability (Table 3). The thematic curriculum was designed as a matrix that matched a six-week thematic learning unit, called Organizing Idea (OI), for each of the K-5 grade levels. Each OI belonged to a specific theme. The OIs' design presented the disciplinary content (Table 2) in a thematic way, supplemented and reinforced with technology (Table 3). For example: Grade Two's science disciplinary curriculum (Table 2) included topics such as grouping of animals and ancient living things in Life Science, as well as fossils and dinosaurs in Earth Science. In the thematic curriculum, these topics were clustered into the OI, "What Evidence Tells Us About Our World?" under the Overarching Concept (theme) of "Communication" (Table 3). In this OI, the students use, among others, fossil evidence to communicate and draw conclusions about the world. This approach to curriculum design is a modification of the original curriculum integration model of Jacobs (1989) in the sense that it focuses on maintaining the disciplinary learning objectives, but presenting them in a thematic manner. In this way, the teachers, supported by PISD's curriculum coordinators, designed an array of 36 OIs (Table 3).

Overarching Concepts: Each for a Six Week Period (not in teaching sequence)						
Gd	Continuity & Change	Systems	Interactions	Diversity	Communication	Balance & Stability
K	Change is All Around Me *Changes Around Us*	All Aboard for Systems	What's the Connection? *Grady's Weather Window*	What's Alike? What's Different? *Animals and Their Homes*	How Do I Learn About My World?	Off to a "Beary" Good Start!
1	Cycles *Events in My World*	It's No Mystery, It's a System *Calling All Problem Solvers!*	Cause and Effect	Why Classify? *Animals in Their World*	Making Connections	Solid Foundations *Fun With Maps*
2	What Impacts Our World?	How Do Systems Help Us Connect in Our World? *Weather, Climate & You*	How Are Communities Interdependent in Our World? *Get the Story!*	How Are We Alike and Different in Our World? *Many Places, Friendly Faces*	What Does Evidence Tell Us about Our World? *Message in a Fossil*	Where is Harmony in Our World?
3	A Matter of Time *The Way We Live*	Where Would We Be Without Systems? *Yourtown*	Seeking Reasonable Solutions *Animals in Our World*	Proud to Be an American	The Fine Arts of Sharing *Adventures in Problem Solving*	Drawing Upon Our Resources
4	Changes Over Time	One Affecting the Other *Body Balance*	Many Faces, Many Places *Earth: Forces and Formations*	State of Diversity	Clues That Communicate *Sun, Earth, Moon*	Mankind and Nature in Harmony *Our Environment*
5	How Variables Cause Change *Go West!* and *American Historical Map Room*	In Sync with Systems	How the Parts Interact to Make a Whole	Strength in Diversity *Decades of Change*	The Ins and Outs of Communication	It's a Balancing Act *Frontier Ahead!*

Map Room and *Visual Planner* (Tools) are used throughout the OIs from 1st through 5th grades.
Interactive Computer Lessons are utilized through Grades 1 -5.
Names of OIs are in normal text; names of custom educational software programs are in italics.

Table 3: Plano ISD Integrated Thematic Curriculum: Organizing Ideas and Custom Edunetics Software

Almost all of the OIs included custom multimedia learning products that were used as a crucial component throughout the six-week learning period in the OI. The multimedia products were designed and produced by Edunetics' instructional design specialists, with the full involvement of, and guidance from, PISD teachers. All OIs were designed to follow a general basic structure exemplified by the Grade Two OI, "What Does Evidence Tell Us about Our World?" (Figure 1) under the theme, "Communication": An introductory 1-week unit, followed by 3-5 interdisciplinary-based units, and a 1-week culmination unit. The culmination unit brought the thematic activities and understandings together through further synthesis, analysis, and application, providing a "big picture" thematic overview. Plano's curriculum design process was unique also in the sense that the teacher teams took the leading role in this design process thereby ensuring that both the overall curriculum structure and the computerized and off-line learning materials complied with the teachers' and students' curriculum needs.

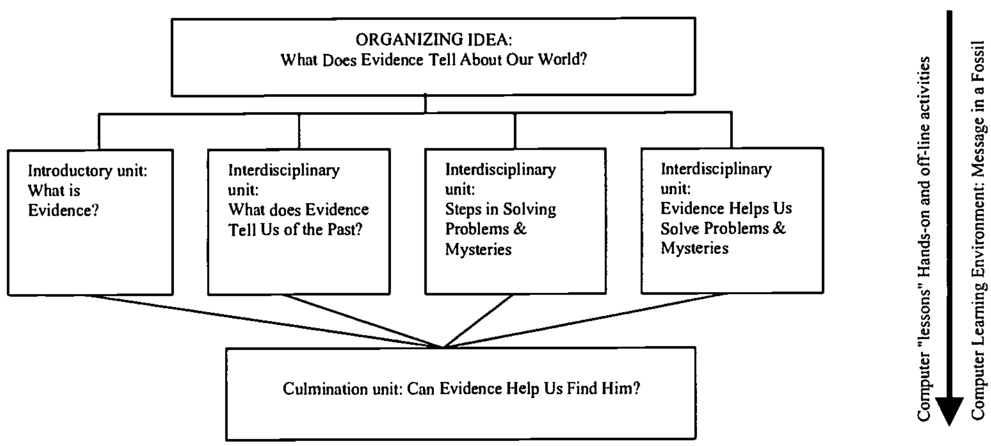


Figure 1: Basic organization of a six-week thematic unit (OI), using a Grade Two OI as an exemplar.

Developing the learning materials: A unique teacher-multimedia producer interaction

The Plano Project included the production of mainly three types of learning materials:
1. Hundreds of offline written and hands-on-small-group activities developed by the teachers.
2. Approximately 200 short discipline-based interactive "computer lessons" that addressed major curricular topics in Science, Language Arts, Math, and Social Studies. The computer lessons included simulations, games, "lecture-type" presentations, simulated labs, and interactive tutorials.
3. 26 multimedia interactive learning environments (Table 3), mainly microworld simulations, databases, and learning tools that served as crucial components of the OIs. In addition, PISD teachers incorporated some off-the shelf computer products that were available on the market. However, according to the Science Coordinator in PISD (Mainwaring 1999, personal communication), teachers found their use somewhat limited because these products were not custom-designed for the project.

To ensure that the computerized learning materials dovetailed with the pedagogical concepts and the content requirements of the integrated curriculum, a special interactive production process was established. The process consisted of the following stages: preliminary ideas, product specification, prototype alpha and beta versions, implementation, and evaluation. Review of the processes occurred throughout production. Both the consumers (teachers) and the producers (Edunetics) were equally engaged in this process. According to Hord (1992), long-term changes occur if teachers take part in corporately contributing towards re-educating their own values and attitudes and changing the school's culture. This includes collaborative in-situ identification of issues by the change agents; in our case, these were the teachers, curriculum coordinators, and Edunetics pedagogical content and software producers. From the PISD experience, such a process requires long-range planning and can be challenging to execute due to a variety of difficulties. One of these is, not surprisingly, given their differing professional backgrounds, the different approach to planning and design brought by the teachers on the one hand, and the software instructional designers, on the other. The successful implementation of the computer products in PISD schools (Henderson, Klemes, & Eshet 2000) illustrates the value of producing custom-made products for such technology integration projects.

Integrating the software into the curriculum

A major impact of computers and instructional software on the learning process of children is achieved only when they are integrated into the curriculum as a vital element for instruction (Shade & Watson, 1990). In the Plano project, the custom-developed educational software played a significant role in the instruction within each OI (Table 3) in supplementing the disciplinary and interdisciplinary content, encouraging students to engage in higher order thinking about the concepts, and in creating thematic understanding. An example of this approach is seen with Message in a Fossil (MIF), one of the 26 multimedia products that were developed for the project (see Figure 1; Table 3). MIF is a microworld simulation in which the student plays the role of a paleontologist who excavates in virtual dig-sites, discovers plant and animal fossils, and reconstructs the prehistoric world by constructing a museum diorama. According to a second grade teacher, MIF was "the thematic and content backbone of the Organizing Idea, 'What Evidence Tells Us About Our World'" (Henderson, Klemes, & Eshet 2000). The major theme of the OI was gathering, interpreting, and communicating evidence to solve mysteries and problems, particularly those that inform our understanding of the past. For approximately 45 minutes each day, the class worked in stations where each small group activity integrated the OI and themes across curriculum areas. One of these daily rotating activities was learning with MIF, which was also included in the time allocated for reading. This meant that each student used the software each day for at least 20 minutes, for a period of 6 weeks. Henderson et al. (2000) concluded that the length of time students accessed software was a significant factor in student learning outcomes.

Each of the computer products was used in a similar way to MIF, although their role in the OI may have varied from one OI to another. In the course of developing the project's learning materials, it was found that while it was relatively easy to incorporate the science and social studies topics in the thematic curriculum, it was much harder to do so for topics in Arts and Language Arts. Therefore, these topics continue to be taught separately, in a disciplinary manner, during part of the day.

Technology and class redesign

Papert (1993) advocated the incorporation of computers inside classrooms rather than in computer labs in order to increase their impact on children's learning and a reconceptualization of classroom layout to enable thematic learning and group work (Jacobs 1989; Marzano 1992; Brooks & Brooks 1993). This influenced the PISD project as it included a complete redesign of the architecture of the classrooms and the each school's technological infrastructure. In order to enable an open and more flexible learning atmosphere, the "frontal chalk-and-talk classrooms" were redesigned as spaces that allowed an easy access to the class computers and promoted team work and group discussions. The large computer labs were dismantled and replaced by networked computers in each classroom, at a ratio of three students per computer, and in the library and administration areas. Accessory equipment such as a video player and a large TV monitor were included as classroom equipment along with a printer for each four classrooms. The networked computers enabled student access to the available on-line learning environments and utility programs. This combination, of new classroom architecture and new technology infrastructure design, have contributed to the establishment of a new teaching and learning culture in the PISD participating schools (Henderson, Eshet, & Klemes 1998; Kent & McNergney 1998; Provenzo, Brett, & McCloskey 1999).

Impact of the Plano Project

The Plano Curriculum Integration Project had a decided impact on the teaching, learning, and management culture of the entire district, affecting the teachers, students, and district administration. (Eshet, Klemes, & Henderson 1999). One such impact is provided in a study of second grade children who participated in the Plano Project (Henderson et al. 1998; Henderson et al 2000). The authors report several clear changes in the classroom culture. The new classroom architecture and the introduction of computers into the classroom promoted team and small group work. This also affected the teacher's teaching culture that became more student-oriented and problem-solving based. The research findings also indicate, in comparison with the way it was taught pre-MIF and the new thematic integrated curriculum, an increase in studcnts' engagement in the learning processes and an improvement in transferring their learning into other domains (Henderson et al. 2000). A second, and probably the biggest impact of the project, is best portrayed by the fact that today, the 30 to 40 teachers who participated in designing the thematic curriculum, are engaged in training teachers nationwide in developing similar curriculum integration projects. A final impact, the decision of PISD to extend the Curriculum Integration Project into their middle schools, illustrates successful implementation of systemic change in a school district.

Conclusions

The technology-based curriculum integration project in Plano provides a valuable opportunity to identify the ingredients of a successful technology integration project. The following are highlighted:

1. Introducing hardware and software is not enough; an educational technology-based project must involve appropriate curricular considerations that might require the design of an entire new curriculum.
2. Learning materials should be developed especially to complement and be integral to the curriculum. This applies particularly to computer-based learning materials.
3. Teachers should be involved in agenda-setting and decision-making, including those concerned with the curricular approach and production of learning materials, both on-line and off line.
4. The introduction of technology into schools requires consideration of classroom architecture, placement of in-class computers, and technology infrastructure, and, not least, their effect on the teaching-learning culture in school and school-home interconnectivity.

References

Brooks, J.G. & Brooks, M.G. (1993). The case for constructivist classrooms. Washington: Association for Supervision and Curriculum Development.

Bryson, M., & de Castell, S. (1998). New technologies and the cultural ecology of primary schooling: Imagining teachers as luddites in/deed. Educational Policy, 12 (5), 542-567.

Bybee, R. W., & McInerney, J. D., (Eds.) (1995). Redesigning the science curriculum: A report on the implications of standards and benchmarks for science education., Colorado Springs: BSCS.

Education Week (1999). [Online] http://www.edweek.org/sreports/tc99/articles/survey.htm Accessed October 18, 1999.

Eshet, Y., Henderson, L., Klemes, Y. (1999 February). Breaking the mould in Plano: Technology and systemic change. Association for Educational Communication and Technology (AECT) National Conference, Houston, Texas

Henderson, L., Klemes, Y., Eshet, Y. (1998). Educational multimedia implementation in schools: Producer-teacher-student links. In T. Ottman & I. Tomek (Eds.) Educational multimedia and hypermedia (pp. 579-585). Charlottesville: Association for the Advancement of Computing in Education.

Henderson, L., Klemes, Y., Eshet, Y. (2000). Just playing a game? Educational simulation software and cognitive outcomes. Journal of Educational Computing Research., 22 (1), 105-129.

Hord, S. (1992). Facilitative leadership: The imperative for change. Austin, Tx: Southwest Educational Development Laboratory. Also [On-line] http://www.sedl.org/change/facilitate/welcome.html Accessed 19 March 2000.

Jacobs, H. H., (Ed.), (1989). Interdisciplinary curriculum: Design and implementation. Washington: Association for Supervision and Curriculum Development

Jacobs, H. H. (1997). Mapping the big picture: Integrating curriculum and assessment K-12. Washington: Association. for Supervision and Curriculum Development.

Jonassen, D. H. (1991). Objectivism versus constructivism: Do we need a new philosophical paradigm? Educational Technology Research and Development, 39(3): 5-14.

Kent, T.W. & McNergney, R.F., (1998). Will technology really change education? Corwin Press Inc., Thousand Oaks, Ca.

Kovalik, S. & Olsen, K. (1994). ITI: The model – Integrated thematic instruction. n.d.: Kovalik & Associates.

Marzano, R.J. (1992). A different kind of classroon – teaching with dimensions of learning. Washington: Association of Supervision and Curriculum Development.

Otto, D. (1997). Curriculum integration: We're writing the book. [Unpublished Internal Document]. Plano: Plano Independent School District.

Papert, S. (1993). The children machine: Rethinking school in the age of the computer. Basic Books: New York.

Provenzo, E.F., Brett, A., & McCloskey, O.S., (1999). Computer, curriculum and cultural change. London: Lawrence Erlbaum Associates.

Resnick, R. M. (1999) National Survey of Teachers' Use of Digital Content. Education Week, 19(4) 7-39. Also [On-line] http://www.edweek.org/sreports/tc99/articles/survey.htm Accessed 19 March 2000.

Shade, D.D., and Watson, J.A. (1990) Computers in early education: Issues put to rest, theoretical links to sound practice, and the potential contribution of microworlds. Journal of Educational Computing Research, 6, 375-392.

Texley, J., and Wild, A. (1996). NSTA pathways to science standards. Washington: National Science Teachers Association.

A Course Website a Year Later: Lessons Learned

Christopher Essex
Instructional Systems Technology
Indiana University
United States
cessex@indiana.edu

Brian Beatty
Instructional Systems Technology
Indiana University
United States
bjbeatty@indiana.edu

Pamela Song
Instructional Systems Technology
Indiana University
United States
casong@indiana.edu

Abstract: This paper is a report of the findings of a study that describes the development, evaluation, and revision process for an on-campus graduate level Statistics course website. Focus groups, interviews, and document analysis were examined to determine patterns and amount of student use during the website's initial semester of use. Findings indicate a lack of integration into course activities contributed to minimal student use of the website throughout the semester. Student expectations about the currency of information on a course website suggest that regular review and updating of on-line materials should be planned for and accomplished. If on-line conferencing is to be part of a course website, it needs to be both required and structured by the instructor to be successful. Finally, a comprehensive review of printed course materials should be performed in order to ensure that website contents are not simply a redundant collection of course materials.

Introduction

Since 1994, when the worldwide web became available to most colleges and universities, the number of websites for on-campus courses has grown exponentially. The World Lecture Hall, a directory of these websites at the University of Texas-Austin, lists 129 websites in the field of Education alone, and this listing is far from comprehensive. But too many of these websites, we would argue, are thrown together quickly, almost immediately become outdated, and do not effectively serve the needs of the students taking the course, their primary audience. And once created, these websites often tend to be ignored by the instructor, becoming outdated and irrelevant, filled with useless information about past semesters and a graveyard of dead links.

This paper describes the systematic design and development process for a graduate-level statistics course website, with a special focus on the continuing development and revision process after the initial semester of use of the website is over. We wanted to discover how the website had actually been used during the course of the semester, and how it met, or failed to meet, the needs of the students and the course instructor. We also undertook a careful review of the website usage logs to determine patterns of use.

The design team consisted of three advanced doctoral students from the Instructional Systems Technology department at Indiana University. During the initial design process, the project team followed a common instructional design and development model. Major sections of the design effort included: analysis of the task and audience, prototype design and testing, design revision and full-scale development, final usability testing and revision, implementation and summative evaluation. In this paper, however, we will focus our description and analysis on our post-instructional website development activities.

Methods

Our analysis in this study focused on two major questions. The first question was, "How (and when, and where, and why) did the students actually use the course website?" The second question was, "Based on the patterns of student usage found in the initial semester of use, what changes in the course website (in terms of content, structure, etc.) need to be made?" To answer these questions, we conducted focus groups of a random sampling of students who had just taken the course. This was followed up by a survey of the entire population of students who had taken the course. The instructor was interviewed about her use of the website and her perceptions of student use. Finally, the website usage logs were carefully analyzed

Focus Groups

A random sampling of students enrolled in the Spring 1999 section of the course were invited to focus group sessions to discuss their use of the website during the semester. A sequence of questions was developed for these sessions by the design team, and additional questions were added during the sessions themselves. These questions were chosen to gain an understanding of several issues: which sections of the extensive website were most commonly used; the ease of use of the website; the times during the semester that the website was used, and the tasks associated with that use; and those aspects of the website that were incomplete or lacking.

Surveys

With that data in hand, we then sent, via email, a survey to all of the students who had taken the course in the past semester. The survey was designed to help us confirm the findings, and assure us of the accuracy, of our focus group data. The survey asked the students questions similar to those asked during the focus groups, simply revised and refined versions to fit the survey format.

Instructor Interviews

Throughout the semester previous to the first usage of the website, and during the website's initial semester of use, we had met with the instructor of the course, a tenured professor in the Counseling and Educational Psychology department. We again met with her, just before our focus groups with the students, to gain an understanding of her use of the course website during the semester, how she had introduced the website to the students, and her perception of the amount and quality of student use of the website.

Document Analysis

We had access to the usage logs for the course website, which gave us information on how often each page (of the over 100 web pages of the site) was accessed and when it was accessed during the semester. We were able to determine the most popular pages on the website and the days during the semester that the website was most often used. This information was compared with the course schedule to help understand patterns of student use as they related to course assignments. We were also able to view aggregate information about website visitors. This information helped us determine whether the students were accessing the site from computer labs on campus, dormitories on campus, or through dial-up connections.

Findings

Student Use of Site

Unfortunately, we found that the course website was not used much during the initial semester, according to the students we talked to. Server logs back this up, though use did increase from 729 page requests in January to a high of 5162 requests during March, before falling back to 765 students again in May, as the course was ending. For comparison, another course offered by the same department had 10571 requests during March, almost twice as much activity (Bonk, 2000). As one student noted regarding the website, "Didn't use it much. Didn't have to."

Students indicated that the professor's reference to and use of the website in course meetings was minimal. Several mentioned that they might have used the website more if they had a better understanding of its contents. During one of the focus group sessions, one particular student discovered many useful and interesting resources when he was reviewing the site contents. He commented that, "I am currently working on a research design and I can really use these resources right now. The instructor should have emphasized this more during the class."

Technology Details

The campus provides both Windows and Macintosh computers in student computer labs, and both platforms were used to access the site. The server logs confirmed student reports that they accessed the website from university labs, dorms and libraries and off-campus homes. Both high-speed networks and slower modems were used to access the site.

Both Internet Explorer and Netscape web browsers were used by students to access the site. Interestingly, many students reported using both web browsers depending upon the location from which they accessed the site. Perhaps surprisingly, students reported no technical problems accessing or using the site, even though it included advanced Javascript features on every page.

Site Content

Students primarily used the site for one purpose: viewing and printing examples of assignments and bibliographies (which were not in the course reader) as models for their own work. The article review samples and bibliographies were cited by many students as by far the most useful elements of the site. For example, in March and April, 1999, during the part of the semester that the students did the majority of their assignments for the course, the page that included links to these items was the second most popular page on the site, after the home page.

Other sections of the site that were favorably mentioned were: the links to information about the software that was to be used in the course, sample questions for the test, instructor contact information, and the links to professional journals. Students reported that they occasionally recommended the site to other students or referred peers to information they found on the site, especially information regarding assignment completion. One feature of the site, the bulletin board, a feature that can produce much site activity, was not used at all, and some students commented that they wished it had been used. One student said, "The discussion section would be helpful for after-hours help." Normally when the students sought after-hour help, they sent email messages to the professor. The professor would send a reply directly to the student and forward a copy of the message to the whole group. Students commented that the communication between students and professor might have been more efficient if the bulletin board had been used.

Some students mentioned material that could have been included on the site but wasn't, such as: links to the library's online article search systems, answers to lab assignments, lab assignment handouts, case study examples, and sample problems to use with the statistical software. One student complained that while they read from several books, only the readings from one of the books were included on the schedule. Some of the content, specifically examples of studies cited in the bibliography, seemed out of date to the studcnts as they were several years old. The list of scheduled readings was also out-of-date, referring to the schedule of a past semester.

We got the strong indication from students that because use of the site was not necessary to be successful in the course, they therefore had little motivation to visit it. Several commented that because much of the site's contents were already in their printed course reader, it was not necessary to access them via the website.

Site Design

Overall, students reacted favorably to the look of the site and the utility of the navigation options. Several students commented that they appreciated the large image on the home page and the color scheme of the site (Fig. 1). One student said the site was "fun looking," though another complained that the light blue of the central image made the site look "faded." After extensive usability testing, detailed earlier in this paper, several methods of navigating the site (menu bar, sidebar, search, pulldown menu) had been provided for student use and each of these systems was in fact used by some students in our focus group interviews, though some showed strong preferences for one system over another. For example, one student said, "I never used the buttons at the top, I just used the links at the bottom." Students pointed out that some secondary pages lacked the navigation elements found on primary pages of the site.

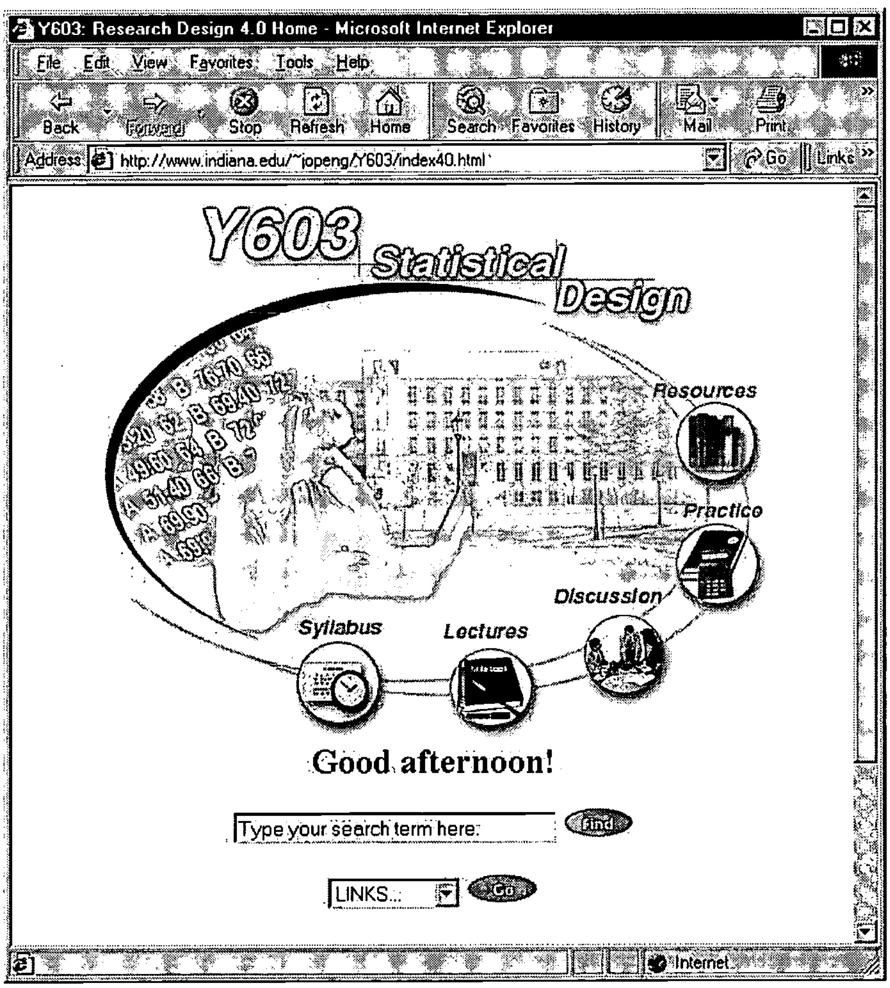


Figure 1: Website Main Page

The website did not influence student's feelings about the course in general; however, some students felt Dr. Peng was a strong advocate of instructional technology because she had her own website.

Recommendations

Based on our findings, we have made the following recommendations to the instructor of the course.

- A careful review of the contents of the printed materials given to the students needs to be made. Which of these materials would more appropriately be provided in print form, and which in online form? Are there materials that should be available in both formats?
- Students expect online resources to be regularly updated, providing them with the most current information available. Because of this student expectation, materials on the website should be periodically reviewed and updated to reflect changes in the course, related materials, and on-line resources.
- The instructor should consider methods by which the students can be made more aware of the resources contained on the website from the very beginning of the semester. Perhaps part of the initial class session should be used to introduce the website. Throughout the semester, the instructor could also point out occasions when the website could be profitably used.
- Course activities which require more use extensive use of the website resources should be integrated into the course.
- The instructor should take advantage of the interactive potential of the website by providing opportunities for students to discuss issues related to the course. Specifically, if the bulletin board conferencing tool is to be included as part of the website, students need to be made aware of its existence and encouraged to participate in the discussions. We suggest that use of the tool should be made a required part of class participation, since, in our experience with courses using such tools, unless use is mandatory, some students will only minimally use the tool and many will avoid it all-together. (ARTT: Practical Strategies for Using IT, 2000)

Limitations and Recommendations for Further Study

While we do not claim that our experiences are generalizable beyond this particular website design project, we do believe, based our experiences as instructional designers for other course websites, that our findings and recommendations will be useful to other instructional designers working on similar projects. Regarding the limitations of this study, obviously it is only one course of around 35 students, and the particular subject of the course, statistics, may have had some important implications regarding the students' use, or lack thereof, of the site. Also, the fact that the website design team also interviewed and surveyed the students may have had some influence on their responses, though we attempted to minimize this.

Conclusions

Course websites, even given their growing numbers, are still a new resource for instructors and students; they are exploring an unfamiliar realm when it comes to using this new technology in their teaching and learning. As instructional designers, we need to keep the academic needs of both students and instructors as our main focus throughout the design and revision process. Unless the course website serves their needs as efficiently and effectively as possible, it will not be utilized and our time and energy in developing it will be wasted. We hope that in this study we have added to the knowledge available about this design task, and hope that other instructional designers will find our experience useful.

References

University of Oregon Teacher Effectiveness Program. (2000). *Academic Resources for Teaching with Technology: Practical Strategies for Using IT* (Feb 10, 2000). (On-line). Available: http://darkwing.uoregon.edu/~artt/guide.html

Bonk, C.J. (Feb 1, 2000). *World Wide Web Access Statistics for www.indiana.edu.* (On-line). Available: http://www.indiana.edu/~smartweb/nisdata/199903-total-usage.html

Rosenfeld, L. and Morville, P. (1998). *Information Architecture on the Worldwide Web.* Sebastopol, CA: O'Relly & Associates.

University of Texas at Austin. *World Lecture Hall: Education.* (On-line). Available: http://www.utexas.edu/world/lecture/edu/

ALIS: An Adaptable Learning and Information System

Shahriar Fakher
Department of Data Processing Technology
FernUniversität Hagen
Feith str. 140
D-58084 Hagen, Germany
Shahriar.Fakher@FernUni-Hagen.de

Abstract: The capability of Hypermedia to exploit associative linking between contents and to provide multiple navigation paths through them makes this medium predestinated for mapping and representing knowledge spaces (Bush 48). Especially the possibility of mapping knowledge makes Hypermedia a very interesting medium for educational purposes. But access to information, as e. g. in the Internet, does not equal learning. In educational settings, we must adapt the mere access to information to educational needs. On the one hand we need to support the authors in the production and maintenance of these non-linear contents, on the other hand we must give the students tools to be able to work with these contents. In this article, we present the core functionality of an adaptable learning environment, ALIS[1]. The ALIS project aims to support the production and use of interactive Web-based learning applications. We have developed an authoring System for organizing the contents of the learning system and an editing tool for the students, which allows them to adapt the learning material while working interactively with the learning materials.

Introduction

In the recent years the demand in computer-based learning systems has been growing continuously. This is due to the need of life-long learning and the fact that most of the students wish to be able to learn any time, any where.
Using hypermedia systems for achieving these goals seems very reasonable because of the characteristics of this medium. A hypermedia system is a good platform for representing knowledge spaces and for interacting and navigating in them. The very strength of hypermedia as a medium to transfer knowledge is the mapping of nonlinear content.

Normally, when writing course material, the authors convert their nonlinear knowledge into a linear form to be able to transfer this knowledge on a linear medium such as written text. The learners on the other side must de-linearize the contents to be able to embed this knowledge in their own knowledge space (Lowe, Hall 99).
It is clear, that both, the authors and the students, would not need to go through this process, if they were able to work at the non-linear level. On the other hand the capabilities of hypermedia to exploit associative linking between the learning objects and to provide multiple navigation paths through them make the production and the maintenance of material very difficult. These difficulties are increased by the rapid technological progress and constant change in tools and standards. Especially the building of hypermedia learning systems is a cumbersome and expensive task because the authors need various skills to develop the solutions. They have to decide how to model and represent the knowledge to be transferred to the students, how to organize and administer this material, how to embed it in existing technology standards (browsers, operating systems, ...) and how to offer the students tools to work effectively with this learning material.

The Idea

The idea behind the ALIS System can be summarized by the following requirements for a learning environment:

1 http://www.fernuni-hagen.de/ALIS/

- Learning is the process of knowledge construction, not knowledge recording or absorption (Harel & Papert 91)
- The learners need environments, in which they can be an active designer rather than a consumer (Fischer 98)

Consequently we need a learning tool which has the following characteristics:

- it is adaptable, and expandable
- it visualizes also the semantic interrelation of the contents and gives the learner the possibility to use this as an interface to adapt these structures to his own needs.
- it must be a generic tool, so it can be used for any kind of domain

The interesting question at this point is, how is it possible to build a generic system, which can map a knowledge space independent of its contents As a solution, we have chosen to give the learner always two visual perspectives of the knowledge space. On the one hand we have the presentation of the particular content (at the present time made of HTML pages) in which other media types (e.g. JPEG, GIF, MPEG, applet) are integrated. Thus one special aspect is covered and shown in a browser window.
On the other hand we have got an overview of all pieces of content and their relations within the whole context. For this purpose we use the mind map, which is a specialized form of a concept map.

A concept map is a well-known formalism for representing structural knowledge (Jonassen 93). Concept maps tend to be much easier for human users to understand than other knowledge representations such as pure text or predicate logic (Nosek & Roth 90). It is a directed acyclic n-dimensional graph consisting of a set of *m* concept labels {C1...Cn} and a non-empty set of *r* relationships between them. Different diagrammatic representations are used to visualize such graphs. One of the most popular study aids in educational settings are mind map (Buzan 93). Their advantages for the learner are described e.g. in (McAleese 98, Novak & Gowin 84). McAleese stresses the role of concept maps for the important self-regulatory study process, which he calls "reflection".

The Learning Tool

We have developed a Java and XML-based learning tool, which aims to provide more flexibility for students while working with courses and allow them to personalize them. It can be used online, off-line or in a mixed way.
Its user interface provides two separate windows: one of them is a normal browser window presenting the content, the other one is a structural navigation tool as shown in Fig. 1 . The navigation window includes a concept map (right and lower left window pane), a navigation tree (upper left pane), and a pyramid shaped depth indicator (middle left pane).

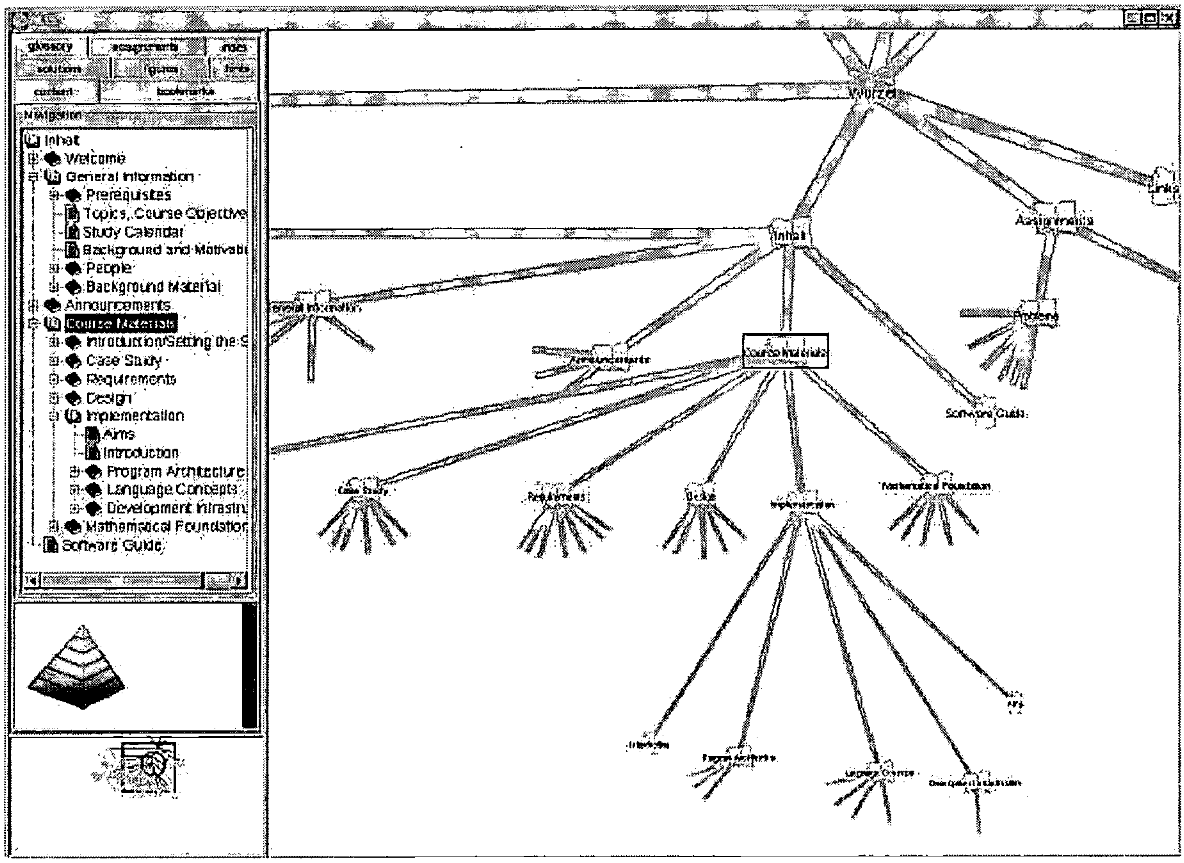


Figure 1: The learning tool

Functionality of the Learning Tool

With ALIS, the learners are able to access the content directly in the browser window and navigate from content page to content page. Alternatively, they can manipulate a visual concept map. The manipulations of ALIS' concept include: shifting the focus to the topic of interest, folding or unfolding concepts nodes, adding nodes or associative links among nodes that are not member of the same sub-hierarchy, or select presentation pages to be shown in the browser window in a point-and-click fashion. In addition the learners can easily insert their own notes and select bookmarks in the map and save same a personal bookmark register in the navigation tree. The navigation tree, which shows a folder hierarchy, allows the learner to access the content by clicking into a selected folder hierarchy and selecting a leaf item denoting a content page opened up in the browser. The nodes or folders in the tree are color coded. Red indicates an unread item, blue indicates items visited, and green refers to a page or collection of pages the user confirmed explicitly to have understood. There is also the possibility for the user to create context sensitive views on the content in different trees, which can be accessed by separate registers. For instance, a student's learning application might include a tree for examples, for related links, for exercises, and for definitions allowing him/ her, for example, to quickly refresh the content before entering an examination. Another pane of the navigation tool shows a 3D visualization of the focus depth hierarchy. The idea behind this view is to indicate the level of detail a knowledge piece as belonging to. The assumption here is that the deeper the content is placed in the hierarchy the more specific the selected information is. The pyramid window also includes a learning progress indicator (the bar on the right side of this pane), which shows the learning progress percentage-wise using the same color coding as in the tree representation.

The different views on the course material are always synchronized. This ensures that the structural navigation tool always refers to the page shown in the browser window and vice versa. The learning tool supports also a merge functionality. This means that the students are able to synchronize their own extensions with other students or with the update information about the course on our servers. This functionality gives them the possibility of collaborating with other students.

Implementation

The first version of the navigation tool is operational and in use.

The Authoring System

According to Elliot and al. (Elliot et al. 95) "if an authoring environment were to allow developers to" draw "their subject domain on a screen as a semantic net and then add the hypermedia features it would considerably facilitate development". In the ALIS project, we are developing an authoring system, which allows authors to use this framework to gather pieces of information and weave them into a hypermedia system. For doing so, ALIS offers several views upon the content and its structure. Our main goal by developing the authoring system was to give the authors the possibility to concentrate on forming and designing the subject domain and to be able to store this knowledge into a data base.

In the first pane the authors define the educational objectives to be able to control, whether all of the relevant themes are included. In a second pane, they use the concept map designer to structure and organize the information space. While working with the concept map, they are able to compare the consistency of the contents with the educational objectives and check the associations between contents. After putting up the main semantic structure of the contents, the authors can use this scaffold and fill it with contents and style information by clicking the nodes of the concept map and adding the descriptions to this particular topic. After collecting and structuring the information in this way, it is possible to automatically generate and build up the learning application out of the data base. The advantage of this approach is a high level of separation between knowledge, its presentation and its implementation in a hypermedia application. The authors don't need to take care about the presentation of the contents, the navigational support, and other facilities of an learning application.

Implementation

The first version of the authoring system is operational. It supports the building and organizing the of contents at the semantic level. The screen units can be edited with external HTML Editors. In the next level of development we will also separate the style and markup information from the contents to store them also in the data base. Doing so, the authors can assemble the course and the contents with their style and markup information, at the time of delivering.

Conclusion

In this article we have illustrated the learning environment ALIS with its generic functionality. ALIS lets the students adapt the learning material to their own needs by adding links to up-to-date information and integrating their own elaborations. Students collaborating in geographically dispersed teams can make their personal extensions accessible to their peers through a simple update function that just exchanges the differences in the individual link structures. Flexible navigation mechanisms support multiple perspectives on the course material and allow them to find their own tour through it. Personal notes and links to related material of their choice can be added by drag-and-drop functions.

We know that the author's task of developing such flexible applications is difficult and hardly supported by suitable tools reaching the comfort of traditional CASE tools. Commercial authoring tools such as Director, Toolbook, or Authorware can at best be considered low level design and programming tools.

Few tools and techniques are available at present that help authors to elicit the requirements for a new course (including learning objectives, subject topics to be taught, appropriate didactic approach, learning material and presentation media suitable for the clients, navigation structure) and systematically evolve such requirements into a hypermedia application. The extensions we plan for ALIS aim to overcome some of these difficulties in the near future.

References

V. Bush (1948), *As We May Think.* Computer Bulletin, March, 35-40.

T. Buzan (1993). The mind map book: *Radiant thinking – the major evolution in human thought.* BBC Publications.

G. Fischer (1998), *Beyond 'Couch Potatoes': From Consumers to Designers.* Paper presented at the 3rd Asia Pacific Computer Human Interaction Conference, Kanagawa, Japan.

I. Harel, S. Papert (1991), *Constructionism.* Norwood, NJ: Albex Publishing Corp.

D. H. Johannessen, K. Beissner, and M. A. Yacci (1993). *Structural knowledge: Techniques for representing, conveying, and acquiring structural knowledge.* Lawrence Erlbaum

D. Lowe, W. Hall (1999). *Hypermedia & the Web: An Engineering Approach.* John Wiley & Sons Ltd.

R. McAleese (1998). *The knowledge arena as an extension to the concept map: Reflection in action.* Interactive Learning Environments, 6(3):251--272.

J. T. Nosek, I. Roth (1990), *A Comparison of Formal Knowledge Representation Schemes as Communication Tools: Predicate Logic vs. Semantic Network*, International Journal of Man-Machine Studies, 33, pp. 227-239

J. D. Novak & D. B. Gowin (1984), *Learning How To Learn.* New York: Cambridge University Press.

THE ARISTOTLE PROJECT:

Gordon Faulkner, Sumathi Gopal, Abraham Ittycheriah, Richard Mammone, Attila Medl, Miroslav Novak
Center for Advanced Information Processing
Rutgers University
USA
gbfaulk@caip.rutgers.edu

Abstract: This paper describes research being conducted at Rutgers University into the design of Distributed Learning Systems for asynchronous delivery of multimedia educational material to students via broadband networks. A pilot system called Aristotle comprising videotaped lectures, text transcripts and textbook figures all organized into short synchronized presentations has been successfully implemented and is described in detail. The experience gained during the project has fueled ongoing research in the areas of automated speech recognition, automated question-answering, and development of tools for generating and organizing media content, all briefly described herein.

1. Introduction

This paper describes the design and implementation of the Aristotle system, a web-based educational tool intended to supplement classroom instruction for an introductory course in General Biology. The Aristotle system is a Distributed Learning System that makes a multimedia database containing segmented lecture material augmented with text and graphics available to students via a broadband network. Section 2 of this paper presents the design approach. The implementation of the Aristotle system is described in sections 3 and 4, which contain an architectural overview followed by a more detailed discussion. Section 5 describes the deployment of the system and the design of an ongoing study to determine its effectiveness. The paper concludes in Section 6 with a summary of proposed enhancements, which are currently under development.

2. Approach

In the development of Aristotle as well as its ongoing work, the project team considered three main objectives :

1. to present information to the student in a highly-integrated manner
2. to organize information content in a way that facilitates learning
3. to develop tools and processes for efficient capture of data

These objectives form the basis of an approach to the design of Distributed Learning Systems which is discussed more fully in the following paragraphs.

Integrated Presentation of Information

We seek to provide students with a learning experience that is convenient, engaging and saves time. The presentation of information will be attractive, and facilitate the cognitive processes used in learning. To achieve these goals, the system will support user interaction via all the sensory modalities employed during traditional classroom-style instruction: visual/auditory (while listening to the lectures), visual/tactile (recording notes), verbal/auditory (asking questions), visual-only (reading textbook). Moreover, all interaction can occur at a single time and location, by contrast with conventional learning where information delivery is disjoint (lectures, reading, and visits to library and instructor must be done at different times and places) and the student must expend extra effort to integrate these experiences into a consistent framework.

Content Organization

We will introduce new logical structures for defining and linking objects within multimedia databases. The objects, which we call "knowledge containers", will present educational information pertaining to concepts or ideas. The links will describe relationships between the objects and will facilitate learning and rapid information retrieval. For example, a student learning for the first time about viruses may obtain a clearer understanding by referring to a description of a specific virus such as influenza or by contrasting it with a disease caused by infection, such as scarlet fever. However, the student may not initially know enough about a high-level concept to search for the correct terms or phrases. In this example, the "virus" container could be connected to the "influenza" container via a link of type "example", and to the "scarlet fever" container via a link of type "counter-example".

These new types of data structure will also facilitate so-called "meta-cognition" or "meta-learning" – that is, a student's conscious awareness of the process by which he or she acquires knowledge. Through a visual representation of the knowledge containers and their relationships, a student can track his or her progress in learning a subject, and to make better decisions regarding which topics or ideas to consider next.

Content Generation

A key design goal will be to minimize the labor required for capture and organization of lecture material. We will seek methods for unobtrusively capturing lectures as they are delivered within the normal classroom setting. Automated tools and methodologies will be developed for video capture, speech transcription, and multimedia presentation authoring. These tools will be custom-built for the distributed learning application in order to ensure that they will be simple and efficient.

3. Project Overview

The Aristotle project is a pilot program whose purpose is to explore the technologies and concepts described in the introduction. For this project, a web site was created containing multimedia instructional material derived from an introductory Biology course (http://lilac.rutgers.edu/bio/aristotle.html).

Twenty-five lectures from the course were videotaped at an on-campus television studio. Using written outlines of the lectures, the project team prepared many brief multimedia presentations that could be indexed, and retrieved using a personal computer. Software utilities were written to generate the hundreds of files associated with the presentations automatically. The presentations include video and sound clips from the lecture, textbook figures that pop up to illustrate concepts referred to in the lectures, scrolling text transcripts of the lecture, and written definitions of biology terms. Students view the material using a standard web browser. Headsets were provided in order to permit students to listen to lecture audio.

The multimedia presentations were classified into two types: topics, and key words. Topic presentations contain all the material relevant to a concept covered in the lecture, while key word presentations are very short and concise, designed to give only the definition of the term in question. Students search for topics using an index based on the lecture outlines just as they would search the table of contents of an online book. Key word indices are also provided for each lecture, but are organized in alphabetical order instead of the order in which the material was covered by the instructor. Information can also be located using full text search.

4. Implementation Details

4.1 Major components

The course content resides on a computer located in the research center's computing facility (Fig. 1). Media files, such as JPEG and MPEG files, are managed by a streaming media server (the RealServer from Real Networks Corp.) while HTML files are handled by a standard web server (Apache). Students access the course content from a computer lab on campus. A 100 Mb/s Ethernet connection links the two facilities. In the future, access will be extended to include any facility served by the Rutgers University Network (RUNet 2000).

A web browser configured to handle streaming of compressed video, can be used to access the web site. Two plug-ins are required: the Real Networks RealPlayer G2 plug-in, and the "MPEG by Bitcasting" plug-in - designed specifically for streaming MPEG-1 system files (files containing audio and video data interleaved) at high bit rates.

Management of the web server, and video server is accomplished using Apache Administrator and RealAdministrator, respectively. These are web-based interfaces that allow configuration and control of the respective servers from any browser capable of connecting to the server computer. Using these interfaces, system administrators can start and stop the servers, set bit rate limits, enable or disable access control, and collect site usage statistics.

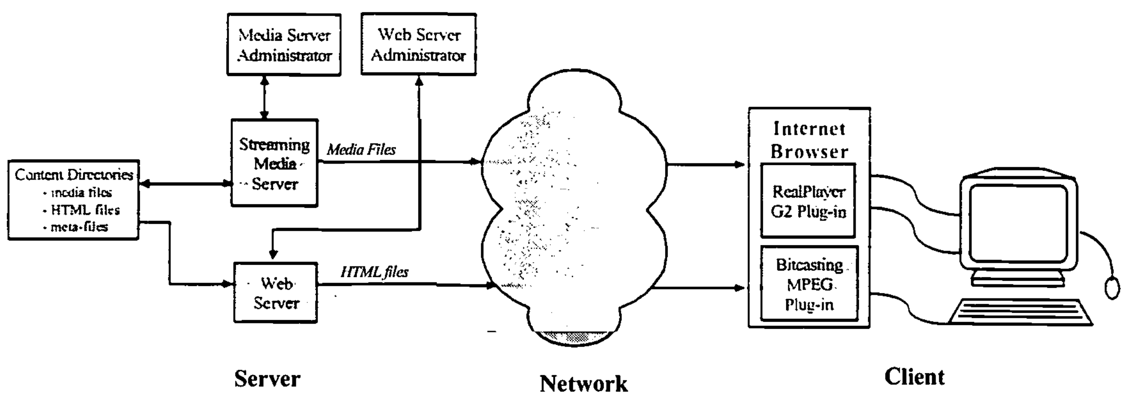


Figure 1: Major Components of Aristotle

4.2 Web Site Design

When students access the web site, they begin with the Aristotle Welcome Page which contains a brief description of the project, as well as a link to the Virtual Classroom page which lists the biology lectures that are available for viewing. Links from the Virtual Classroom page lead to HTML pages containing topic and key word indices which, in turn, lead to the core of the web content – the multimedia presentations for each topic and key word (Fig. 2).

Topic pages contain both standard links and embedded objects. On the left side of the page are links which:

1. lead back to the lecture outline and key word index
2. connect to the web search feature
3. lead to the previous topic or subsequent topic.
4. generate a pop-up list of the figures associated with the topic, if any are available

Helpful prompts describe each link when the mouse arrow is placed over the link text. The remainder of the page contains the multimedia window, which is split into: video region (view of professor and blackboard), transcript region (contains scrolling text), and illustrations region (contains pop-up figures – also contains a link to an expanded view of the figure which opens in a separate window). Across the bottom of the multimedia window there are playback controls and a playback status display.

Key word pages are identical to topic pages, apart from the fact that the links region on the left hand side contains a link which, when selected, activates a pop-up window containing a text definition of the key word in question).

The key component of a multimedia presentation for a topic or key word is a file containing code written in the Synchronized Multimedia Integration Language (SMIL). SMIL (Hoschka, 1998) is a markup language for multimedia presentations that can be interpreted by compatible media players (such as RealPlayer, in this instance). Using SMIL, it is possible to define screen regions, associate media objects with the regions, and synchronize the appearance of media objects (for example, to define when figures appear and disappear).

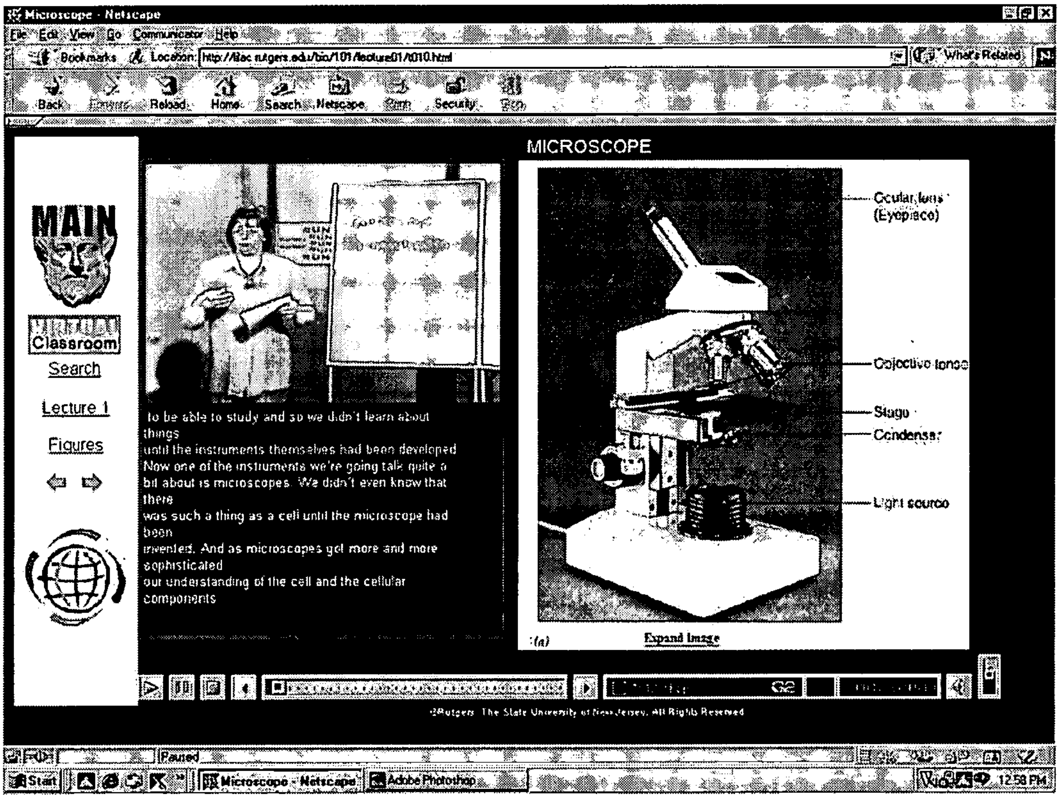


Figure 2: Example Topic Page

4.3 Search Engine

Students can access a site-specific text search engine via links embedded within several of the Virtual Classroom pages. To search for a word or phrase, without using lecture outlines or key word indices, they can go to the search page, type in their query and obtain a list of links to relevant pages within the web site.

4.4 The Lecture Production Process

The Biology course comprises 25 lectures amounting to over 36 hours of video and audio, 250 figures, and approximately 150,000 words of transcripts and other data. The web site contains presentations on 400 topics, and 1800 key words. Clearly the process of generation of this material needed to be as streamlined as possible. Through trial and error, a reasonably efficient approach was adopted (Fig. 3):

1. video tape lectures in studio (Betacam format)
2. edit lectures using an AVID Express non-linear editor
3. encode video in MPEG-1 format using a hardware encoder board (Optibase MovieMaker)
4. review lecture video and identify time codes for figures, and topic/key word boundaries
5. scan (digitize and compress) textbook figures
6. generate topic/key word files (HTML,SMIL, RealText)
7. generate transcripts
8. transfer content to server

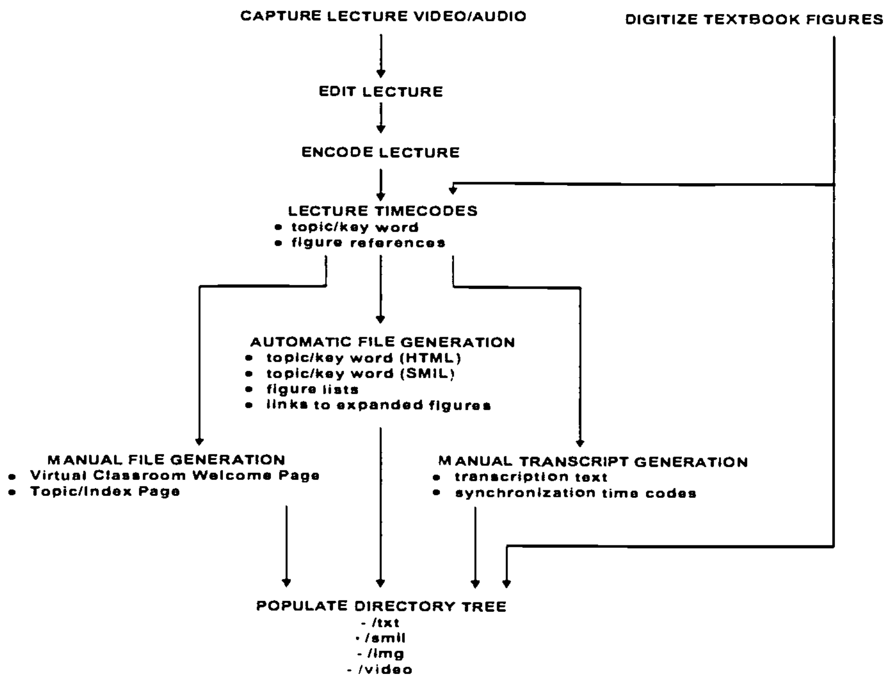


Figure 3: Lecture Production Process

5. DEPLOYMENT AND EVALUATION

A study is now in progress to determine the effectiveness of the Aristotle system. In the fall of 1999, informal anecdotal feedback was obtained from a pilot group of one hundred students who were given access to the web site during its development. A more formal study involving a group of similar size is planned for the summer of 2000. Final grades, a user satisfaction survey, and web site usage statistics will be used to measure the quality of the learning experience. Final results will not be available until the end of the semester; however, initial feedback has been very encouraging. In the meantime, several important lessons have been learned simply through the process of developing the Aristotle system, which help to point the way for further research. These lessons and proposed enhancements for the Aristotle system are described in the following section.

6. ONGOING WORK

Lecture Transcription

Currently, the process of generating lecture transcripts is by far the most time-consuming and labor-intensive step in generation of course content. Transcripts, however, are necessary for incorporating full-text search as a means of locating specific information; therefore, future generations of the DLS must incorporate more efficient methods for their generation. Experiments with a commercial speech transcriber indicate that automatic speech recognition is not yet sufficiently accurate for the task. One reason for relatively low accuracy is that the standard language model is not well suited to the biology domain. Although a significant error reduction (40% relative) could be achieved by training a biology-specific language model (using a biology textbook containing approximately 600,000 words as training text), the amount of the training data was not sufficient to bring the recognition error rate to the desired level. Analysis of the transcription errors suggests that a significant benefit could be realized by employing long range language models that attempt to deduce the current context based on words recently spoken and using the results to condition the predictions of the short-range trigram models that are currently employed. At present, our research is focused on investigation of such techniques.

Multimedia Authoring

We will seek to develop tools and procedures to make content preparation` as painless as possible. As a first step, we are developing multimedia authoring software specifically designed for systems like Aristotle. Where standard authoring or editing tools use time lines and frame-by-frame playback of video content for segmentation and synchronization of media content, our tool will be based on lecture transcripts. The author will be able to use text search to quickly locate relevant sections in a video clip, then will employ a "point-and-click" interface to select words from the transcript that bracket a topic segment or figure reference.

To further enhance the functionality of the tool, we are investigating ways to automatically determine the location of topic boundaries within the transcript text. The segmentation algorithm will use lecture outlines and passages from the course textbook that have been labeled with the name of the topic discussed therein. Using labeled passages as templates, Local Context Analysis (Xu & Croft, 1996) will be applied to a large corpus of unlabeled biology text in order to find words that are strongly indicative of a given topic. Short segments from within the lecture transcripts can then be categorized by topic, and systematically clustered into longer segments, based on the presence or absence of such characteristic words.

Question-Answer Capability

Future versions of the DLS will allow students to find information by asking questions, as they would of a professor. We envision a user interface in which the student interacts with an animated character that is capable of speaking and responding to voice input. Research into question-answering techniques is being conducted using data and guidelines developed for the question-answering track of the National Institute of Standards and Technology (NIST) Text Retrieval Conference (TREC). The initial research objective is to find optimal methods for:

1. Question analysis with a view to predicting the type of answer required.
2. Full-text passage retrieval (using the question as a query).
3. Analysis of the retrieved text passages to select the most relevant given the question and answer type prediction.

Organizing Content: the Knowledge Web

Our future Distributed Learning Systems will go beyond the use of topics and key words for segmenting and organizing information. A new data entity called a Knowledge Web will be developed based on the eXtensible Markup Language (Bray, et al, 1998). The Knowledge Web will define Knowledge Containers, and the relationships that link them. Currently, fundamental software components are being developed that will allow experimentation with various web structures. These components include a graphical editor for creating and modifying containers and links, and a hierarchical visualization tool called a Knowledge Map for viewing and traversal.

6. REFERENCES

Bray, T.,, Paoli, J., & Sperberg-McQueen, Eds. (1998). Extensible Markup Language (XML) 1.0. *W3C Recommendation 10-February-1998*, http://www.w3.org/TR/REC-xml-19980210.html.

Hoschka, P., Ed. (1998). Synchronized Multimedia Integration Language (SMIL) 1.0 Specification. *W3C Recommendation 15-June-1998*, http://www.w3.org/TR/REC-smil/.

Xu, J., & Croft, W. B.(1996). Query Expansion Using Local and Global Document Analysis. *Proceedings of the Nineteenth Annual ACM SIGIR Conference on Research and Development in Information Retrieval*, Zurich Switzerland. 4-11.

Conversation, the constructivist perspective

Gary Ferguson-Smith
Faculty of Education
University of Wollongong
Wollongong, NSW Australia
gary_ferguson-smith@uow.edu.au

David Allibon
Apollo Parkways Primary School
Greensborough, Vic Australia
dallibon@apollo.vic.edu.au

Christine Brown
Faculty of Education
University of Wollongong
Wollongong, NSW Australia
christine_brown@uow.edu.au

Barry Harper
Faculty of Education
University of Wollongong
Wollongong, NSW Australia
barry_harper@uow.edu.au

John Hedberg
Faculty of Education
University of Wollongong
Wollongong, NSW Australia
john_hedberg@uow.edu.au

Abstract: This paper is a report in progress on a longitudinal case study over six years at Apollo Parkways Primary School. Apollo Parkways is an elementary school in middle to lower-middle class socioeconomic suburb in Melbourne, Victoria Australia. The study examines the changes in formal and informal conversations as the school evolved from a 'community of learners' to a 'learning community' (Sergiovanni, 1994) when a technology rich environment was created. The nature of the conversations is providing evidence, which supports the concept that conversation can be an indicator and catalyst of change. More importantly this study is identifying elements in the school, which have supported sustainable change.

Introdnction

In today's society greater demands are being placed on education systems at all levels to produce citizens who can use knowledge in new domains and different situations. Members of society at every level are being asked to demonstrate advanced levels of problem solving to retain their utility as employees. Learning to think critically, to analyse, to synthesise information, to solve problems in a variety of contexts and to work effectively in teams are crucial skills for modern employees, and yet there is little evidence that our education systems are developing these skills in our children (Bransford, Goldman & Vye, 1991). Some (Schank & Cleary, 1995) argue strongly that our educational systems are not developing these essential skills. The Cognition and Technology Group at Vanderbilt (CTGV, 1993) cite Whitehead's (1929) notion of "inert" as opposed to "active" knowledge as a consequence of conventional approaches to schooling and teaching. Berryman (1991) has delineated several erroneous assumptions on which much of the teaching and schooling process is based.

Schools now faced with mandates for the infusion of information and communication technology (ICT) throughout the curriculum may feel they are at a crossroad. Technology is not universally seen as a panacea for current educational woes. As long ago as 1984 Cuban warned "there should be a page in the Guinness Book of Records on failed classroom reforms, for few ever seem to have been incorporated into teachers' repertoires". Like past revolutions in education, it will go the way of previous technologies unless there are changes to the educative framework.

In Australia, similar concerns were raised in discussions with senior departmental officers. In March1991 Dr Terry Burke, Deputy Director-General, NSW Department of Education and Training raised serious issues regarding the implementation and long term viability of the Technology High School program (18 months into the program). In November 1996, Mr Phillip Arthur, Manager, Schools of the Future, Victorian Department of Education emphasised the need to model the Navigator School program on key findings from recent studies into the use of technology in teaching and learning.

In many similar programs, managers and administrators have simply said, "Pretty simple, just train them (the teachers) to use the computers – as experts in curriculum and instruction, the teachers will do the rest". In his critical review of computers in schools and universities, Bork (1995) argued that the effective use of new instructional paradigms required: "a shift in teachers' pedagogical approaches and software that supports modes of instruction with alternative frameworks". The failure of many programs to bring about sustainable change in the classroom may have been linked to ignorance of the need to change pedagogical approaches, and with them, the nature of interactions and conversations among teachers.

This paper outlines a study in progress of what occurred within one school as it traversed the crossroad – it is a study of whole school change through the integration of technology, using a model based on a decade of ACOT (Apple Classrooms of Tomorrow) research. The implementation model began with the key findings of twenty-two published ACOT reports, and the venue was Apollo Parkways Primary School.

The Setting

Apollo Parkways Primary (Elementary) School is a government school located in the north east outer suburbs of Melbourne, Victoria Australia. Socioeconomic area -middle class Australia. Prior to 1995, technology in the school consisted of one or two computers in some classrooms. In 1995 the school, with support from the local community, installed a single computer laboratory, increasing the total number by 16 computers. In October 1995, the school was named 'Navigator School of the Future' by the Victorian Department of Education. In August 1996, it was also announced as the eighth ACOT site in the world. As part of the ACOT and Navigator school programs, in July 1996, the school received over 200 computers, file servers, network and Internet connections. The computer student ratio had decreased from 1:30 to 1:3. During this time, the school population continued to grow by 5-10% per annum. Currently, there are nearly 700 pupils, 34.2 teaching staff, 3 executive staff and 4.2 administrative and support staff.

The challenge seemed simple – share key ACOT research findings (Fisher, Dwyer, & Yocam, 1996; Baker, Gearhart & Herman, 1993; Ferguson-Smith, 1998) with staff, give students and teachers immediate access to computers, show them how to use the technology, and introduce them to open-ended software.

The Study

From a research perspective, the key question was how to capture the essence of what occurred in some meaningful way so others could benefit. The formal and informal conversations within a school were initially considered in their capacity as an indicator. Lambert's (1995) 'typology of conversation' (dialogic, inquiring, sustaining and partnering) in a constructivist leadership environment suggested a vital role for conversations in the change process, thus elevating the status of conversation from indicator to focus.

The purpose of the study is to examine the change in conversation at the school before, during and after the introduction of technology rich classroom learning environments. It addresses three main questions:

1) How has the conversation changed?
2) How has the classroom practice changed?
3) How have teachers' views of learning changed?

A qualitative approach to the research is followed in this ethnographic study – the researcher is a participant observer in a naturalistic paradigm (Lincoln and Guba, 1985) with an interpretivist goal (Willis, Thompson & Sadera, 1999). A variety of techniques have been employed for data collection and analysis, informed by researchers such as Dwyer (1985) – understanding stories, and Beittel (1973) – using artefacts and observation. Data sources have included official documentation, observations, unstructured discussions, interviews, questionnaires and personal diaries.

The analysis of all the school official documents and publications including daily bulletins, newsletters, annual magazine, the web site, teacher journals, student portfolios, student observations and reports involved identification then tallying of themes evident in these formal conversations.

The identified themes have generated questions to be included in interviews, questionnaires and unstructured discussions with community members including the school executive, teaching staff, administrative and support staff, the students and parents, visiting educators and participants of the different professional development programs.

School Change

During the first visit to the school, at the after school staff meeting, the vision of ACOT and the key research finding were shared. An underlying assumption was that the findings would translate from the American experience to an Australian school. Over the next twelve months, each of the 35 staff members participated in 3000 hours of professional development. These activities covered a wide range of topics. The exercise provided clear support for many key research findings, such as stages of adoption (Hall, 1997), the nature of learning (Roblyer, Edwards & Havriluk, 1997), constructivism (Cobb, 1994; Fosnot, 1996) and reflective practice.

Working in collaboration with the school executive and project coordinator, key issues of professional development (Hargreaves & Fullan, 1992; McLaughlin & Marsh, 1983) were revisited. These discussions soon highlighted many of the issues and concerns associated with school change (Hargreaves, 1994; Fullan & Hargreaves, 1996; Schlechty, 1997, Stoll & Fink, 1996; and Sandholtz, Ringstaff, & Dwyer, 1996). Reorientation towards constructivist learning environments (Cobb, 1994; Fisher, Dwyer, & Yocam, 1996; Fosnot, 1996; and Lambert, 1995) coupled with adjustments to the physical, technical and social ramifications of increased technology created a complex pattern akin to Rogers' (1995) diffusion of innovation model.

With a developing awareness, understanding and appreciation of key research findings from several technology based programs around the world (ACOT in the USA and River Oaks School in Canada) Apollo Parkways implemented support structures to ensure a successful and sustainable experience which could improve student outcomes and learning.

The successes and challenges faced by the teachers in the altered instructional settings resulted in a mix of readiness by individuals to accept and implement technology. Their willingness to accept and adopt change is described by Rogers' (1995) adoption and diffusion of innovation, "from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision". Researchers studying teacher development have found that all teachers who are implementing educational innovations progress through a series of stages:

survival, mastery, and impact (Stoll & Dean, 1996; Hall & Loucks, 1979). According to Rényi (1996), teachers make or break a school:

> *"To improve schools we must focus on the teachers. Schools can only be as good as the teachers in them. This is something that all other so-called 'reform efforts' have missed. It's what teachers know and can do that will make the difference in improved student performance."* (http://www.nfie.org/takechar.htm)

Preliminary Data Analysis

Intuitive analysis of the formal publications have so far identified some key sub-questions that will be used to build the interview and questionnaire protocols:

- How did you implement whole school change?
- What protocols (strategies or formal elements) have been employed?
- What were their frequencies?
- Were they subjective or objective? Why?
- Were there any hidden messages? If so, how did they involve forward planning and reflective practice?
- Who did it impact?

Intuitive analysis of the informal themes of conversation identified the following key concepts:

- Spontaneous
- Subjective
- Circumstantial
- Current or immediate future or past (here and now)
- Formative
- Focused on the individual perspective

The complete data set for the formal conversations is too voluminous to interpret in its entirety, so sampling methods have been applied to certain documents. Bulletins have been sampled from the months of Term 1 - January, February and March each year. Table 1, provides the analysis framework for each publication type. This involves a 3-D graph for each year (1994-2000), with the following axes;

x axis = dimensions of the publications
y axis = characteristics of the formal conversation
z axis = qualitative assessment of how these have changed over time (judgement / depth) or rate of change of the changes (using a rating scale 1-5, where 1 is the lowest)

Table 1 : Depth of assessment of the characteristic and dimension of conversation

	Conversation					Culture			Power structure				Curriculum					Welfare		Reward system		Budget		Technology		Beliefs	
													KLA Integration	Organisation/planning										Learning	Location		
	• Planned																										
	• Protocol																										
	• Frequency																										
Formal	• Objective																										
	• Reflection																										
	• Planning																										
	• For the 'good of all'																										

					Culture			Power structure				Curriculum					Welfare		Rewarded system		Budget		Technology		Beliefs	
Conversation												KLA Integration	Organisation/planning										Learning	Location		
• Target Audience																										
Informal																										
• Spontaneous																										
• Subjective																										
• Circumstantial																										
• Currency																										
• Formative																										
• Individual perspective																										

The links between the dimension, characteristics and depth, from Table 1, will help formulate the themes and provide the basis for some of the questions to be raised in the interviews and questionnaires. Teacher interviews will be conducted with 5 to 6 teachers who have been with the school throughout the study, and 3 to 4 teachers who were new to the environment in 1999 and 2000. Interviews with other key staff include members of the executive, parent and citizen association, school council and a small sample of visitors.

Interview questions will originate from four sources:

- **Analysis of data** (above) – to triangulate findings from analysis of written documents
- **Theory** – to test the teachers' understanding of certain theory, and to validate patterns suggested by research literature
- The **structural framework** for data analysis – to identify key features of formal and informal conversations across several pre-specified themes (see below).
- **Intuitive ideas** of the researcher who participated in the design of professional development experiences for staff within the time frame of 1996 – 1999.

Table 2, outlines some pre-specified arbitrary categories that have been chosen as a starting point to identify patterns and trends in data. The preliminary results from the analysis of formal and informal conversation before and after the introduction of technology in the school is providing evidence that supports the conversation as an indicator and catalyst of change.

Table 2 : Initial framework for data analysis

Themes pre-specified to begin data analysis	Formal Aspects	Informal Aspects
School organisation	What changed formally in the school organisation? What led to these changes?	How much did teachers initiate changes to school organisation on an informal basis? What sort of changes made a difference within individual classrooms?
Pedagogy	What formal changes were made to curriculum planning and integration of ICT?	Who did teachers talk to on an informal basis? How were these critical friends found? Did this increase over time?
Staff Skill acquisition	What PD activities were run formally	How much did teachers learn informally from

	for skill acquisition and what software was used?	peers and others?
Technology diffusion (hardware)	How was hardware formally distributed for the duration of the study?	Did teachers attempt to use hardware out of school time? Have staff members purchased their own equipment for home use?
Conversations	What themes can be identified in the formal conversations monitored in the school?	What themes can be identified in the informal conversations monitored in the school?
Researcher as PD Designer	What programs did the researcher design?	What was the nature of the researcher's informal input to staff members?
The underlying reality that is being sampled: What happened at Apollo Parkways Primary School between 1996 and 2000.		

The school, during 1996/7 implemented several guiding principles, highlighted by recent research about learning and technology. These principles can be summaries by the following:

- Provide continued and extensive professional development that was situated in the contexts of practice.
- Adopt a constructivist learning approach in the classroom
- Create learner centred and technology rich learning environments
- Engage teachers from the school in an ongoing conversation and reflection about their practice, their students, theories of learning, how they learn, alternative forms of assessment, the appropriation and integration of technology and what they would change or not change in their classrooms.
- Teachers in teams, develop integrated units of work, lesson plans and other learning tasks that were cross curricula used technology.

Conclusion

There is evidence to suggest that a new way of thinking about change and technology is required, based on a thorough knowledge of the processes and the people, blending research and experiential knowledge, Fullan (1991). Effective change management is facilitated by supportive management structures. The constant communication of outcomes and results is essential in order to maintain support and it is advisable to keep personal political agendas transparent.

This study may provide some insight into the key elements contributing to effective change management. The question is, do successful agents of change have a characteristic stance, a capacity for creating personal vision, inquiry, technology mastery and collaboration in addition to a sizeable 'repertoire of procedural knowledge'?

The implications of this whole school study can provide important lessons and strategies for administrators, educators, schools, districts and education systems in an Australian setting. Those at the crossroads would do well to listen to the conversations of those who have successfully traversed the terrain.

References

Baker, E. L., Gearhart, M., and Herman, J. L. (1993). *The Apple Classrooms of Tomorrow, The UCLA Evaluation Studies, CSE Technical Report 353*, Los Angeles, CA : Center for the Study of Evaluation/Center for Technology Assessment, University of California

Beittel, K. R. (1973) *Alternatives for Art Education Research: Inquiry into the making of art*. Dubuque, IO: WM. C. Brown Company Publishers.

Berryman, S. E., (1991), *Designing Effective Learning Environments: Cognitive Apprenticeship Models*. ERIC Document 337 689, 1-5

Bork, A, (1995) Guest Editorial: *Why Has the Computer Failed in Schools and Universities?* Journal of Science Education Research, 4(2), 97-102.

Boyer, E. L. (1995). *The Basic School: A community for learning*. San Francisco, CA: Jossey-Bass Inc.

Bransford, J., Goldman, S. R., and Vye, N. J. (1991). *Making a difference in peoples' abilities to think: reflections on a decade of work and some hopes for the future*. In L. Okagaki and R. J. Sternberg, (Eds.). Directors of development: influences on children, Hillsdale, NJ: Erlbaum, pp 147-80.

Cobb, P. (1994*) Where is the Mind? Constructivist and Socialcultural Perspective's on Mathematical Development*, Education Research, (pp13-20) AERA Washington, DC

Cognition and Technology Group at Vanderbilt (CTGV, 1993*). Integrated Media: toward a theoretical framework for utilizing their potential*. Journal of Special Education Technology, 12(2), 76-89

Cuban, L. (1984), *How teachers taught: Constancy and change in American classrooms 1890-1980*. New York: Longman

Dwyer, D. C., Lee, G. V., Barnett, B. G., Filby, N. N., and Rowan B. (1985), *Methodology. Understanding the Principal's Contribution to Instruction: Seven Principals, Seven Stories*. San Francisco, CA: Far West Laboratory

Dwyer, D. C., Sandholtz, J. H., and Ringstaff, C. (1990). *Teacher Beliefs and Practices, Part I: Patterns of Change The Evolution of Teachers' Instructional Beliefs and Practices in High-Access-to-Technology Classrooms*, First–Fourth Year Findings, ACOT Report 8, 9 and 10. San Francisco, CA: Apple Computer, Inc.

Ferguson-Smith, G.D., (1998) *Beyond TILT*: Discussion Paper. Sydney NSW: NSW Department of Education and Training.

Fisher, C., Dwyer, D. C., and Yocam K. (1996), *Education and Technology: Reflection on Computing in Classrooms*. San Francisco, CA: Jossey-Bass Inc.

Fosnot, C. T. (1989). *Enquiring Teachers, Enquiring Learners: A constructivist approach for teaching*. New York, NY: Teachers College Press.

Fosnot, C. T. (1996). *Constructivism: Theory, Perspectives, and Practice*. New York, NY: Teachers College Press.

Fullan, M. G. (1993). *Change Forces: Probing the depths of educational reform*. London: Falmer Press.

Fullan, M. G., and Hargreaves A. (1996). *What's Worth Fighting for in Your School*. New York, NY: Teachers College Press.

Hall, G.E. (1997). *Stages of Concern*. Albuquerque: paper presented at the ACET In- CITE'97 Conference.

Hargreaves, A. and Fullan, M. G. (1992). *Understanding Teacher Development*. New York, NY: Teachers College Press.

Havelock, R.G. (1978) *The change agent's guide to innovation in education*. Englewood Cliffs, New Jersey: Educational Technology Publications.

Lambert, L., et al (1995). *The Constructivist Leader*. New York, NY: Teachers College Press.

Lincoln, Y. S. and Guba, E. G. (1985). *Naturalistic Inquiry*. Beverly Hills, CA: SAGE Publications Inc.

McLaughlin, M. W. and Marsh, D. D. (1983). *Staff Development and School Change*, Santa Monica, CA: Rand Corporation.

Rényi, J. (1996). *'Teachers take charge of their learning: Transforming professional development for student success'*, Report: National Foundation for the Improvement of Education, (NFIE) July.

Roblyer, M.D., Edwards, J., and Havriluk, M. A. (1997), *Integrating Educational Technology into Teaching*, Upper Saddle River, NJ: Prentice-Hall.

Rogers, E. M., (1995), *Diffusion of Innovations*, Fourth Edition. New York, NY: The Free Press.

Sandholtz, J. H., Ringstaff, C., and Dwyer, D. C. (1989). Teacher Beliefs and Practices, Part II: Support for Change The Evolution of Teachers' Instructional Beliefs and Practices in High-Access-to-Technology Classrooms First–Fourth Year Findings ACOT Report 9, Cupertino, CA: Apple Computer Inc.

Sandholtz, J. H., Ringstaff, C., and Dwyer, D. C. (1996). Teaching With Technology: Creating Student-Centered Classrooms, New York, NY: Teachers College Press.

Schank, R. C., & Cleary, C. (1995). *Engines for Education*. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Schlechty, P. C. (1997). *Inventing better schools: An action plan for educational reform*. San Francisco, CA: Jossey-Bass Inc.

Sergiovanni, T.J. (1994), *Building Community in School*. San Francisco, CA: Jossey-Bass Inc.

Sherry, L. (1998). *An Integrated Technology Adoption and Diffusion Model*. AACE paper: AACE Association for Educational Communications and Technology.

Stoll, L. and Dean F. (1996). *Changing Our Schools: Linking School Effectiveness and School Improvement*. London: Open University Press.

Whitehead, A. N., (1929), *The Aims of Education and other Essays*. New York: MacMillan

Willis, J., Thompson, A., and Sadera, W (1999), Research on Technology and Teacher Education: Current Status and Future Directions. ETR&D, Vol 47, No. 4 (pp 29-45).

Adapting an Internet Based Learning Environment to a Hybrid Approach

Katrin Franze, Hagen Wahrig, Olaf Neumann
Dresden University of Technology
01062 Dresden, Germany
{kfranze|wahrig|neumann}@rn.inf.tu-dresden.de

Abstract: In the past years there has been a tremendous movement in the area of teleteaching/telelearning. Many institutions try to find solutions for distance learning that could be used especially with the Internet. Today's solutions cover synchronous scenarios like teaching using videoconference systems and asynchronous scenarios like putting teaching material on the web.
JaTeK (Java based Teleteaching Kit) is a system for both telelearning and teleteaching. Teleteaching, for us, means composing teaching material and using tools for self learning, seminars as well as synchronous and asynchronous communication and cooperation. JaTeK is completely implemented in Java and consists of client components and the JaTeK servers managing material, users, groups, and permissions as well as communication and evaluation). First experiences with JaTeK have shown that there is strong demand for the system on offline media. This article describes the realized approach of a hybrid version of JaTeK that solves the problems related with its availability off-line.

Introduction to JaTeK

JaTeK (Java Based Teleteaching Kit) is a three-tier client/server system with an underlying object oriented database (see fig.1). As both JaTeK and the DBMS are completely implemented in Java, the system is applicable on all platforms with a Java virtual machine installed.

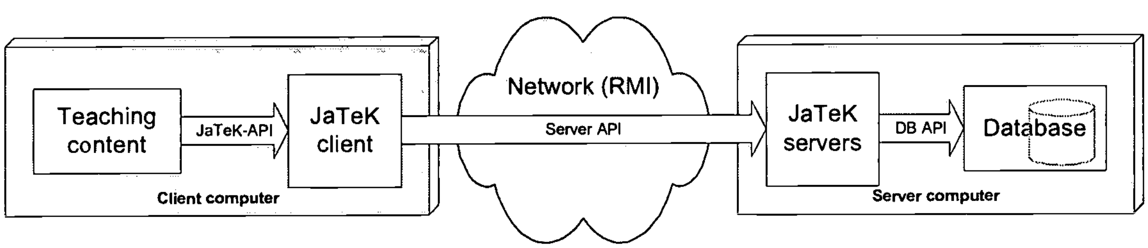


Figure 1. JaTeK Architecture

Application data are managed by ObjectStore PSE, an object oriented DBMS completely implemented in Java that makes its functionality available via the database API. The JaTeK server provides high level functions to create and login users as well as to create, write, read and delete objects implementing the server API. The JaTeK clients allow to display and administer the teaching content (e.g. documents, exercises, and experiments), and encapsulate the JaTeK server interface. They consist of the actual applications realizing the graphical user interface and the data objects representing the teaching contents that will be read from the server.

When a user logs into the server-based system, the client application gets a reference to a user-specific server object via RMI naming service. That manages all subsequent user requests to data objects on the server. The data objects are read from respectively written to the database by the JaTeK server. The teaching content is implemented in form of different material templates that use methods of the JaTeK API to communicate with the client application or with the server, respectively (e.g. for receiving or saving material data).

For the hybrid system to work, JaTeK's functionality had to be enhanced by a new component responsible for controlling the hybrid mechanism, storing of data in the local database, and data equalization (see fig 2). The hybrid control supplies the application with data objects by loading them from either the local database or the remote server, depending on the current application mode. Communication services that are part of the JaTeK system do not access the local database. Only if the remote JaTeK server is reachable their data are handed over.

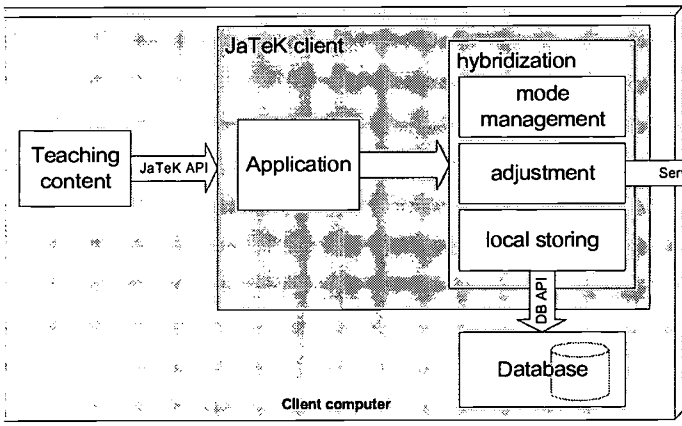


Figure 2. Architecture of the hybrid system

Scenarios of the hybrid approach

Originally, the JaTeK system was required to be available over the Internet. However, our experiences and the results of evaluation cycles have shown that more flexibility regarding Internet connectivity is needed. To meet the requirements of a wide ranged usage the hybrid system has to cover the following scenarios:

1. Usage as non-hybrid system via HTTP/RMI-server without client-side storing
   An educational institute offers teaching material on a server that students may access over the Internet. Mostly they use the JaTeK clients from within a university computer laboratory, so a fast network connection can be assumed. All data - that are kept in a database on the server - may be transferred via the network.

2. Local usage without communication- and write-requests
   A student without network access can use the standalone version of JaTeK. All data are stored locally and the system will be started from CD-ROM or local hard disc. Since CD-ROMs are read-only media, in this case just read operations can be executed. For write operations a medium that can be written to, e.g. a hard disk, is required.

3. Hybrid usage
   A user with but a slow network connection would still want to access the most recent data. Using the system in the hybrid modus, the user would transmit as few data as possible via the network - thus minimizing network traffic and delays.

   In this scenario, the system is installed locally on the hard disk. For regular work, only data locally stored are accessed. They will be updated only if the data on the server have been changed since the last equalization. Write requests are performed on the server and on local data.

4. Data equalization
   Normally, if a local database is used it is not necessary to hold a network connection alive all the time one works with JaTeK. For instance, course material could be created in the standalone modus. When the work is finished, the server database can be updated with that material.

   This scenario supplements that of local usage without communication and write requests.

The scenarios described above are summarized in table 1. The need of connecting the server in one of the scenarios implies to respect its user and permission management. The permissions have to be applied to the local database in order to avoid inconsistencies between the server and client databases.

Scenario	*Database access*	*Data equalization*
1. Usage as non-hybrid client/server system	server	No
2. Standalone	local	No
3. Hybrid	hybrid	Yes
4. Equalization	hybrid	Yes

Table 1. Summary of the scenarios covered by the hybrid mechanism

The form of database access inevitably derives from the scenario currently used. Exclusively in scenario 3 and 4, the databases are equalized with each other.

System requirements of the hybrid approach

A system that covers all of the scenarios described above has to meet the following requirements:

* Work as "pure" client server system
  The system should be able to deactivate the hybrid functionality and to switch to a mode not using this additional functionality. That means the system must be workable without a local database.

* Data equalization in both directions client server and server client
  Usually, only client data will be updated with newer server data. However, if local data are changed in the standalone mode, these changes will have to be processed in the server database, too.

* Functioning without a server
  To use the system without network access, it has to be able to work in standalone mode with just the client database. Therefore, all necessary components (i.e. database, class files, etc.) have to reside locally, without network based communication services being available.

* Keeping resource consumption low
  Since the client computers running the hybrid component usually have fewer resources than the server computer, the hybrid component must not consume resources excessively.

* Automatic/manual start of the full data equalization
  Full data equalization can be run automatically at the start and/or at the end of a session, or be started manually to keep the entire database up to date while working in standalone mode.

* Data equalization on demand
  If the client is working online, local data will not be equalized until they are accessed by the application. Thus several small data transfers are performed, consuming less time than one big transfer.

* Transparent data access
  Accesses to the local and the remote database have to be realized transparently to a large extent. For the user and the application, there should be no difference between a query to the local or the remote database. Only the hybrid component has to know where the needed data are located and use this information.

* No separate application for data equalization
  In order to keep the user interface simple the hybrid functionality is integrated into the existing client software. No external application is needed for data equalization.

Database access in the hybrid system

Different possibilities of access have to be considered to determine the form of database access:

* Database access:
  * direct via the database API
  * via a server process

* Database Access by
  * a Single user
  * multiple users concurrently

* Using a database
* on the local computer
* on a remote computer

Since the used DBMS does not support a remote use of the database API, it is impossible to directly access a remote database API (e.g. via RMI). Neither is accessing a local database via a server process effective as this approach consumes resources and brings no advantages in the context of the system. The scenarios best applicable in the hybrid system are, therefor, the use of a local database directly via its API for accessing cached data, and of a remote database via a server process for updating data.

Access	**Local**		**Remote**
	Single user	*Multi user*	
Direct via database API	Local solution	Concurrency problems	Impossible
Via server process	Incommensurate		Server solution

Table 2. Scenarios of database access

As the server process is capable of handling multiple users, remote access by multiple users has not to be regarded separately. A direct access to the database API in multi user mode could result in the database being opened by multiple processes. That, in turn, could lead to undefined database behavior since JaTeK uses the DBMS ObjectStore PSE, which does not provide cross-process concurrency control mechanisms.

Therefore, the hybrid system uses the database API to access the local database directly. The multi user server process is used for accessing the remote server database which in this case is shared with other clients.

Assigning client objects to server objects

For equalizing the objects of the local client and the remote server database in the hybrid system, corresponding objects have to be assigned. To unambiguously assign an object of the server database to one of the client database a unique external link must exist. Equivalent objects reside at the same position in the object tree of their databases. Client and server objects are thus identifiable database-independently by the object path – indicated by the names of the nodes - from the root to that object. To find the corresponding object one has to navigate along the path from the root to the object.

Another approach would be to use unambiguous identifiers - "external references" - for persistent objects in the server database. They contain information about the database, the segment in which an object is stored, and the location of that object in a segment. The problem, here, is that segment and location information are not identical for objects of the client and the server databases. Storing the external reference of the server objects together with the object data of the client database could solve this.

	Path	*External reference*
Advantages:	* Database independent	* Fast access to server database objects * Only the object and perhaps the parent object have to be known
Disadvantages:	* Navigation through whole path necessary * Whole path has to be known * Problems after renaming nodes	* Database dependent * May vary after reorganizing database

Table 3. Comparison of methods to find equivalent objects in the client and the server databases

The two possibilities to allocate objects in the client and server databases considered here are compared in table 3. If the server database will never be reorganized, both segment and location of objects of the server database remain the same during the entire life span of the persistent server object. Thus, corresponding objects can be easily allocated and identified by the external reference of persistent server objects. As this is faster and more reliable than identifying objects by path, this method is used in the hybrid system.

Timestamps

Another important aspect of equalizing data is the method of determining their age. The local data will have to be updated if comparing the timestamps of local and remote data shows that the server data are newer.

For that reason every object (in the server and client databases) contains a timestamp representing the time of its last modification. If the application changes an attribute, the timestamp will be set to the current time. As the real time clocks of the clients are not synchronized, they may differ. Therefor, timestamps are not created by each client, individually, but by the server. This timestamp is sent to the client during data equalization and applied to the according object.

The consideration of using timestamps led to the discussion of three different approaches:

1. To have only one timestamp per object would lead to the whole object tree having to be searched by comparing the timestamps of every client object with that of the corresponding server object. Especially for full data equalization, that consumes too much time.

2. To reduce network traffic and dispensable operations, objects have collective timestamps (called ts_{Child}) summarizing the timestamps of the child objects reachable by the current object. The collective timestamp shows, for server objects, the timestamp of the youngest and, for client objects, the timestamp of the oldest child object. If the collective timestamps of the server object is not younger than that of the corresponding client object, no data equalization of the child objects is necessary. If this is valid for the root object, the client database is up to date and no data equalization is needed.

   If one object in the tree was modified, the collective timestamp has to be changed up to the root. Although this approach offers a better basis for optimizing data equalization, it does not produce enough information to unambiguously recognize modifications. That led to the following approach:

3. To avoid having to compare all nodes of the path another timestamp (ts_{Self}) - representing the time of the last modification of the current object - is introduced. For instance, if a *Material* object has been changed or added, ts_{Self} of this object and ts_{Child} of all parent objects on the server are set to the current time. If a *Material* object has been deleted, only ts_{Child} of all former parent objects are set. For a better handling collective timestamps are divided into one for every type of an object's children.

Timestamps are not used for data equalization on the server. Only in hybrid mode, all local changes will be put directly to the server. Otherwise all local changes that cannot be performed immediately on the server (e.g. client is started in standalone mode) are recorded to be processed when the server equalization is started.

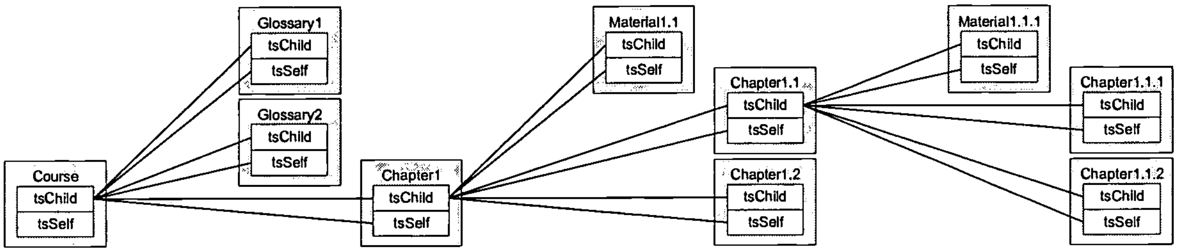


Figure 3. Excerpt of an object tree with the use of timestamps (ts_{Self} and ts_{Child})

Instead of timestamps for client equalization changes may be recorded by the server and sent to the clients. But there is an indefinite number of clients whose local databases could differ considerably, if they exist at all. Trying to keep track of changes by recording them would therefor mean to store records of all changes since the creation of the database for an unlimited period. As this is inexpedient, the method of timestamps is used for updating the clients so they can create (if no local database exists yet) and update their local database by requesting just the needed server objects and comparing timestamps.

Outlook

The hybrid JaTeK system has been integrated in the real learning environments. It now has to prove its stability and usability. Until now the hybrid system can only be administered by editing a property file (e.g. naming the local database and determining the mode, i.e. local, hybrid, or server only). However, a more convenient graphical user interface will be implemented and embedded suitably into the user interface of the clients.

While work at the project is going on not only course data but also Java classes are subject to modification. A mechanism for updating Java class files would ensure that all client components are up to date.

Some data used by teaching content has to be accessed via the network - even if the client database is up to date. In a future version, these data must be stored in the local database to be available in the standalone mode, too.

References

Project JaTeK – Java Based Teleteaching Kit; Dresden University of Technology; URL: http://telet.inf.tu-dresden.de/

JavaTM 2 Platform API Specification; Sun Microsystems; URL: http://www.java.sun.com/products/jdk/1.2/docs/api/

JavaTM Remote Method Invocation Specification; Sun Microsystems, 1998;
URL: http://java.sun.com/products/jdk/1.2/docs/guide/rmi/spec/rmi-title.doc.html

ObjectStore PSE/PSE Pro for Java API User Guide; Object Design, Inc. 1998; Online-Documentation

ObjectStore PSE/PSE Pro for Java API Reference; Object Design, Inc. 1998; Online-Documentation

Barek, W. G. (1998). *Using Macromedia Authorware˜ to design Hybrid CD-ROM/Web Course Related Materials*; in: ED-Media & ED-Telecom 98; Association for the Advancement of Computing in Education (AACE); Charlottesville

Dynes,S., Litchfield, L., Curtis, C., Chiquito, A. (1998). *The Case for database support in Multi/Hypermedia Application Development and use*; 1997; in: ED-Media & ED-Telecom 98; Association for the Advancement of Computing in Education (AACE); Charlottesville

Dadam, Peter (1996). *Verteilte Datenbanken und Client/Server-Systeme*; Springer-Verlag, Berlin-Heidelberg

Farley, J. (1998). *Java Distributed Computing; First Edition*, O'Reilly & Associates, Sebastopol

OCCA: Development of an Institutional Strategy for 'Mass Customization' of Online Learning

Paul Fritze
Multimedia Education Unit
The University of Melbourne
Australia
p.fritze@meu.unimelb.edu.au

Dr. Robert Kemm
Department of Physiology
The University of Melbourne
Australia
r.kemm@physiology.unimelb.edu.au

Abstract: Development and implementation of systems for online learning is a major task for institutions. Policy must be based on a sound pedagogical knowledge and supported by strategic decisions at different levels. This paper examines two studies considering organizational strategies for IT policy. These views are related to the experiences of the individuals in a collaborative development of online learning materials. This development has simultaneously informed the design of a generic architecture for customizable online learning. Projects such as this are the direct outcome of University funding policy. This is high cost/high risk approach not suited to every institution and it is therefore essential to develop understanding of the relationship between policy, project and participants in order to maximize benefits to the institution. It is proposed that grounded analysis of representative projects can be used to more fully inform strategic thinking by management, academics and developers.

Background

Transformation of curricula into more flexible forms is a critical process for institutions in an increasingly competitive education market. Strategies adopted must balance pedagogical needs with rapidly changing technologies and should reflect the culture of the institution. The Multimedia Education Unit (MEU) works in conjunction with faculty units in providing educational design, evaluation, media production, programming and staff development services to faculties. From this position, MEU is well placed to identify and promote strategic approaches to educational technology in the institution. The operational strategies to bring about centralized teaching and learning systems will impact at different levels in the university. For the purposes of this paper, these levels involve the organizational 'climate' created by strategic management counterpoised against the working experience of teachers at the educational coal face, and somewhere between, a supporting technical infrastructure that ties together both sets of requirements. This paper contends that the complexity of decision making associated with institutional approaches to online earning environments requires active consideration and reflection on the interaction between top down and bottom up processes. In attempting to do this, the paper examines a model for strategic management of change in IT (Yetton 1997), its extension to a more functional level guide for online systems (Reid 1999) and relates these views to the actual experience of 'producers' engaged in development and teaching. The case examines one project, the direct outcome of central funding strategies, from the perspectives of the developer of scalable online learning systems and teacher creating innovative learning environments.

Models for Managing IT-based Strategic Change

1. The EIP Study

A study of the strategic approaches to IT in twenty Australian universities has been undertaken for the Department of Employment, Education, Training and Youth Affairs (Yetton 1997). In this, the institutions' performance is analyzed against five key factors: strategy, structure, management process, roles and skills, and technology. The study uses a qualitative methodology, using in-depth, semi-structured interviewing and document analysis to investigate management issues. The strength of the approach is to ground the analysis in the trends and patterns observed in field research, rather than testing only against pre-determined theoretical frameworks.

Strategic choices made by institutions were found to depend on the historical context and capabilities of that institution, recognizing factors such as age, size, resources, location and reputation. To individually prioritize and manage the five key factors would a complex task. What emerges from the study however are certain organizational forms, or patterns of factors, that serve to reduce the overall complexity of decision making. Three distinct approaches were identified, each related to the different contexts of the institutions (Tab. 1). Although more than one approach might co-exist within an institution, it would appear that pressure to reduce differentiation would be experienced. Yetton also anticipates that new models are likely to emerge with changing economic and technical environments. In looking at the organizational configuration as a whole, IT plays a central role in each model as an enabler, not driver.

Model	Description	Difficulties
The 'Old' University *Cottage industry*	IT used to support its elite learning community. Based on maintaining the established base while funding independent new ventures. Successful ventures grow while feeding the institution with their innovations in teaching, learning and research. Attracts high status academic risk takers & innovators. *Provides Control over IP*	Requires strong funding base. *Costly, not scalable*
The 'Divisional' University *Single product approach*	IT supports the success of semi-autonomous faculties. Enabled by powerful central IT structure, devolved powerful faculties develop their own IT technologies, skills & processes according to their interests & competencies. *Low startup cost*	Difficult to manage *Blackbox problem, not scalable, inefficient*
The 'New' University *Mass production approach*	IT is central and critically underpins the strategic agenda. IT based teaching and learning delivered from a separate, centrally resourced unit, building new core competencies. Designed to deliver quality and reliability to large student numbers. *Low startup costs, consistent look and feel*	*Inflexible, high staff development costs, loss of control of IP*

Table 1: Yetton's emerging organizational forms in universities managing the introduction of IT into educational programs and administration. Additional interpretations by Reid are in italics.

The University of Melbourne, to this point at least, has fitted the old university, or cottage industry, model with its strong research culture and tradition of intellectual independence of faculty. A Multimedia Development Fund has seen the distribution of large amounts of money into 'innovative' curriculum projects over a number of years. These have been primarily driven by individuals or small groups and are diverse in their technical and pedagogical approaches. Individual involvement is also encouraged by policies that recognize creative input in any commercialization of intellectual property and the contribution of good teaching practice to staff appraisals. Such a climate has encouraged innovative, and perhaps higher risk, application of new teaching technologies by faculty staff (Taylor 1998). Yetton's model illustrates broad institutional policies to create an organizational climate in which innovation is fostered, although offers little in the way of a decision-making framework for the new online learning infrastructures.

2. Reid's University Strategy for Online Instruction

Reinterpretations and extensions to Yetton's model reflect the emergence of highly scalable and interoperable online learning technologies (Reid 1999 p24). Reid identifies difficulties for each of Yetton's models (Tab. 1) and proposes a fourth model, 'Mass Customization', to address problems of scalability and cost.

Mass customisation model:	Central IT framework provides academic with in house developed tools and templates – interoperable technology supports innovation and experimentation.

In this model, corporate IT systems support extensible frameworks to facilitate innovation and flexibility in the development by the user. For example, templates, simple authoring tools or communication components might be developed to meet particular local learning needs. These facilitate efficient development of learning materials and add value to the provider IP by leveraging off the functionality of corporate delivery and administrative systems. Reid defines criteria for system, producer and user issues for online instruction (Tab. 2). With these guidelines Universities can respond rapidly over time, according to the economic, social and technical environment. These criteria provide another perspective from which to generate policy for the development of online resources, extending Yetton's broader organizational models to address system issues in greater detail.

System Issues	1. Extensibility and interoperability: Open systems, rather than 'black boxes', allow flexibility in structuring and efficient use of materials. Online frameworks are supported by corporate IT systems. 2. A critical choice: Functionality vs. interoperability and extensibility Degree of functionality as a determinant for product selection comes only after conditions for integration with corporate systems and broader adoption across the university are met. 3. Security Consistent authentication and administration systems across the university
Producer Issues:	1. Role of subject developers: Sustainable processes by online subject developers and support by IT support staff. 2. Role of application developers Continuing creation of system components and applications according to accepted standards provided by central systems and online frameworks
User Issues:	1. Access to materials 2. Usability: Minimized complexity for staff and students

Table 2: Reid's criteria for judging policy for development of online resources.

The Online Courseware Component Architecture (OCCA)

OCCA is an online component framework under development at the MEU that displays many of the elements identified by Reid in his Mass Customisation model. It's aim is to support creation of rich interactive learning customized to local requirements, while ensuring that both software and pedagogical techniques are scalable and transferable (Fritze & Welch in press). The component architecture is viewed here from Reid's perspectives of functionality, extensibility and scalability.

Functionality

From a teaching perspective, OCCA provides a mechanism for academic staff to create various forms of online learning activity to solve their local teaching problems and create novel and flexible forms of learning activity. These could involve, for example, customized interactive interfaces, techniques for reflective & open-ended questioning or group interaction environments. Educational requirements targeted include:

1. customized interactive user interfaces to discipline knowledge;
2. provision of customized feedback in response to a student's actions;
3. support for learning activities involving subjective knowledge;
4. capacity to design learning sequences that can incorporate elements of face to face interaction; and
5. provision of reflective summaries and overviews of the learning experience for both student and teacher.

Such requirements have been derived directly from the experiences gained working with faculty teaching staff on many real course projects over a number of years.

Extensibility and Interoperability

As a technology for online component scalability and inter-operation, the OCCA specification regularizes communication between conforming Web components devised in Shockwave, Java, JavaScript or HTML. It uses open protocols for information transfer including XML and a 'State Description Protocol' (SDP), with which 'snapshots' of arbitrary interactive Web pages can be saved, recalled or analyzed.

The online OCCA browser activity may involve user interface components such as forms elements and/or interactive Java or Shockwave interface objects, supported by generic OCCA 'glue' components (Fig. 1). The key to the inter-operation of these components is the SDP description of the page. As well as providing the means to save and restore the state of customized pages to a database, additional functions can be independently developed to provide specialized feedback, navigational management or access to SDP database records. For example, SDP records can be recalled from the database and embedded dynamically into other OCCA pages.

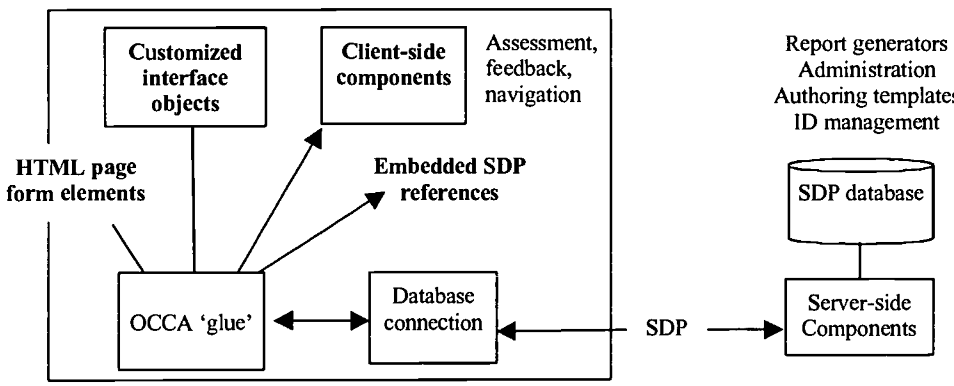


Figure 1: OCCA component and protocol framework. Visible browser page objects are in bold text.

Perspectives on the development and implementation experience of OCCA

In order to better understand the full range of processes by which a frameworks such as OCCA occurred, a reflective history of the development of OCCA and the earlier Learning Engines project is currently being undertaken. This is intended to make visible the coal face complexity of a real project development and to reveal models by which this complexity can be managed. This research is intended to complement that of Yetton and Reid by relating the bottom up experience, discovered through a grounded theory methodology, with top down strategic models (Glaser & Strauss 1967). Preliminary findings are given from the perspectives of the MEU developer focussing on scalable online solutions and teaching staff engaged in creating innovative learning environments. While the experience of this involvement is unique and does not by itself define any model to be adopted, the intention of this research is to better inform management decisions for IT at an institutional level.

Framework Developer Perspective

The current implementation has evolved out of prior work in the Learning Engines project (Fritze & Ip 1998), the Virtual Apparatus framework (Ip et al 1997) and Component-based Object Library (Ji 1998). Development has also depended on collaborations with numbers of independent faculty projects, but involved only a small number of MEU staff until the later stages of the project. Some characteristics that emerged:

1. The basic aim of the project, to provide a component based online component-based framework for rich learning activities, on the surface remained constant, but understanding of the pedagogical structures and specific technical implementations evolved significantly.

2. The framework progressed through a number of distinct phases, identified by different collaborative involvements, technical and pedagogical approaches, descriptive vocabularies and personal experiences.
3. The researcher/developer maintained substantial control of the framework technical and functional design until the transition and production phases of the project, when substantial shifts in roles occurred.
4. The continuous pedagogical input from involvement with a number of independent curriculum projects played a large part in the shaping of the functional operation of the framework (Fritze et al 1998b).
5. Although the project is now being integrated into general University IT strategy, the development process progressed along a number of 'dead end' directions, at times causing stress as different approaches were explored and rejected.
6. The online environment necessarily involves of a number of parallel technologies and is fraught with technical challenges not present in equivalent stand alone developments. These are particularly prominent at the interfaces between technologies, for example between Shockwave, Java and Javascript.

Teacher Perspective

One of the main faculty projects associated with Learning Engines and later, OCCA, involved the development of tutorial systems for the department of Physiology. The project involved the writing of online materials extending across 24 weeks of campus-based tutorial workshops to make up time otherwise spent in lectures. The online techniques complemented the use of commercial applications and locally developed, highly interactive, single use CAL programs. The purpose of the customized online materials was to create an environment for timetabled workshops that would stimulate student thinking in a manner that had proved difficult with other approaches, such as using the TopClass learning framework. The aim was to develop the techniques that could be implemented as an ongoing process by local teaching staff. The experience of collaborating in the development of these online techniques was characterized by:

1. The need to work pragmatically with different versions of the software, adapting to the incomplete functionality where necessary, while still addressing the desired pedagogical approach
2. The online component technique made possible forms of interactions not possible with alternative approaches, e.g. particular question activities that involved sorting complex processes or use of a free form graphing object
3. Unexpected benefits could arise from situations where limits were reached with software implementations, leading for example, to improved understanding of computer supported collaborative classroom environments.
4. Teaching ideas developed as a result of 'negotiation' with developer over desired vs. possible functionality.
5. On campus collaborative learning within supported timetabled workshops has great potential. A close hands on involvement with classes needs to be maintained, for example to appreciate the cultural variation across student groups.
6. The availability of funding was a prime enabler for the exploration and development of new ideas for teaching.
7. Participation in conferences, seminars and academic papers provided valuable opportunities for reflection, development of ideas and documentation.

Discussion

For the University, OCCA fits the many of the criteria proposed by Reid for functionality, extensibility and scalability in an online learning environment. This is the 'mass-customization' model in which a centralized framework supports continuing innovation and customization of materials at various levels of involvement. Systems-focussed criteria however, while interesting to apply retrospectively, or in selecting between existing products, are fairly blunt instruments with which to guide the development of generic and innovative strategic frameworks. Reid's suggestion that functionality *follows* interoperability and scalability as 'the major determinant for product selection' is against our experience. We have found that the rapid evolution, problematic nature and complexity of online technologies demand a close connection between developer and academic teacher. The complexity of this connection was illustrated in the development history of OCCA and further grounded studies of this type should be used to inform strategic decisions coming from above. The balance between individual, faculty and institutional control will continue to fluctuate in response to changes in technology and environmental pressures.

The 'Old' University approach can foster an environment in which ideas and innovations can be successfully incubated. It is important however, that successes from this environment are effectively transferred into broader use within the institution or beyond. The development of OCCA was enhanced by ability to link developers and faculty teaching staff in real projects across a cross-section of discipline environments. The developing model could be subjected to a wide variety of probing from discipline, pedagogical and technical requirements. This approach however was characterized by directional changes and frustrations. In adopting such approaches, it is important for the both institution and participants to acknowledge the nature of these processes and the inherent risks involved.

The EIP study is an interesting snapshot of strategic IT practices of a cross-section of Australian universities and further broad studies like it are required to maintain pace with technological and social change. Deeper understanding of institutional development cultures and activities is also required to optimize strategies for transformation of teaching and learning with IT most appropriate for each institution. Grounded theory analysis of representative projects is one way in which strategic thinking by management, academics and developers can be informed.

References

Fritze, P., & Ip, A. (1998). Learning Engines - a functional object model for developing learning resources for the Web. *Proceedings of the ED_MEDIA & ED-TELECOM 98 Conference*, Frieburg.

Fritze, P., Johnston, C., & Kemm, R. (1998b). Structured open-ended learning activities using client-side interactive objects. *Proceedings of Flexibility: The Next Wave? Conference*, Australasian Society for Computers in Tertiary Education (ASCILITE), Wollongong.

Fritze, P. & Welch, S. R. (in press) Foundations of a component framework for rich online learning activities. *Proceedings of New Millenium, New Technology, New Worlds of Learning Conference*. Apple University Consortium Conference 2000, Wollongong.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: strategies for qualitative research*. New York: Aldine de Gruyter.

Ip, A., Canale, R., Fritze, P., & Ji, G. (1997). Enabling Re-useability of Courseware Components with Web-based Virtual Apparatus. *Proceedings of the What Works and Why Conference*, ASCILITE'97, Perth.

Ji, G., Ip, A., Canale, R. & Fritze, P. (1998). Keep the web server cool: a proposal for server-side object development for online courses. *Proceedings of Flexibility: The Next Wave? Conference*, Australasian Society for Computers in Tertiary Education (ASCILITE), Wollongong.

Reid, I. C. (1999). *Beyond models: developing a university strategy for online instruction*. Journal of asynchronous learning networks, 3(1), 19-31.

Taylor, J. (1998). *Strategies for transforming teaching and learning using multimedia: cultural change in university teaching*. Report commissioned by the University of Melbourne.

Yetton, P. (1997, March 1997). *Managing the introduction of technology in the delivery and administration of higher education*. Department of Employment, Education, Training and Youth Affairs. Available: http://www.deetya.gov.au/highered/eippubs/eip9703/front.htm [1999, 24.10.99].

The Reflection Assistant: Investigating the Effects of Reflective Activities in Problem Solving Environments

Claudia Gama
School of Cognitive and Computing Science
University of Sussex
Brighton UK - BN1 9QH
claudiag@cogs.susx.ac.uk

Abstract: This paper presents theoretical issues about the role of metacognition in learning, as well as the architecture and design of a learning system dedicated to monitoring and helping students to use their metacognitive skills. This system is called the Reflection Assistant and is supposed to be used together with problem solving or case-based learning systems. Thus, through interactions with the Reflection Assistant during problem solving activities, students can also improve their metacognitive skills (such as planning, self-monitoring and assessing), as well as their knowledge in the specific domain. The purpose of this research is to investigate better means to increase metacognitive knowledge, including awareness on the learning process and capacity of transferring skills to new learning situations. The motivation for this research is that it is necessary to focus as much on the metacognitive processes of problem solving as on the cognitive ones to develop good problem solvers.

1. Introduction: Theoretical Issues

1.1 Metacognition and Learning

The argument that drives this research is that metacognition plays a major role in cognitive development. Thus, enabling students to develop a conscious, explicit model of their metacognitive skills by means of reflective activities facilitates the improvement of both cognitive and metacognitive expertise.

Research in the area of cognitive psychology (Flavell, 1976, 1979, Schoenfeld, 1987, Derry, 1992, amongst others) shows that an important type of knowledge underlying the construction of complex representations and solutions strategies is *metacognitive knowledge*. Metacognition refers to a cognitive system's intelligence about itself and its ability to regulate and control its own operation. So, knowing about one's own cognition forms the basis for most metacognitive abilities. These abilities include knowledge about one's perceptions, memories, decisions, and actions (Shimamura, 1994, p. 253).

Metacognitive knowledge can be divided into three related but distinct categories of intellectual behavior (Schoenfeld, 1987):

Knowledge about thought process

This is related to people's ability to accurately assess their knowledge and knowledge acquisition process. In a learning situation one of the final goals is to help students develop good study skills. Those skills depend, in part, on students' ability to make realistic assessments of what they can learn. Hence, it is important to know how likely it is that students will reflect on their thinking and how accurate those reflections will be.

Control and Self-regulation

This aspect of metacognition is related to the monitoring of cognitive activities. One way to look at this aspect of metacognition is to think of it as a management issue, i.e., how well one manages her time and effort, as she is involved in cognitive tasks. In the context of learning self-monitoring or self-regulation refers to an individual's ability to conduct on-line self-checks of the problem solving process, for example; a skill that is particularly important when the student deals with an ambiguous or confusing problem. Thus, this self-regulation could provide the student with information to guide her problem solving actions.

Beliefs and Intuitions

These are related to the ideas about a learning topic that the student brings to her work, and how it shapes the way the student faces the topic.

Another important aspect of learning is transfer. Educators hope that students will transfer learning from one problem to another within a course, from one year in school to another, between school and home, and from school to workplace. Transfer can be improved by helping students become more aware of themselves as learners who actively monitor their learning strategies and resources and assess their readiness for particular tests and performance. Metacognitive approaches to instruction have been shown to increase the degree to which students transfer to new situations without the need of explicit prompting (Bransford et al., 1999).

1.2 Problem Solving, Metacognition and Reflection

According to Schoenfeld (1987), problem solving activities can be divided into three conceptual stages, named: Preactive (activities performed before starting to solve the problem), Interactive (activities performed as the student works on the problem) and Postactive (all those activities performed after finding a possible solution to the problem). Considering these conceptual stages, three important metacognitive processes can play a major role: planning (mainly in the preactive and also in the interactive stage), self-monitoring (in the interactive stage) and assessing the problem solving efforts (in the postactive stage).

Metacognitive processes are important contributors to problem solving performance across a wide range of domains (Davidson et al., 1994). In problem solving situations there are always metacognitive processes involved, such as (1) identifying and defining the problem, (2) mentally representing the problem, (3) planning how to proceed, and (4) evaluating what you know about your performance.

The successful application of these metacognitive processes depends on characteristics of the problem (if it is a well-structured or an ill-structured problem), the problem solver, and the context in which the problem is presented. To the extent that what is desired is to identify and develop good problem solvers, what is needed is to focus as much on the metacognitive processes of problem solving as on the cognitive ones (Davidson et al., 1994).

Hence, it is important that students can recognize and explore their own metacognitive processes. Reflective activities encourage students to analyse their performance, contrast their actions to those of others, abstract the actions they used in similar situations, and compare their actions to those of novices and experts. The reflection on the metacognitive skills can bring awareness of their thought process and increase their capacity of transferring these skills to new learning situations. Fig. 1 summarizes the interrelationship between the problem solving conceptual stages, the metacognitive processes, and the role of reflection in this context.

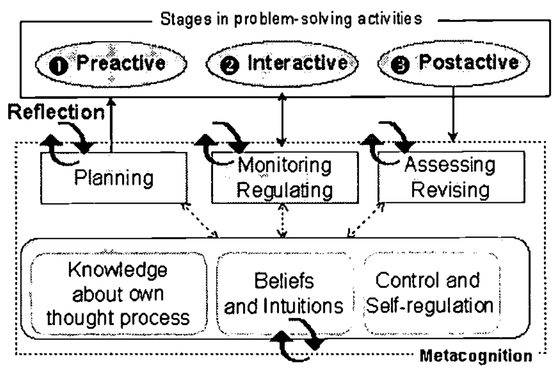


Figure 1- Metacognition, Reflection and Problem Solving

2. The Design of the Reflection Assistant

BEST COPY AVAILABLE

The Reflection Assistant is be a specialized system that monitors, analyses and improves student's metacognitive skills in problem solving situations. It is still in the design phase (it has not been implemented yet). It is designed to be used in combination with different problem solving systems (e.g.: mathematics problem solving systems, case-based medical system, geometry system, etc.). Indeed, the Reflection Assistant is disjoint of the specific domain learning system, and it has to be configured accordingly to the specific domain that it will be applied.

The two major goals of the Reflection Assistant are:

(1) Create learning environments that afford and encourage metacognitive processes.

(2) Improve metacognitive skills development in general and thereby enable the transference of these skills to future learning situations.

Through graphical tools and specific activities the Reflection Assistant makes perceptible to the student certain metacognitive skills used in distinct moments of instructional activities. Thus, initially students can use these mechanisms to monitor their learning process and become aware of the metacognitive strategies they are using when engaged in problem solving activities. After that, in a subsequent phase they can use appropriate mechanisms to help them to improve these metacognitive strategies.

The important points this research aims to investigate are:

(a) The appropriate timing for providing metacognitive scaffolding and reflection on the problem solving process.

(b) The effective balance between reflection focused on the learning task (domain specific) and reflection on general metacognitive skills (domain independent) for a particular problem solving situation.

2.2 Description of the Reflection Assistant

The Reflection Assistant contains four main components. The general architecture is shown in Fig. 2 and the function and characteristics of each component are explained.

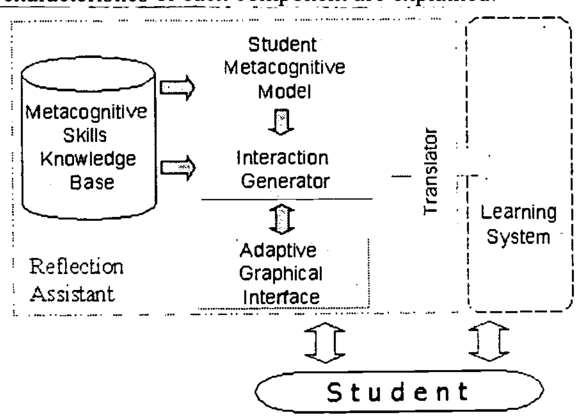


Figure 2 - Architecture of the Reflection Assistant

Metacognitive Knowledge Base

This component has detailed information about metacognitive skills used in problem solving situations. Each metacognitive skill is described in the Reflection Assistant in terms of variables, which may have their values modified according to the importance that the specific skill plays in the specific domain.

Student Metacognitive Model

This is responsible for recording the student's responses and keeping track of the student's performance. The Student Metacognitive Model uses information from the Student Log and from the Metacognitive Knowledge Base to generate a structured model of the student's metacognitive capabilities and progress.

This model informs the kind of assistance that should be provided to a particular student and also serves as an inspectable model for the student (in other words, the student can also view her use of strategies).

Interaction Generator
This component combines information provided by the Student Metacognitive Model and Metacognitive Knowledge Base to elaborate the content and format of the metacognitive activity proposed.
Translator
This is the communication mechanism (or protocol) that will make possible the integration of the Reflection Assistant with the learning system. There is a two-way communication between the two systems: (1) the learning system provides information about the actions of the student during her interaction (in the format of a log file); then, the Translator interprets this information and a metacognitive log is created in the Reflection Assistant. (2) The reflection assistant sends suggestions of possible new actions to the learning system, so adapting the teaching strategy according to the student metacognitive model.
Despite being decoupled from the learning system, the Reflection Assistant is not completely independent of it. It keeps an intermediate level of interaction with the system through a communication channel. This interaction is reflected in the architecture of the system, where its main components need to contain several parameters that are modified depending on the circumstances under which the assistant is used (i.e., the specific learning system to which the Reflection Assistant will be associated with or the kind of reflective activities relevant to a specific domain or for certain problems).

2.3 The Different Types of Reflective Assistance

Following the idea of dividing the problem solving activities into three conceptual stages (as explained in section 1.2) the Reflection Assistant can be used in different configurations. The reflection activities can happen either before starting a new problem/case; or during the interaction with the problem/case; or even after finishing the problem/case. A specific visualization method will be selected depending on both the timing of the reflection and the particular metacognitive skill emphasized (c.g.: planning, monitoring, etc.). Indeed, the combination Metacognitive skills - Timing - Visualization method (or approach) is determined by the characteristics of the domain and task and, also the student's preferences. Besides that, the degree of specificity of the behavior of the assistant depends on the level of integration between the Reflection Assistant and the Learning Environment. This integration is generated by the amount of information provided by the problem solving system to the Reflection Assistant's Translator.
To organize these different arrangements the system provides three basic types of assistance, corresponding to a particular moment of the interaction. Before solving a new problem (or case) the Preparation to Reasoning Assistant helps the student to recall previous knowledge or studied cases. While the student is trying to solve the problem he can interact with the Support to problem solving Assistant. And, finally, after finding a solution, the student could use the Reflective Follow-up Assistant that provides means to reflect on the performance in the task and the general progress. These assistants aim at providing structured support to the student, establishing ``check-points" to reflect over the learning process. The kinds of assistants that comprise the Reflection Assistant and which metacognitive skills (or processes) they are mainly related to are detailed below.
Preparation to Reasoning Assistant
Questions like *What prior knowledge can help me with this particular task? What do I need to know before I can successfully deal with this task? What should I do and in which order? How much time do I have to complete the task?* drive the activities proposed by this assistant. The idea is to anchor new concepts into the learner's existing cognitive knowledge to make them retrievable. The aim of this assistant is to prepare the student for the problem solving activity, promoting reflection upon the necessary skills to solve the problem, more specifically, the capacity to recall previous knowledge and make generalizations.
Sometimes the reflection process does not occur, in part because students are not really motivated to perform reflection after solving the problem and in part because the current problem solving medium (paper and pencil) does not really lend it self to this activity (Collins, A. & Brown, J. S., 1988). Because the Reasoning Assistant is going to be used before the learning activity takes place, it may contribute to bypass problems of low motivation.
Support to Problem Solving Assistant
This assistant offers a means for monitoring the student's plan of action. It helps the student during the cognitive activity with mechanisms to reflect on the necessary skills to solve a problem, making

them think about, among other things: *How am I doing? Am I on the right track? How should I proceed? Should I move in another direction? What do I need to do if I don't understand?*
Also an important point is to use the Reflection Assistant as a means to aid the student when she feels *stuck*. Thus, the Support to problem solving Assistant should provide support for students to seek for clarification and to reexamine their problem solving strategy.

Reflective Follow-Up Assistant

After concluding the cognitive task the student can use this assistant to verify her performance and compare it with previous interactions. Here, generalizations are again used to help the student to organize the case or problem studied into a general knowledge framework. Examples of common points to reflect on in this moment can be:
Did my particular course of thinking produce more or less than I had expected? What could I have done differently? How might I apply this line of thinking to other problems?

2.4 The Design of the Reflective Follow-up Assistant: First Prototype

There are several points to take into account in the development of such a learning system. The abstract nature of the metacognitive processes is indeed a major concern. Also, the graphical tools used to represent these processes have to be adequately developed. Moreover, these tools and metacognitive processes probably vary from one student to the other, depending of their own characteristics.
So, in order to collect information about all these factors that influence the whole system, some initial studies are being performed. As part of this initial phase a first version of the Reflective Follow-up Assistant is being designed and will be used with the PATSy system. PATSy (Patient Assessment Training SYstem) is a case-based interactive learning environment that keeps a database of medical cases in the domain of aphasiology (Lum & Cox, 1998, Cox, 1999). PATSy provides a context in which students may practice diagnosis via deductive reasoning. Thus, the Reflection Assistant will help students to monitor their reasoning process. PATSy keeps an electronic log of all actions performed by the student (sequence of clinical tests chosen, cases studied, etc.).
The first version of the Reflective Follow-Up Assistant will provide two types of information: quantitative assessment and qualitative assessment of the metacognitive skills used during interaction with the PATSy system. Fig. 3 (a,b and c) show mock-ups of this prototype.

Quantitative Assessment

After each session with the PATSy system students will see a graph showing the time spent in cognitive and metacognitive activities. For example, Fig. 3a shows a sample graph of a student. Using that, the student can see graphically the amount of time spent analysing the problem, planning, studying previous cases or solutions and attempting to solve the problem. Other information provided are the moments where the student reflected on her studying process. PATSy already provides some questions that should help students to step back and ask *what they want to do next*. Further information generated is the summary of the total amount of time spent in the task.

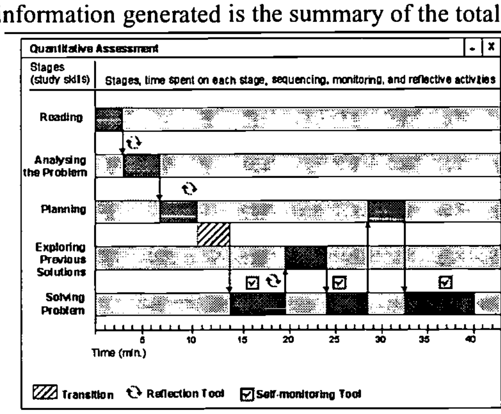


Figure 3a - Quantitative Assessment (sample 1)

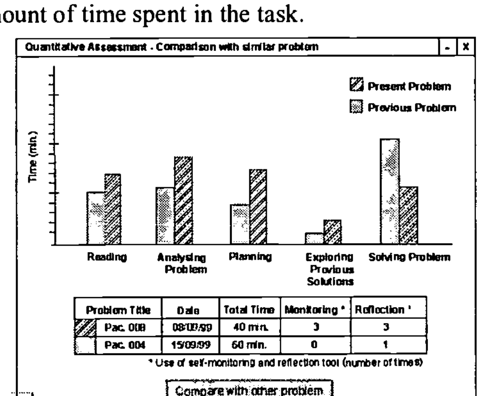


Figure 3b - Quantitative Assessm. (sample 2)

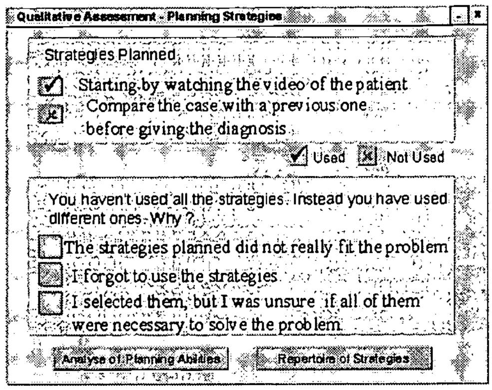


Figure 3c – Sample of Qualitative Assessment

Another graph from the quantitative assessment is shown in Fig. 3b. It is a graphical comparison between the performance in the present case and in previous cases. Another possible comparison could be between the performance of one student with those of other students.

Qualitative Assessment

This kind of assessment aims at providing more detailed explanations to the student about how to improve her metacognitive skills. It is achieved by asking questions about the student's performance. For example, Fig. 3c shows a qualitative assessment of the planning skills of one student. The student is invited to explain why she failed in using the planning strategies she proposed to use at the beginning of the task. The idea is to make the student to reflect on the importance of a good plan of action that has to be followed during the problem solving. In addition, the system will to provide scaffolding to increase the planning abilities of that student.

3. Conclusions

This research investigates better means to make students learn important self-monitoring and other metacognitive skills in computer-based problem solving environments. The final goal is the design of a new learning environment that extend the possibilities of interactive learning systems, giving students opportunities for reflection, revision and feedback over their problem solving efforts.

This paper has presented the design of the Reflective Follow-up Assistant Module to be used in the postactive stage of problem solving. It focuses on both quantitative and qualitative assessments of students' performance. More work has to be done in the design of the other modules of the Reflection Assistant: the Preparation to Reasoning Assistant and the Support to Problem Solving Assistant.

A distinguished characteristic of the Reflection Assistant is that it is both a domain independent system and also maintains an intermediate level of interaction with the learning system that uses it. The granularity of interaction is an interesting point of investigation. This relates to the tension between teaching metacognitive skills within a particular context and ensuring their transferability to other contexts. Some initial studies have been done and the first prototype is under development.

References

Bransford, J. D. , Brown A. L. & Cocking, R. R. (Eds.) (1999). *How People Learn: Brain, Mind, Experience, and School.* National Academy Press. Washington, DC.

Collins, A. & Brown, J. S. (1988). The Computer as a Tool for Learning Through Reflection. In Mandl, H. & Lesgold, A. (Eds.), *Learning Issues for Intelligent Tutoring Systems.* Springer-Verlag.

Cox, R. (1999). Modelling the Diagnostic Reasoning Skills of Expert Clinicians and Students in the Domain of Aphasiology. *Proceedings of C-LEMMAS: Roles Communicative Interaction in Learning to Model in Mathematics and Science*. Brna, P.; Baker, M. & Stenning, K. (Eds.).

Davidson, J. E. et al. (1994). The Role of Metacognition in Problem Solving. In Metcalfe, J. & Shimamura, A. P. (Eds.), *Metacognition: Knowing about Knowing* (pp. 207-226). The MIT Press.

Derry, S. J. (1992). Adaptative Learning Environments - Foundations and Frontiers. In Jones, Marlene & Winne, Philip H. (Eds.), *Metacognitive Models of Learning and Instructional Systems Design* (pp.257-286). Springer-Verlag Berlin Heidelberg: Nato Asi Series Books.

Flavell, John H. (1976). Metacognitive Aspects of Problem Solving. In Resnick, Lauren B. (Ed.), *The Nature of Intelligence.* Lawrence Erlbaum Associates.

Flavell, John H. (1979). Metacognition and Cognitive Monitoring. *American Psychologist Journal*, 34 (10), 906-911.

Lum, C. & Cox, R. (1998). *Patsy: A Case-Based, Distributed Multimedia Approach to Patient Assessment Skills Training*. WWW document: http://www.cogsci.ed.ac.uk/~rcox/patsy_paper/PATSy.html

Schoenfeld, A. H. (1987). What's All the Fuss About Metacognition? In Schoenfeld, Alan H. (Ed.), *Cognitive Science and Mathematics Education*. Lawrence Erlbaum Associates.

Shimamura, A. P. (1994) The Neuropsychology of Metacognition. In Metcalfe, J. & Shimamura, A. P. (Eds.), *Metacogntion: Knowing about Knowing* (pp. 253-276). The MIT Press.

Acknoledgements

This research is supported by a grant from CNPq-Brazil no. 200275-98.4. The author would like to thank Prof. Benedict du Boulay for his comments and suggestions on this paper.

Pedagogical and Instructional Modeling via On-line Assistants

Penny Ann Garcia, Ph.D.
Department of Human Services and Professional Leadership
College of Education and Human Services
University of Wisconsin Oshkosh USA
E-mail: garcia@uwosh.edu

Abstract: Classroom teachers' comfort and familiarity with computers and software influences student-computer use in the schools. Too often teachers and students remain mired in repetitive preoccupation with basic software mechanics to the neglect of interaction with the content at hand. To offload these tasks onto the software, an On- Line Assistant (OLA) was developed to accompany the commercial hypermedia software, HyperStudio. This OLA introduced the software, provided a framework for students to storyboard projects, sequentially introduced software mechanics, and suggested basic principles of good design. The impact of this OLA on the nature of classroom interactions and on the quality of projects produced was investigated. Control group students used the hypermedia software alone and the experimental group used the software with the OLA. Projects employing the OLA were consistently rated higher than those using software alone. Student usage of the OLA significantly reduced interactions dealing with basic software mechanics while significantly increasing interactions concerning design, stack issues, and content. Interactions significantly increased for the experimental group in the areas of advanced software issues, design, stack issues, and content. The OLA did not diminish the teacher's role but perceptibly shifted the nature of interactions to those areas requiring higher order cognition.

Introduction

The use of computer technology in today's schools is often limited by educators who feel overwhelmed by the demands placed upon them to become proficient at the hardware, the software, and curriculum development simultaneously (Howe & O'Shea 1980). The majority of educators are familiar with computer usage at a second state level of technological innovation (Maes 1994). At this level the computer is used in conjunction with existing technologies to do what can already be done albeit more efficiently. The majority of software developed over the past thirty years has reflected this second level of innovation. Computer assisted instruction has long focused on replicating the traditional classroom model of top-down teaching, drill and practice, and teacher directed learning (Naisbitt 1982; Glasser et al. 1988). However, later research began to acknowledge learning as a constructive process (O'Shea 1979; Druin 1998; Ennals 1983). Recent innovations in intelligent agents have pointed towards a collaborative partnership between computer and student (Lockard et al. 1997).

New epistemologies of learning are emerging that indicate a dichotomy between theorists' accounts of cognition and the actual practices of people in learning activities (Perkins 1993). It is increasingly evident that cognition does not reside entirely in the individual mind but may have portions of it distributed among other people and simple or complex tools (Papert 1980). One subset of the current work on distributed cognition is *off-loading* which occurs when a person places some of the cognitive burden for performing a task onto another person or tool (Salomon 1993). This can be a positive condition such as when one creates a list of items rather than trying to carry those items in memory. However, it can be a negative experience in the classroom. Educators have long assumed portions of students' cognitive burden when they make all the choices about what to study, how to study it and what resources to use. In computer usage, this off-loading is part of what makes meaningful integrated computer usage so overwhelming to teachers. It is simply too much to be the expert on the hardware, the software, and the curriculum while simultaneously planning the implementation of the project with integrated computer support.

The use of an on-line assistant, or OLA, can facilitate off-loading some of the teacher's responsibilities onto the OLA smoothing the way for better computer integration into the learning experiences of students. With this support, students are able to assume responsibility for learning the mechanics of the software and for planning projects. This study focused on the addition of an on-line assistant to commercial hypermedia software (HyperStudio) and the subsequent impact on the quality of the completed project, the nature of teacher/student interactions, and the nature of student/student interactions.

Study Design

A quasi-experimental design was used in this study. Two existing, intact 4th grade classrooms of nine year olds from an urban school were used as the experimental and control groups. Random assignment of subjects to groups was precluded. A nonequivalent posttest-only control group design was employed. Both classrooms and their teachers were pretested to determine familiarity with the basics of the commercial software program to be used in the study. In addition, NCE scores on the Iowa Test of Basic Skills were compared between the two groups. These comparisons determined initial equivalence of the experimental and control groups.

Both groups used HyperStudio to develop a project consisting of a stack with a minimum of five cards. Both groups had access to HyperStudio software as well as their classroom teacher. The control group of 22 students used the software in its unedited form while the experimental group of 23 students had access to an on-line assistant (OLA) developed by the researcher to assist students in planning their project, in learning the HyperStudio software, and in developing awareness of rudimentary design elements. Quality of the finished HyperStudio projects was assessed for both groups to determine effectiveness of the treatment.

Teacher/Student and Student/Student interactions were evaluated in both groups. Interactions in the following seven areas were tallied daily: Software issues - basic (new cards, buttons, text boxes); Software issues- advanced (graphics, transitions, new button actions); Design issues (color, font, layout); Stack issues (linking and layout); Spelling and Grammar; Content material (appropriate content); and, Content composition (appropriate discourse form).

Hypermedia projects completed during the research period were collected, copied, and distributed to raters. The MEDIA HCI Design Evaluation (Druin 1998) was used to assess four areas: *Reaction to Visual Design* (card layout and design, organization of information, and sequence of cards); *Reaction to Stack Construction* (user interface with the stack); *Reaction to Content* (content and presentation of information); and the *Overall Reaction to Stack.*

The teacher of the classroom using the software with OLA was interviewed to discuss her reactions to the presence of the on-line assistant, how effective she felt it was with her students, and her general reactions to helping students develop a project using HyperStudio. Her students were surveyed to assess their acceptance of the OLA. Additionally, an exit interview was held with the teacher of the classroom that used the software alone to discuss her reactions to helping students develop a project using HyperStudio.

The On Line Assistant

The researcher developed an OLA whose persona was based on Addy, a dog that already periodically appears in existing dialogue boxes in HyperStudio. It was felt that the appearance of Addy both in dialogue boxes and as the OLA would maintain consistency within the software. The name of the OLA service was *Ask Addy* and it first assisted the students in designing a HyperStudio stack by introducing a storyboard approach to design. This component of the OLA sent the students off-line to develop a storyboard. Students consulted with their teacher on the storyboard's links and content. The completed storyboard served as the working plan to be followed when students returned to the software to begin stack construction.

Upon returning to the software to begin stack development, the OLA sequentially guided the student through a series of steps. First, students created each card with only text boxes and content inserted in those boxes. Next, the portion of the OLA was brought on-line to assist students in adding buttons. After students had demonstrated their stack to their teacher the next portion of the OLA was added which assisted students in adding graphics to their existing cards. Finally, the OLA offered advice on modifying existing text and button objects. Concurrent with the on-line components that addressed adding and modifying buttons and graphics, the availability of design hints were added. These design hints covered such items as choice and variety of fonts, color selection, and button transitions.

The researcher developed the OLA using HyperStudio software. The OLA was implemented as a series of independent stacks, each linked to a menu card that was in turn linked to the cards in the students' stack. This enabled the researcher to bring various components of the OLA on-line sequentially throughout the experimental period. To manage memory size, the OLA contained only text and graphics. No voice or animation features were included. This sequential introduction of the OLA enabled a certain amount of control over the students' process.

Research Results

Results of the study suggest that the presence of an OLA significantly impacts the quality of students' completed hypermedia projects. There was a significant difference between the holistic quality scores of the completed projects of the group using software with the OLA and the quality scores of the group using software alone. The results of the MEDIA HCI Design Evaluation forms showed that the mean holistic score of the stacks completed by students in the group using the OLA was 38.9 points higher than the mean of those students using the software alone. See Table 1 at the following URL: http://www.coehs.uwosh.edu/faculty/garcia/addyres.htm.

To measure the *nature* of teacher/student and student/student interactions, seven areas were chosen for consideration. These seven areas formed a hierarchy of possible interactions. At a rudimentary level, the frequency of interactions concerning basic software issues about mechanics of the HyperStudio software and spelling and grammar was measured. Then interactions about advanced software skills such as importing graphics and specialized button actions were measured. Next, interactions were measured that required the application of more complex thinking skills such as design issues, stack issues, content material and content composition. Finally, the sum of the total number of interactions in all seven areas was computed and analyzed.

Results of the study suggest that the presence of an OLA positively impacts teacher/student interactions by increasing the number of interactions concerning areas that require higher-order thinking skills while reducing the number of interactions concerning basic software issues. There was no significant difference in the total number of interactions between teacher/students in the group using software with the OLA and the group using the software alone. However, a shift in the *nature* of teacher/student interactions could be seen as indicated by the frequencies of interactions occurring at the differing levels of complexity. The observed pairs in the group using software with the OLA had significantly fewer interactions with their teacher about basic software issues. while there were significantly more interactions in the complex areas of design issues, stack issues, content material, and content composition. See Table 2 at the following URL: http://www.coehs.uwosh.edu/faculty/garcia/addyres.htm.

Further results of the study suggest that the presence of an OLA positively impacts student/student interactions by increasing the number of interactions between students concerning areas that require higher-order thinking skills. There was no significant difference in the total number of interactions between student/student in the group using software with the OLA and the group using the software alone. However, a shift in the *nature* of student/student interactions could be seen as indicated by the frequencies of interactions occurring at the differing levels of complexity. There were significantly more interactions between students in the observed pairs in the group using software with the OLA in the areas of advanced software issues, design issues, stack issues and content issues which require the application of complex thinking skills. See Table 3 at the following URL: http://www.coehs.uwosh.edu/faculty/garcia/addyres.htm.

The study results suggest that the presence of an OLA is accepted by students as most useful in helping design a hypermedia project and is an acceptable source for information. All students in the group using software with the OLA completed a Post Treatment Survey. From the responses on this survey it may be concluded that a majority of students found *Ask Addy* to be helpful, easy to understand, and quick to get help. A majority of students would like *Ask Addy* to be able to offer more help than was available in the prototype. However, the majority of students reported that they still had to ask their teacher for help even after using *Ask Addy* and the majority of students felt that they turned to *Ask Addy* less often than they did their teacher. Over fifty percent of the students indicated that *Ask Addy* was most helpful in helping them learn how to design a HyperStudio stack. Secondarily, *Ask Addy* was most helpful in assisting students in learning how to make text boxes. See Table 4 at the following URL: http://www.coehs.uwosh.edu/faculty/garcia/addyres.htm

Finally, results of the study suggest that there is a positive relationship between student acceptance of an OLA and the quality of their completed hypermedia project. Data analysis confirmed that there is a moderate correlation between student acceptance of the OLA and the quality of their completed hypermedia stack. This acceptance of the OLA was indicated by ninety percent of the students indicating that they found *Ask Addy* helpful. Over fifty percent of the students also indicated that they would like to be able to use *Ask Addy* for getting more help. Students indicated that they found *Ask Addy* to be most helpful in the design process and in adding text boxes. This overwhelming student acceptance of Addy's assistance positively correlated with raters' assessment of the quality of students' stacks. See Table 5 at the following URL: http://www.coehs.uwosh.edu/faculty/garcia/addyres.htm.

Discussion of Results

The completed projects of the students in the group using software with the OLA were consistently rated higher than those completed by students in the group using software alone. Although both groups of students had been instructed by their teacher to create a minimum five-card stack, those students in the group using software with the OLA went well beyond that five-card minimum. The greater number of cards in these stacks and the more web-like construction may be attributed to the storyboarding process. The researcher observed that the use of storyboarding did not occur naturally to either teachers or students.

The teacher of the group using the OLA said, "I was pleasantly surprised by the fact that the five-card minimum was never a discussion point with these kids. They got all carried away with their storyboards and connections and put down so many more cards. I thought they'd never complete it but since they had this plan (storyboard) that *they had committed to*, they did it!" It is important to note the italics in the prior quote. The students had committed to the plan because *they* created it. The teacher did not impose the plan; the product was not the emphasis. The storyboard places the emphasis on the process instead. The creation of a storyboard allowed the students to assume responsibilities or *executive functions* (Perkins 1993)– deciding on content, locating resources, arranging those resources– that would have traditionally been off-loaded to the teacher. The storyboarding period provided a rich environment for teacher/student and student/student interactions on the content of the material to be presented in the stack. The group using the OLA showed a significantly higher number of teacher/student and student/student interactions about content material. The bulk of these interactions occurred during the storyboarding period.

The storyboarding process also provided opportunities for the teacher and students to talk about how their stack was constructed. The teacher of the group using the OLA averaged thirty-seven interactions with groups on the stack construction and layout while the teacher of the group using the software alone averaged only five interactions. This lack of interaction was reflected in the smaller stack size and linear design of the students using the software alone. *Ask Addy* was able to significantly reduce the number of teacher/student interactions that dealt with basic software issues. These mechanics form the foundation for all work in HyperStudio and are relatively easy to learn but require much repetition from the classroom teacher in a lab setting.

Total facility with any software is a matter of practice and experience. Educators usually lack the time to develop that facility and are therefore hesitant to move students ahead in a project using unfamiliar software. *Ask Addy* was brought on line sequentially in a manner that facilitated students' completion of their storyboard plan. Initially, *Ask Addy* only provided help in creating new cards and adding text boxes in which to enter text. *Ask Addy* asked that students make all the cards in the stack first before adding buttons and graphics. Because this involved the bulk of the on-line work (word processing) the teacher of this group became concerned. "Will they actually finish this project?" she asked, eight days into the data collection period. Having spent three to four days storyboarding and then another four to five days creating the rudiments of the cards for the stack, it did indeed seem that they were lagging behind. However, the finished products demonstrated that the sequential introduction of skills facilitated that completion of the stacks as originally envisioned by the student.

It is important to note from the data analysis of teacher/student interactions that the addition of an OLA did not significantly affect the total number of teacher/student interactions. However, it did impact the *nature* of the teacher/student interactions. As previously discussed, the storyboarding period required by *Ask Addy* did significantly increase the number of teacher/student interactions related to stack issues, and content material. In addition, there were significantly more teacher/student interactions concerning content composition and design issues during the time spent on-line with HyperStudio stack development. Students' self-assessments of the presence of the OLA also supported the conclusion that the need for a teacher is not diminished by the on-line assistance. Fifty-seven percent of the students indicated that they did not *Ask Addy* for help more than they asked it of their teacher. The same percent of students also reported having to ask their teacher for help even after asking Addy for assistance.

The total number of student/student interactions was also not significantly different in observed pairs in both groups. Again, however, the *nature* of that interaction was different as observed in the frequency of interactions in the areas of advanced software issues, design issues, stack issues, and content material. As previously discussed, the story boarding period provided an environment in which students could have intense discussions on stack design and content material. During the actual stack production period on the computer, student/student interactions in the group using the OLA gradually shifted to design issues, advanced software issues, and appropriate discourse form for this media. These students actively debated over the quantity of print versus the ability of pictures to tell a story. They discussed what *Ask Addy* listed as good principles of basic design, deciding whether to listen to her advice or discard it in the interest of curiosity and personal taste.

An another interesting phenomena occurred as individual groups were freed by the OLA to move ahead with more advanced techniques. Groups or individuals began to emerge as resident-experts on specific techniques which resulted in an impromptu *Jigsaw II* (Slavin 1990) method emerging. Again, this emerged from the student process.

It did not require that the teacher assume the responsibility for building in the peer tutoring as part of the process.

Student responses on the Post Treatment Survey when correlated with the MEDIA HCI Design Evaluation form holistic scores indicated a moderate correlation between student acceptance of the OLA and the quality of the finished project. Students demonstrated a purposeful acceptance of *Ask Addy*. The majority of students indicated that they did find *Ask Addy* helpful particularly in the areas of design and adding textboxes. These two areas are indicative of student concern with the complex issues of content and process. The *Ask Addy* prototype was devoid of anthropomorphic qualities; Addy's assistance was straightforward and presented in a formal manner. Therefore, students acceptance of *Ask Addy* was based on the quality of help offered rather than an attraction to the character, Addy.

Students did indicate a fascination with the possibilities of an OLA. In discussions throughout the production period, they discussed their visions of what *Ask Addy* could be. Students wanted much more than what the prototype could offer. They wanted *Ask Addy*'s bank of assistance to be much broader. Some students, familiar with Microsoft's Office 97, wanted more personas available as well.

Conclusion

An OLA can help students and teachers facilitate a process and produce better quality work. It can also suggest a learning environment that is conducive to a different, more complex nature of teacher/student interactions. While the act of directing students to make a storyboard prior to the production process did not require an OLA, it demonstrates that an OLA can provide valuable guidance in a suggested process for using that software. This would help a teacher who is unfamiliar with the basic hypermedia software in the implementation of a project.

The role of a teacher is not diminished by the presence of an OLA but that role is perceptibly altered in the interactions between teacher and student. The on-line assistant is able to assist the students in learning the rudimentary mechanics of a hypermedia software program while making make them sensitive to the discourse form of hypermedia. The OLA may stimulate children to take more responsibility for higher level activities such as planning strategies, locating resources, and organizing information that have typically been off-loaded onto the teacher. This in turn can free teachers to interact with students concerning more complex content and process issues while guiding their discovery.

References

Dewey, J. (1963 (Originally published 1938)). *Experience and education*. New York: Macmillan.

Druin, A. (1998). *The MEDIA Program*. Albuquerque:University of New Mexico.

Ennals, R. (1983). *Beginning micro-Prolog*. New York: Harper & Row.

Glaser, R., Raghavan, K., & Shauble, L. (1988). *VOLAaville, a discovery environment to explore the laws of DC circuits*. Paper presented at the ITS, Montreal.

Howe, J. A. M., & O'Shea, T. (1980). Teaching mathematics through LOGO programming: an evaluation study, *Computer Assisted Learning: Scope, Progress and Limits* . Amsterdam, North Holland.

Lockard, J., Abrams, P. D., & Many, W. A. (1997). *Microcomputers for twenty-first century educators*. (4th ed.). New York: Longman.

Maes, P. (1994). Agents that reduce work and information overload. *Communications of the ACM, 35*(7), 31-41.

Naisbitt, J. (1982). *Megatrends: Ten new directions transforming our lives*. New York: Warner Books.

O'Shea, T. (1979). *Self-improving teaching systems: An application of artificial intelligence to computer assisted instruction*. Basel: Birkhauser Verlag.

Papert, S. (1980). *Mindstorms*. Harvester: Brighton.

Pea, R. D. (1993). Distributed intelligence and designs for education. In G. Salomon (Ed.), *Distributed cognitions; Psychological and educational considerations* (pp. 47-87). Cambridge: Cambridge University Press.

Perkins, D. N. (1993). Person-lous. In G. Salomon (Ed.), *Distributed cognitions: Psychological and educational considerations* (pp. 88-110). Cambridge: Cambridge University Press.

Resnick, L. (1987). Learning in school and out. *Educational Researcher, 16*(9), 3-21.

Roblyer, M. D., Edwards, J., & Havriluk, A. (1996). *Integrating educational technology into teaching.* Columbus: Prentice Hall.

Salomon, G. (Ed.). (1993). *Distributed cognitions: Psychological and educational considerations.* Cambridge: Cambridge University Press.

Slavin, R. (1990). *Cooperative learning, theory, research, and practice.* Englewood Cliffs: Prentice Hall.

Uhr, L. (1969). *Teaching machine programs that generate problems as a function of interaction with students.* Paper presented at the National ACM Conference, New York.

User Interface Design in a Learning Environment based on a Computer Algebra System

Jean-Michel Gélis
IUFM de Versailles
France
jean-michel.gelis@inrp.fr,

Dominique Lenne
Institut National de Recherche Pédagogique
France
dominique.lenne@inrp.fr

Abstract: Computer Algebra Systems (CAS) are complex computer systems that have not been designed for learning situations. In order to enhance their didactic capabilities, we study the possibility to graft mathematics interactive learning environments onto them. We present in this paper our approach that is centered on student interaction and we illustrate it with LIMITS a learning environment that helps students to study, work out and justify limits of rational functions. We describe three activities involved in limits study: entering and selecting sub-expressions, transforming expressions, and calculating the limit by applying theorems. We show how teaching goals have determined the characteristics of these activities.

Introduction

Computer Algebra systems (CAS) such as MAPLE, DERIVE or MATHEMATICA are powerful software tools able to perform a large range of calculus. At the same time, more and more computers are now available in secondary schools. Consequently, the question of how mathematics teaching can integrate this kind of tools is set.

Some research works pointed out specific phenomena which occur when students are working with a CAS (Artigue 1997). Others focused on a long time utilization of a CAS with students (Lagrange 1996). These works emphasized that the utilization of CAS in mathematics learning is not so obvious. The powerful calculus capabilities of CAS help students in the technical part of their work, but do not automatically lead them to master concepts they work on (Tall 1996).

We explore a new way of using CAS with students. CAS were not designed with a pedagogical purpose and we intend to include them in learning environments. These learning environments try to fit the calculus capabilities of CAS to the students levels and to provide them with relevant presentations and manipulations.

In this paper, we present the learning environment LIMITS which is based on MAPLE and allows the students to work on the limit concept. We describe this environment and discuss about some issues this work deals with. The first version of our environment allows students to work on limits of rational functions.

Learning Limit Concept

In the paper-and-pencil context, working on limits implies to carry out two different tasks. The first one consists in applying some transformations when the limit evaluation leads to an indeterminate form (such as 0 x infinity or +infinity-infinity). The second one consists in applying theorems and properties in order to calculate the limit. Teachers note numerous difficulties when students carry out these two tasks, such as calculus errors in the transformations on expressions or misapplication of theorems.

Using CAS to perform limit calculus is likely to help the students to verify their results and to focus on the strategic part of their work. Unfortunately, CAS utilization is not so obvious. Available functions are sometimes too powerful and students may have some difficulties in applying a precise transformation in a given sub-

expression. Other transformations are merely impossible to perform with a CAS because too simple functions (from a technical viewpoint) do not exist in a powerful software. Furthermore, CAS results can sometimes be quite useless for students. For example, CAS can display any limit values but this indication does not suggest any transformation to apply in order to eliminate an indetermination.
We think that the design of a learning environment based on a CAS is likely to solve difficulties that students encounter both in paper-and-pencil and CAS context. Our approach consists in specifying clear pedagogical goals and in designing an interaction that reaches these goals. Students will work with an environment that reifies identified properties and provides well suited functions and convenient calculus facilities.
From now on, we describe the LIMITS environment and explicit the teaching goals we try to meet.

Architecture

The Learning Environment LIMITS is composed of two units. The first one, called the Interaction Unit, interacts with the student in order to specify his/her request. The student can enter an expression, request a transformation upon an expression or a sub-expression or carry out a limit calculus.
On the basis of the student's demand, the Interaction Unit sends a request to the Adaptation Unit. The part of this second unit is to adapt the student's demand to the CAS and to collect the result from the CAS before sending it back to the first unit (see Fig. 1). These units have been developed in DELPHI and the CAS we used is MAPLE.

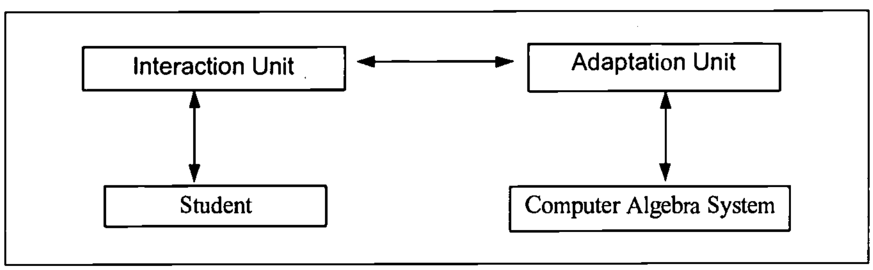


Figure 1: Architecture of the LIMITS environment.

We describe below three activities required to study limits: entering and selecting sub-expressions, transforming expressions, and calculating the limit by applying theorems. We show how didactic goals have determined the characteristics of these activities.

Entering and Selecting Expressions

When a student enters an expression using its linear form, the Interaction Unit parses this expression and displays it in its usual bidimensional form (Fig. 2).

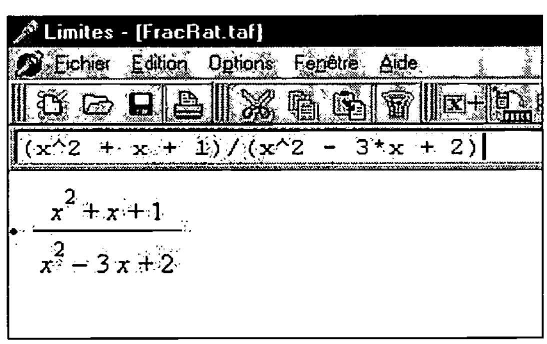


Figure 2: Entering an expression in LIMITS.

The bidimensional display is achieved by using nested boxes which include operators (such as +), variables, numbers or sub-expressions. In order to calculate a limit or perform a transformation the student has to select expressions or sub-expressions. The LIMITS environment allows to select expressions or sub-expressions with the mouse directly on the bidimensional representations of expressions. Our assumption is that such a capability will lead him/her to a better understanding of expressions structures.

Some Difficulties

Different ways of selecting sub-expressions were possible. We chose to give a particular importance to root symbols because their identifications are necessary to deeply understand expressions structures. For example, we chose to select the whole expression x^2+x+1 by clicking on the first or on the second + symbols.

Some situations were however more difficult to solve than others. For example, some operating symbol are not displayed in the usual bidimensional representation. That is the case with the multiply operator in 3x for example. We planed to insert some space between the 3 and x boxes, so that students can select the whole expression 3x by clicking in this space. Another difficulty we had to deal with came from the particular conventions concerning the minus symbol. For example, the real syntactic structure of the x^2-3x+2 expression is x^2+(-3x)+2. We had so to decide what sub-expressions will be selected when clicking on the minus symbol of the previous expression. We have in this case two possible results, either the -3x sub-expression (if we consider that the + symbol of the whole expression is omitted), or the x^2-3x+2 expression (if we consider that this minus symbol is at the same level in the expression that the plus symbol). We chose the second possibility in order to have a mean to select the whole term in expressions such as x^2-3x. A space between the minus and 3 symbol allows the user to select the sub-expression .

Another difficulty was to explain to the user how to select sub-expressions with respect of our particular conventions. We designed a little tool that allows the student to see what expression or sub-expression he/she points out with the mouse.

When passing the mouse all over the expression without clicking, different moving frames are drawn, indicating the different sub-expressions that would be selected by clicking (see Fig. 3).

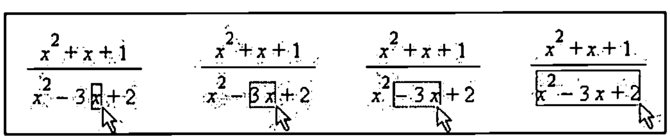


Figure 3: Visualization of different sub-expressions (using the mouse).

Adaptations Needed in the CAS

Expressions and sub-expressions are sent by the Adaptation Unit to MAPLE in order to calculate transformed expressions or their limits. But, working with MAPLE led us to take some precautions.

For example, some operators do not exist within the MAPLE representation. That is the case with the expression 2/x which is parsed by MAPLE as 2*x^-1, because quotient does not belong to the MAPLE operators set.

Another difficulty comes from the simplification algorithm that MAPLE applies as soon as it receives any expression. This algorithm is tedious because it may eliminate some important characteristics of the expression structure. For example, the sub-expression 3x+5x is immediately simplified by MAPLE in 8x, whatever the place in an expression it takes.

It was not possible to return to the student expressions or sub-expressions so deeply changed by MAPLE that the student may not recognize the original object he/she works on. Consequently, we designed a tool within MAPLE which aims at protecting expressions from the powerful algorithms of this CAS. This tool encodes expressions as soon as they are received from the Adaptation Unit. After working on these expressions, it decodes the resulting expressions and sends them back to the Adaptation Unit.

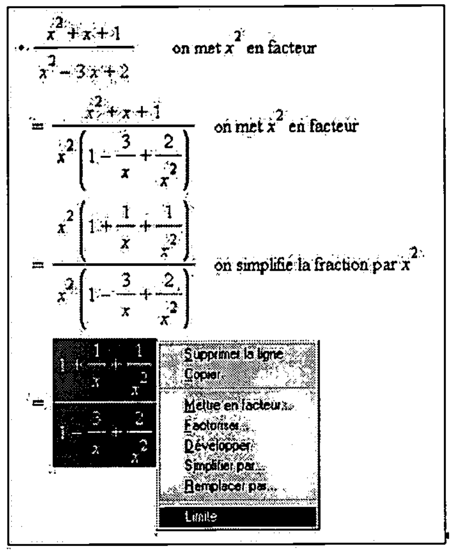


Figure 4: A sequence of transformations.

Transforming Expressions

In order to calculate limits, students have sometimes to perform transformations, specially when the calculus of the current expression leads to an indeterminate limit (such as 0 x infinity or 0 divided by 0). In LIMITS, to transform an expression, a student has to select a sub-expression and the transformation he/she wants to apply.
The figure 4 shows the different transformations a beginner can do in order to calculate the limit of a rational function. He/she first factors out x^2 in the denominator, then x^2 in the numerator, before simplifying the whole expression by x^2. The limit of the whole expression can then be calculated.

Another Way of Transforming Expression

We aim at providing students with convenient capabilities for transforming expressions quickly and precisely. Consequently, we designed another way of transforming expressions by direct manipulation, particularly well suited for elementary syntactical transformation, such as inverting two terms of a sum (Avitzur 1998).
This way of performing transformations requires that the student selects a sub-expression with the mouse and drags it then over the expression. The environment shows to the student what possible transformation he/she would perform if he/she relaxes the mouse button. To do that, the environment displays (when possible) a label pointing out the transformation corresponding to the place the mouse indicates (Fig. 5).

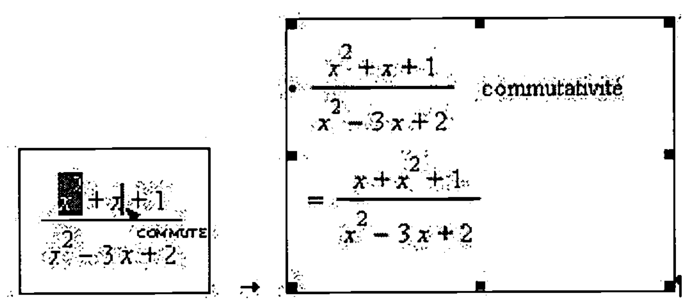


Figure 5: By dragging x^2 after x, the two terms commute.

Adaptations Needed in the CAS

MAPLE functions are generally not well suited for students work. For example, some functions are too powerful. The function expand works not only on polynomial expressions (as expected) but also on trigonometric, logarithmic or exponential expressions. It will be better from a pedagogical viewpoint to break this powerful function into several more precise ones working on specific expression forms.
We also noticed that some useful functions do not exist within MAPLE, which (as any other CAS) does not require too simple functions because its efficient algorithms don't use them. For example, no direct transformation in MAPLE rewrites x^2-3x+2 into x^2*(1-3/x+2/x^2).
Consequently, we had to design a library of specific functions, closely corresponding to the student actions and respecting the types of expressions the student is working with.

Calculating a Limit

Several ways were possible to allow the student to calculate limits of expressions in the LIMITS environment. We noticed that when calculating limits students have often difficulties in applying theorems and properties. Consequently, we make students indicate the theorem they want to apply before proposing any result in LIMITS. In the example of figure 6, the student has first selected the expression 1 and determined its limit by choosing "reference limit". Then he/she has made the same actions with the expressions 1/x and 1/x^2. Finally, he/she has selected the whole numerator and chosen a sum theorem.

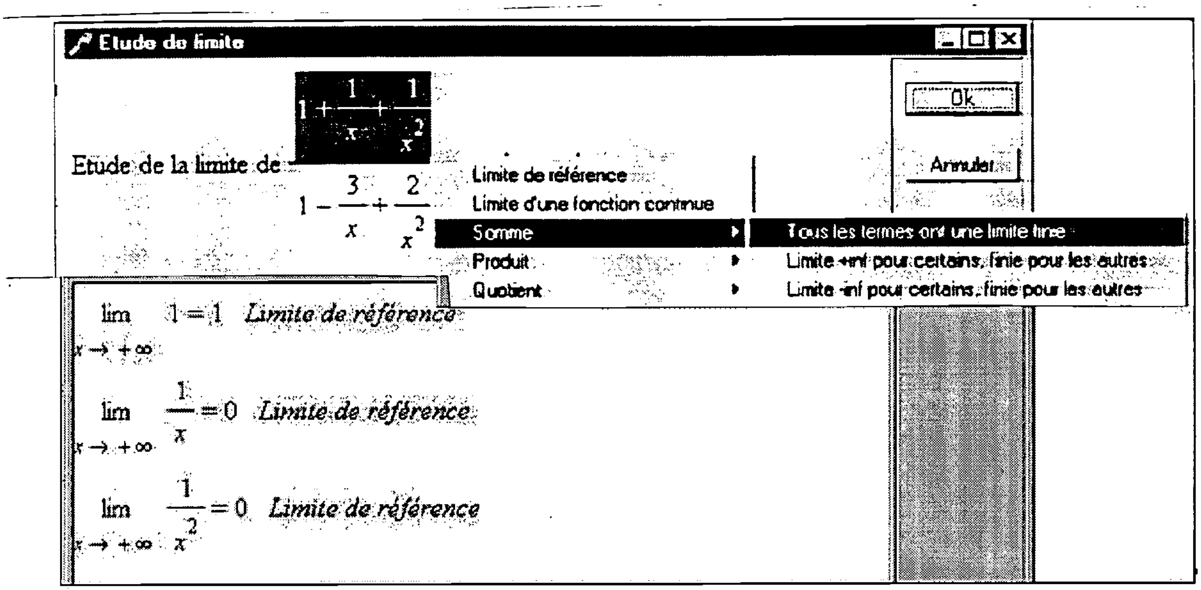


Figure 6: A limit calculus.

Distinguishing different teaching levels

Different levels of justifications corresponding to different teaching levels are available in LIMITS (Fig. 7). At the first level, exhaustive justifications are required, but at higher levels some justifications can remain implicit. At level 2, making explicit the limits of x^2, x, and of the constant terms is not required. Furthermore, unlike at the first level, the sum justification is not divided into several sub-cases. The only case is "sum without indetermination". The third level includes a supplementary choice allowing the student to apply a new property concerning the limit of a polynomial function when the variable approaches infinity. Thanks to this property, the calculus can be performed in only one step.

Level 1	Level 2 / Level 3
$\lim_{x \to +\infty} x^2 = +\infty$ *Limite de référence*	**Level 2**
$\lim_{x \to +\infty} 3 = 3$ *Limite de référence*	$\lim_{x \to +\infty} 3x = +\infty$ *Limite de référence*
$\lim_{x \to +\infty} x = +\infty$ *Limite de référence*	$\lim_{x \to +\infty} (x^2 + 3x + 2) = +\infty$ *Somme sans indétermination*
$\lim_{x \to +\infty} 3x = +\infty$ *Produit*	
$\lim_{x \to +\infty} 2 = 2$ *Limite de référence*	**Level 3**
$\lim_{x \to +\infty} (x^2 + 3x + 2) = +\infty$ *Somme*	$\lim_{x \to +\infty} (x^2 + 3x + 2) = +\infty$ *Polynôme en + infini ou en - infini*

Figure 7: Different levels of justification

Conclusion and future work

In this paper, we presented a Learning Environment based on a CAS. We specified clear pedagogical goals and designed a software providing the student with well suited calculus facilities. We hope consequently that our Learning Environment LIMITS will prevent the student from usual paper-and-pencil errors and will provide him relevant calculus tools.

We intend now to realize some experiments in observing and analyzing some students sessions and the errors they will make. We aim so at knowing how to improve our interaction with the student, for example by asking him/her some numerical results. A second direction of work is to extend the mathematical domain we deal with. Our intention is firstly to design another interaction allowing the student to calculate limits with the help of relevant inequalities. This domain is a more difficult one, because some useful inequalities cannot be found automatically and requires to specify what kind of help to provide to the students.

References

Artigue, M. (1997). Le logiciel DERIVE comme révélateur de phénomènes didactiques liés à l'utilisation d'environnements informatiques pour l'apprentissage. *Educational studies in Mathematics*, 33 (2), 133-169.

Avitzur, R. (1998). Direct manipulation in a mathematics user interface. In N. Kajler (ed.), *Computer Human Interaction in Scientific Computation*, Springer-Verlag, 43-60.

Lagrange, J.B. (1996). Analysing actual use of a computer algebra system in the teaching and learning of mathematics. *International DERIVE Journal*, 3 (3), 91-107.

Tall, D. (1996). Functions and calculus. In Bishop A. J. et al. (Eds.), *International Handbook of Mathematics Education*, 289-325.

Acknowledgements

This reported work has been carried out with the helpful contribution of Hervé Hamon and Michel Enjalbert, mathematics teachers, who are members of our research group.

Blazing Trails on the World-Wide Web

Corinne Glynn, Rachel Heck, Sarah Luebke, Weichao Ma, Hilary Mason,
Erin Nichols, Eleanor Raulerson, Isabel Staicut, and Samuel A. Rebelsky
Glimmer: The Grinnell Laboratory for Interactive Multimedia Experimentation and Research
Department of Mathematics and Computer Science
Grinnell College
United States
rebelsky@grinnell.edu

Abstract: Hypertext clearly has the potential to change the way students learn. However, the World-Wide Web lacks many of the features necessary for truly interactive hypertext; while hypertext pundits speak of students annotating existing pages, building new pages, and linking them into existing hypertexts, the World-Wide Web typically limits interaction to simple point-and-click browsing. At the same time, students encounter a quite different problem when they venture beyond course webs: they get "lost in hyperspace". That is, students have trouble determining where they are and where to go next.

In this paper, we suggest one solution to these two problems: *Blazer*, a system for extending the Web with trails, named sequences of annotated pages. When a student loads a page on a trail, she sees not just the page, but also information about the trail. Trails can give students increased interactivity while grounding navigation.

1. Introduction: Why the Web Needs Trails

The term "hypertext" suggests a rich environment in which readers could not only navigate between pages, but also extend and modify their own reading spaces. Hypertext visionaries suggested systems in which readers could add their own pages, make links between pages, and create trails between pages (Bush 1945) (Nelson 1974) (Landow 1997). Consider Nelson's first description of hypertext, in which he writes "links may be artfully arranged according to meaning or relations in the subject, and possible tangents in the *reader's* mind" (Nelson 1974, p. DM19, emphasis ours). Similarly, Bush envisioned a convenient mechanisms for constructing "useful trails through the enormous mass of the common record" (Bush 1945, Section 8). Clearly, linking and trailblazing are essential to interactive hypertext.

Compare this rich model to the typical Web site. Readers can click on links to select the next page they view, but that is the limit of the opportunity they have to interact with the hypertext. While some sites provide more interactivity, few provide the rich environment the hypertext pioneers envisioned. In particular, while it is certainly possible to link *to* a site, few sites let you link *from* them. But without such links, how can readers arrange links according to their "meaning [,] relations [...] and possible tangents"?

Are there ways to permit Web readers to make and share their own links? Are there ways for teachers to give their students appropriate guidance for traversing the morass of information on the Web? To help students, teachers often want to write:

> To learn more about this subject, read the following Web pages in this specified order. I've included notes on each page to help you understand what is on the page. I've also suggested a few alternate sequences for those of you with different backgrounds.

Similarly, a teacher might wish to provide a sequence of readings and questions, with each element building on the previous ones. A teacher or student might also trace the evolution of an idea or design principle through a sequence of pages. These trails may also include a number of subtrails (which Bush calls "side trails").

How can a teacher implement such sequences? It is certainly possible to write a separate Web page that lists the elements in the sequence and links to each element. However, such an implementation is difficult for students to navigate, as they must go back and forth between the sequence and linked pages, often forgetting where they are. There are also a number of ad-hoc solutions. For example, a teacher might build a sequence of framed pages, each

Experienced computer users preferred the "table of contents at the left" or the "separate contents window" interfaces. Less-experienced users preferred the simpler interfaces. However, less-experienced users also noted that they wanted some way to "jump around" the trail. Almost all users noted that the "table of contents" interfaces used a lot of screen space. Because we were testing on large monitors, they did not find this a problem. However, many worried what would happen when used smaller monitors.

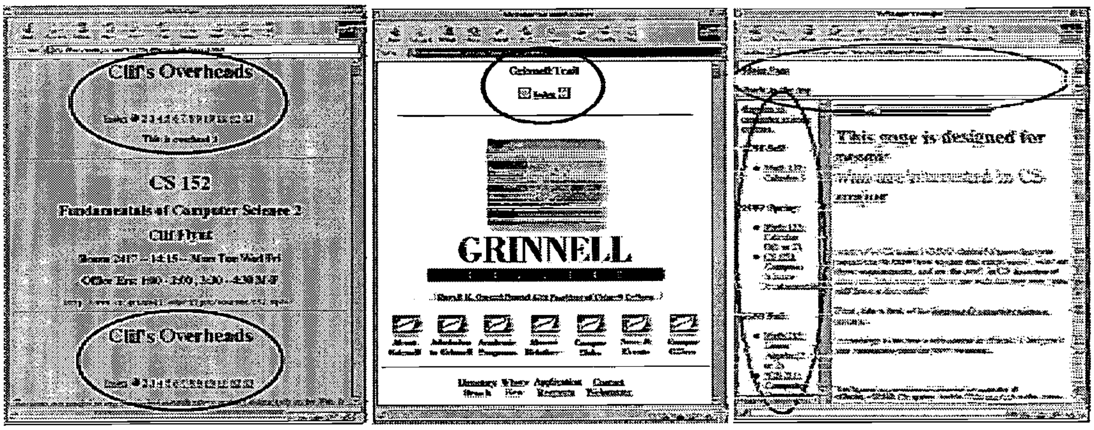


Figure 1: Three trail mockups (Numbered "Blue Dot", Just arrows, and Framed).

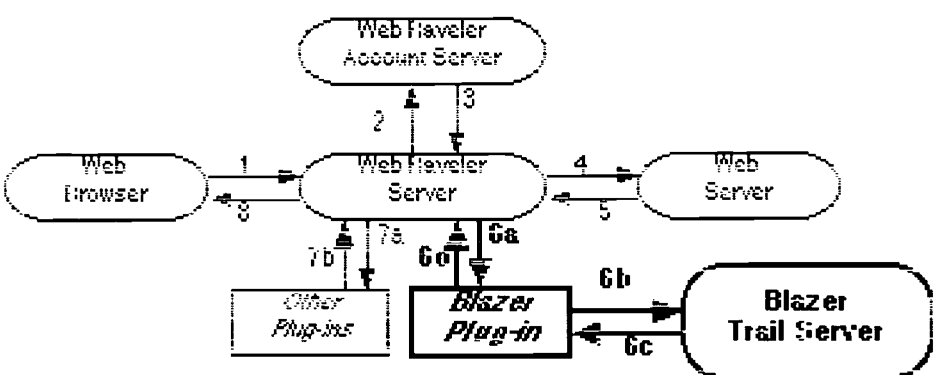
Many comments also served to validate our initial design goals. For example, when an interface seemed to provide less context, readers asked for "more context, as in the other interfaces". Readers also wanted clearer next/back arrows in all but the simplest interface.

Because different readers find different interfaces more intuitive, we decided to include configuration mechanisms in the program. That is, each reader can select which way trails are presented for her.

This decision also gives us the opportunity to do somewhat less direct and more realistic user testing. In particular, we can see how (and whether) readers switch trail interfaces as they become accustomed to using trails. Such testing is planned for spring 2000.

3. Architecture

The architecture of our system is fairly simple and takes advantage of the Web Raveler page-transformation infrastructure (Kensler and Rebelsky 2000). WebRaveler is an account-based system that mediates communication between Web browsers and Web servers. Each time a reader requests a page, Web Raveler intercepts the page before it is returned, looks up information on the reader, and transforms the page according to the needs of the reader. Because Web Raveler supports a plug-in architecture, we were able to develop trails as a plug-in for Web Raveler. (Fig. 2) illustrates the interaction between Web Raveler and Blazers



of which includes the remote page, notes, and a link. Unfortunately, the construction of such solutions is often time-consuming and difficult.

We have developed a suite of tools to make it easier for faculty and students to build and use trails of pages, both local and remote. The suite includes a variety of trail-authoring tools intended for both novices and expert users. Similarly, there are a number of ways that students can view trails, so that each student can choose the way that best suits her. Trails have an added benefit: they ground students in their reading of the Web. Students on a trail know that there's always one good place to go next: the next page on the trail. The trail name also gives students some information as to why they're reading the page. Finally, because our trails can include notes from the trail author, the instructor can give additional context within the notes.

In this paper, we discuss selected issues in the design and implementation of our system, particularly our observations during close user testing.

2. Using Trails

While it is necessary to blaze trails before you can use trails, the technique for blazing trails is somewhat secondary to the interface for using trails, since trails will be more frequently used than blazed. Hence, our work began with the consideration of possible user interfaces for presenting trails to students.

Our work began with an analysis of the necessary components of any interface. We decided that,

- students must always know their current position: what trail they're on, where they can go next, where they can go back to;
- students must be able to reach an overview of each trail;
- a displayed page must include not only the page content, but also the trail context and, possibly, notes from the trail creator;
- pages on a trail must use standard URLs; and
- each page may, but need not, include links to all of the pages in the trail.

These design guidelines gave us a great deal of freedom in the ways to present these different attributes. There are clearly a number of design choices relating to

- positioning of the trail information, which might appear above the page material, to the side of the page material, or even in a separate window;
- the number of links to other pages in the trail, from just two links (next and previous) to a complete list of links, or even a small window on the trail;
- the level of detail in the links to the other pages, which might give the full name of the other page, or simply a position number; and
- the presentation of links to other pages, which might appear as a menu or series of textual links.

At this stage of the work, our goal was to evaluate how students might react to different presentations of the trail. We began with four mockup interfaces that explored different combinations of these choices. While it might have been more appropriate to test each design choice independently, it was also clear that some combinations were more natural. For example, if the trail is presented in a second window, it makes sense for that window to include many or all of the nodes in the trail with their name, and not just the next and previous nodes or numbers for each node. The four mockups were

- A simple interface which included the full list of pages in the trail at the top and bottom of each page. The links were numbers, giving the position of the page within the trail. To give the reader some context, we included a blue dot at the current position within the trail. The first picture in (Fig. 1) shows this interface with a course page.
- A simpler interface which included only trail name and next and previous links as arrows. The second picture in (Fig. 1) shows this interface with an institutional home page.
- A framed interface which presented a textual "trail table of contents" to the left of the page. The third picture in (Fig. 1) shows this interface with a set of major guidelines.
- A separate window listing the textual table of contents.

In almost every case, the design strategy for the mockup bore some resemblance to typical site interfaces on the Web. The two simpler interfaces resemble the lists of pages of search results typically given by search engines like Altavista. Similarly, the table of contents at the left format is a typical navigation tool for sites, one that is sometimes implemented with HTML tables and sometimes with frames.

Figure 2: The Relationship between Blazer and Web Raveler.

A student using Web Raveler with trails first logs in to Web Raveler. She then surfs the Web as normal. After intercepting the page from the server, Web Raveler sends information to the Blazer plug-in (6a) about the student, the URL of the page, and the content of the page to Blazer. The Blazer plug-in then sends the URL to the Blazer server (6b) to determine if the page is part of a trail. The server returns (6c) either a list of trails and associated trail information, or a note that the page is not on a trail. If the page is not on a trail, the plug-in returns it (6d) unchanged. However, when the server indicates that a trail is available for the page, the plug-in modifies the page to add information about the trail and then sends the page back to Web Raveler (6d). Web Raveler may then pass the page through other plug-ins (7) and then returns the "trailed" page to the Web browser (8). The Blazer server uses a simple database to associate trails with each URL.

One unresolved issue in this architecture is how to resolve situations in which multiple URLs are associated with the same page. Many Web servers return a default page when the URL requested is a directory. For example, http://www.math.grinnell.edu/ and http://www.math.grinnell.edu/index.html are the same page. Ideally, Blazer would add the same trail for each URL. Unfortunately, the overhead incurred in checking equivalence of URLs is currently quite great, so Blazer and Web Raveler treat them as separate pages.

4. Blazing Trails

While there are some clear guidelines for how interfaces should present a trail (or at least what interfaces should present), the design of trail blazing tools is somewhat less specified. Just as different Web authors have radically different techniques for building pages, from "raw HTML" to graphical editors like PageMill, from custom applications to "save Word as HTML", so will different trail authors have different preferences for the ways in which they build trails.

To support different trailblazing techniques, we use a standard file format. Just as some authors write raw HTML, so too can some authors write "raw trails". Authors can include comments by beginning a line with a pound character (#). An entry in the file begins with the URL, followed by a vertical bar (|), followed by the Web page title as it should appear to a person browsing the trail, followed by another bar (|) followed by any comments that the author wants to share about that particular Web page.

But few authors will want to create trails in this way. Hence, we chose to include two other mechanisms for building trails. *Trailmaker,* the authoring tool, for novices, runs in any Web browser. The tool presents two frames, one on top of each other. The bottom frame is used for a preview of the page to be included in the trail, and the top frame shows the additional information that will be recorded in the trail. The top frame, used for authoring, includes sections for the URL (which may be dragged and dropped from the top of the browser window), the author's name, page title, and comments. In addition, a preview of the complete trail is shown in a separate Web browser window. Trails can be built from scratch or modified from existing trails.

While this interface is particularly appropriate for those whose primary Web experience is browsing, another interface might be more appropriate for those used to authoring Web pages. Hence, we built a second tool that reads the links in a file and turns those links into a trail. Since every page in a trail includes both title and comments, the link text is used as the comment and the title of the destination document is used as the title in the trail. Authors accustomed to building pages with links can use whatever system they prefer to build a "list of links" page and then run this tool to build their trails. This tool has been successfully used to build some very large trails, including one with over three hundred pages.

We tested the two interfaces on a variety of potential trailblazers, including some whose main use of computers is browsing and some experienced programmers. Surprisingly, users found little to recommend one over the other. Most found it comfortable to create trails in either way.

5. An Application: Student Trailblazing

Why build trails? In the introduction, we suggested two important reasons: trailblazing empowers students and trails ground students, thereby reducing the chance of getting lost in hyperspace. Yet trail-blazing has other educational uses. In particular, a teacher might ask students to create trails based on a particular subject. This activity differs in many ways from the related "build a Web on this subject".

First, students must do more than collect resources; they must also *order* those resources. While hypertext encourages multidimensional structures, students must also learn the ordering and relating that is necessary for coherent arguments and narratives. Second, students must *annotate* these resources. Again, this requires students to do more than just decide "this page is interesting and about my topic". They must explicitly indicate how the page fits into their "narrative trail".

Our initial experiments with asking students to build trails have suggested that students find the task quite challenging. Since their primary experience on the Web is gathering, and not sequencing, they find it difficult to think about how one might sequence these pages that are related by topic but not by order.

6. A Risk: Page Modifiers from the Author's Perspective

While there are many benefits to trail-blazing tools, there are also some significant concerns raised by the use of tools that modify pages on both local and remote sites. Consider the case of ThirdVoice (ThirdVoice 1999) (Warner1999), a browser plug-in that allows readers to add and share annotations. Although there are many appropriate uses for this tool, such as instructors posting notes on remote pages for students to read, many made inappropriate use of the tool, such as posting links to pornography sites on common locations like whitehouse.gov and disney.com. Even without these abuses, many page authors were concerned that ThirdVoice usurped their literal *author*ity, permitting others to "modify" their pages (Oakes 1999). Any page modification tool must consider such issues.

Because we rely on Web Raveler (Kensler and Rebelsky 2000) for our infrastructure, we are able to provide some support for page authors. In particular, Web Raveler includes a language that permits page authors to limit the modifications done to pages. Hence, authors can indicate that they do not want trails added to their pages, or limit trail use to certain domains. If authors permit trails for a page, they cannot specify that certain pages (or types of pages) should not be included in trails.

During early user testing, we built some prototype sites using local copies of remote pages, to support faster access to the locations in the trail. However, we did not always copy images. In one case, a subject-generated trail created some controversy, since the pages in that trail included images from another site. The owners of that site claimed that we were attempting to "steal" both their pages and their bandwidth. Fortunately, we were able to convince those authors that we were working on a useful research project and not attempting to create a mirror of their site. In subsequent work, we turned off remote access for any locally generated trails. However, such issues remain a concern.

7. Related Work

In spite of the importance of trails to the World Wide Web, there seem to be surprisingly few systems that permit readers to add links and trails to pages. The most notable trail-blazing system is Walden's Paths (Shipman et al. 1998) (Shipman et al. 1999). At times, trailblazing is subsumed under a notion of annotation, as in (Roscheisen et al. 1995).

Our Blazer system differs from Walden's Paths in a number of ways. First, Blazer provides more mechanisms for authoring trails. Walden's Paths provides one tool, which has some similarities to our novice interface. Because we use a simple, open, textual, trail format, it is possible to design new interfaces. Second, Blazer gives readers many more opportunities to customize their display of trails and have employed user testing to develop this interface. Walden's Paths uses one fixed display that consumes a significant amount of screen space. Third, Blazer users standard URLs and informs students about the availability of paths when they view pages that happen to be on paths. Walden's Paths assumes that students intentionally start on a path, and also uses special URLs for the pages on the path. Finally, because we rely on Web Raveler (Kensler and Rebelsky 2000), we have the opportunity to use information about the student in presenting path information and to interact with other Web Raveler plug-ins. For example we might automatically present a different path based on information about the student's skills or browsing history.

Admittedly, Walden's Paths has some advantages over our system. It has been used much more widely and has been used successfully for a number of different applications at different levels. We hope to compare the applicability of the two trail-blazing systems for similar activities.

Both Walden's Paths and the Blazer system have many advantages when compared to annotation-based trails. In annotation-based trails, page annotations can include links to the next and previous pages on a trail. However, such trails are clearly difficult to build and maintain. For example, inserting a page into an annotation trail requires that you modify the annotations in three different pages. While trails provide an interesting application of annotations, a separate annotation system is clearly preferable.

8. Conclusions and Future Directions

For the Web to empower readers, it must permit readers to do more than follow links and build pages that link to and never from other pages. The Blazer system empowers readers by letting them build trails through the Web, using both local and remote pages. It therefore provides an important resource for teachers, not only letting them build trails to help guide their students through the Web, but also providing context to browsing and empowering students to create their own trails.

Yet our work is not done. While we have done some user testing for various parts of the interface, we need a comprehensive study of how readers prefer to see trails (and forthcoming). We also need to study more closely how students and faculty will use trail-blazing tools and whether the assignment to "build a trail" can really make students think about linear structure.

9. References

Bush, V. (1945). As We May Think. *Atlantic Monthly*, 176 (1), 101-108.

Kensler, A., and Rebelsky, S. A. (2000). Web Raveler: An Infrastructure for Transforming Hypermedia. *Proceedings of the EdMedia 2000 World Conference on Educational Multimedia.* Charlottesville, VA: Association for the Advancement of Computing in Education.

Landow, G. P. (1997). *Hypertext 2.0: The Convergence of Contemporary Critical Theory and Technology.* Baltimore, MD: The Johns Hopkins University Press.

Luebke, S., Mason, H., and Rebelsky, S. A. (1999). Annotating the World-Wide Web. In B. Collis and R. Oliver (Eds.), *EdMedia 99 World Conference on Educational Multimedia, Hypermedia, and Telecommunications* (Seattle, Washington, June 19-24, 1999), 409-414.

Nelson, T. H. (1974). *Computer Lib/Dream Machines.* Self-published.

Oakes, C. (1999). The Web's New Graffiti? *Wired News.* Online document at http://www.wired.com/news/news/technology/story/20101.html. (Created 9 June 1999. Accessed 20 July 1999.)

Roscheisen M., Mogensen, C., and Winograd, T. (1995). Beyond browsing: Shared comments, soaps, trails, and on-line communities. *Computer Networks and ISDN Systems*, vol. 27, 739-749, 1995.

Shipman III, Frank M., Furuta, R. Brener, D., Chung, C.-C., & Hsieh, H-w.(1998). Using Paths in the Classroom: Experiences and Adaptations. *Ninth ACM Conference on Hypertext and Media*, 267-276.New York, NY: ACM Press.

Shipman II, Frank M., Furuta, R., Hsieh, H., Francisco-Revilla, L., Karadkar, U., Rele, A., Shenoy, G., V., and Brenner, D. A. (1999). Using the Internet in the Classroom: Variety in the Use of Walden's Paths. In B. Collis and R. Oliver (Eds.), *EdMedia 99 World Conference on Educational Multimedia*, 335-340.

ThirdVoice (1999). ThirdVoice.com. (Accessed 20 July 1999.)

Warner, M. (1999). Third Voice. *Fortune.com.* Online document at .http://www.pathfinder.com/fortune/cool/thirdvoice.html. (Created 5 July 1999. Accessed 20 July 1999.)

Acknowledgements

Portions of this work were funded by the Computing Research Association's Computing Research Experiences for Undergraduates (CREW) Program, Grinnell College, and the Robert N. Noyce Faculty Study Grant. The current incarnation of our tool owes a great deal to the Web Raveler infrastructure, and we are grateful to Andrew Kensler for his development and support of that tool. Many members of the Glimmer research team contributed ideas to this project.

INFORMATION LITERACY IN A VIRTUAL ENVIRONMENT: A WEB-BASED APPROACH

Ann Grafstein
Library
College of Staten Island/CUNY
United States
grafstein@postbox.csi.cuny.edu

Abstract: Recent technological innovations have substantially altered the ways in which colleges and universities deliver essential services. Among the academic units most notably affected by technological change has been the academic library. This paper will consider the impact of recent and emerging technologies on the services provided by academic libraries and on the evolving needs students have for library instruction in relation to these new technologies. I will argue that making digital libraries usable for patrons requires the development of effective and innovative forms of online reference.

INTRODUCTION

Recent technological innovations have substantially altered the ways in which colleges and universities deliver essential services. Among the academic units most notably affected by technological change has been the academic library. This paper will consider the impact of recent and emerging technologies on the services provided by academic libraries and on the evolving reference and instructional needs of library patrons in the new digital environment.

Since the development of the World Wide Web in the mid-1990s, colleges and universities have been undergoing a major shift in the nature of their communication with their various audiences. Now college web sites often serve as gateways for information to students, faculty and staff, prospective students, alumni, parents, and the general public. In addition to providing a platform for administrative functions, the web is effecting substantial changes in the way educational services are being offered. It has become the major vehicle for delivering distance education courses. Even locally within a campus, more and more courses are offered either partially or exclusively over the web, and many other more traditional on campus courses integrate the web as an integral part of the course (see, for example, Schulman & Sims 1999).

At the heart of the educational and research functions of the university is the academic library, and there is no part of the university whose services have been impacted by technological change more than the library. Technological innovations have been radically altering the kinds of service academic libraries offer and the way they do business since perhaps the mid-1970s. In order to properly consider the impact of the digital environment on the kinds of services academic libraries provide and the way they deliver these services, it will be useful to clarify the mandate of the academic library. While the digital environment indeed poses new challenges that must be met and possibilities to strive for, the basic mission that guides and informs our work remains unchanged: "to support teaching and research by acquiring and preserving materials in all formats, and by providing access to these materials through systematic organization" (Jayne & Vander Meer 1997:123). However we redesign our services in order to deploy the capabilities of the digital library to maximal effectiveness, we must do so in a way that is consistent with the library's overriding mandate.

The potential of the technological revolution (often referred to as the *information superhighway*) has been touted for quite some time. It is often claimed that libraries in North America are experiencing a major shift in their mandate, which traditionally has been to collect, maintain, store, conserve, and preserve the printed artifacts that represent the recorded knowledge of our culture and society. Although libraries have always responded to the development of other media (LPs, CDs, videocassettes, etc.), talk of a substantial--even a paradigmatic--transformation of the very concept of a library began with the rapid development of computer and communications technology.

DIGITAL LIBRARIES

The concept of a seamless, electronic web of information, universally available on a twenty-four-hour-a-day, seven-day-a-week (24/7) basis, is regularly put forward as the natural next step on the evolutionary ladder, inevitably and inexorably replacing the traditional physical library in which things are stored that have concrete properties which are described in a cataloguing record. This argument is made from several quarters, spanning all types of libraries, although academic libraries are the most common focus. To take just a few examples from the library literature, Herron (1986) was among the early predictors of a virtual library, making no distinction as to type of library. Day (1998) makes the argument with respect to school (K-12) libraries, and Seiler & Surprenant (1993) make it with respect to academic libraries. Denton & Redmond (1994) predict that the days are numbered in which librarians will be needed as search intermediaries, since library "customers" get needed information by posting a query to a discussion list or by running a search on an Internet search engine.

This sort of futuristic or utopian--according to how one chooses to view it--forecasting may seem increasingly feasible because of the wealth of material--information, disinformation and everything in between--that is available over the Internet to anyone with a PC. Library catalogues from all over the world can be searched via the World Wide Web or a telnet connection from home. Even proprietary textual and bibliographic databases, which have customarily been available only from an IP address of a library that subscribes to them (or perhaps from other PCs within a university campus), are now increasingly becoming available remotely by means of some form of password verification or proxy server.

REMOTE ACCESS AND INFORMATION LITERACY

We in the library community can take genuine pride and satisfaction at the expanding level of service we can provide our patrons, service that extends well beyond the walls of the library into homes, offices, community centers, etc., and beyond the traditional hours of library service, toward a 24/7 model. We can not only make our catalogues and the databases we subscribe to available from outside the walls of the library, but our patrons can in many cases ask asynchronous reference questions via e-mail Ask-A-Librarian services, and some libraries have been experimenting with providing synchronous reference service via a MOO (Multi User Object Oriented) environment. For other examples of remote reference services, see Sloan (1998). See also the University of Leicester's Electronic Library at http://www.le.ac.uk/li/distance/eliteproject/elib/, which provides links to numerous sites offering various types of remote reference, including the Remote Referencing Help-Desk Project at the library of the University of Edinborough.[1]

On the other hand, as a counterpoint to this optimistic vision and to forecasts that libraries as we know them are destined to wither away and die, academic librarians confront daily the reality of students who do not know how to define the topic they are researching (beyond, say, *educational psychology* or *history*), much less how to break it down into key words using Boolean logic, or how to use the controlled vocabulary of a database. Sloan (1998) notes that discussions of digital libraries tend to focus on technology and information sources, rather than on service. However, Sloan points out, "[t]echnology and information resources on their own cannot make up an effective digital library" (Sloan 1998). Constant access to data does not by itself make that data accessible and it certainly does not transform it into information or knowledge. Information is accessible to patrons only if they know at a minimum 1) how to define their information needs, 2) how to translate those needs into effective search strategies, and 3) how to evaluate the information they locate.

CHALLENGES AND OBSTACLES

Let us consider some of the issues that might affect a patron's ability to define an information need, to develop search strategies and to evaluate information. For the moment, let us assume as an abstraction a fairly level technological playing field, in which we take as a given that most library patrons have easily accessible Internet connections, can negotiate remote access to proprietary databases, have up-to-date hardware, sufficiently speedy levels of connectivity, and browsers that are capable of handling (and handling within a patron's natural life expectancy) Java, multimedia, graphics, and whatever other features are used in the databases they need. Of course,

[1] Many thanks to Ilene Frank, Danielle Hinton, Laura Kortz, Patricia Memmott, and Diann Smothers, who shared much information on remote reference, in response to a query I posted to the DIG_REF Listserv (see http://www.vrd.org/Dig_Ref/dig_ref.html).

this is a major abstraction, and one, which is not likely to become a reality anytime soon. Nevertheless, even given all this, let us imagine the confusion of the novice patron when faced with our impressive selection of bibliographic and textual databases, not to mention the, to all intents and purposes, infinite possibilities of the Internet.

QUERY FORMATION

This patron may well not realize that in order to address the *specific* topic in question, he or she should be looking for articles on *feminist interpretations of the works of Thomas Hardy*, rather than *Victorian literature*, or for information on *eating disorders in adolescent girls*, rather than *psychology*. Despite the naïve, rather fantastical assurance of many people that the answer to the unformed question is "in the computer," just waiting to extract itself, the fact remains that defining the query is the essential kernel of the research process. Stern (1999) notes that regardless of how powerful and sophisticated a search engine is, and no matter how much it can do for the researcher, the most difficult part of information retrieval is forming the appropriate question. He observes further that as yet "[t]here is no algorithmic substitute for good critical thinking" (Stern 1999:79-80).

CHOOSING DATABASES

Once the issue of query formation has been resolved, the patron is faced with the problem of how to choose the most appropriate resource from those that are available. That the differences between resources are not apparent to inexperienced people is clear to any academic librarian who has been told by a student, in response to a suggestion to search a particular database, that he or she has already "looked on the computer" and hasn't found anything relevant. When the librarian asks the student whether he or she searched on the Internet or on one of the library's databases, often the student does not know. Alternatively, if the student says that he or she found the information by following a link from the library's list of electronic resources, the student often does not know which database he or she searched. Inexperienced users (as well as more experienced ones with complex questions) need guidance in selecting databases that are appropriate to their needs.

Often, in the ideal case, the patron would have the assistance of a trained information specialist. Certainly, as will be discussed below, libraries' web pages can and should walk patrons through the steps of the research process and provide assistance in database selection. Stern (1999) provides examples of navigational tools that will point to metasearch indexes, subject specific indexes, web sites, etc. Still, as Buttenfield (1999) points out, what connects remote users with available resources is a software interface, an interface that cannot, at this point, guide users to the sources that are most relevant to their topic and most suitable to their level. Nor can an interface make eye contact with patrons, and respond appropriately to looks of confusion, disappointment or frustration. Moreover, as Shaw (1996) notes in her evaluation of the Internet Public Library's pilot project providing synchronous reference in a MOO environment, the librarians involved in providing the service reported difficulties that resulted from the lack of the feedback present in face-to-face, or even telephone, communication. Librarians observed that information was lost as a result of the absence of feedback from voice inflection or body language.

CONSISTENCY OF INTERFACES

The third issue we will consider in relation to a patron's ability to effectively exploit the digital library is the consistency of the interface itself. It is the interface, after all, that enables users to extract (or not, as the case may be) the information they need, and, as Buttenfield notes, for many users "the interface IS the system" (Buttenfield 1999:42). Since the rise in public use of personal computing applications, software has undergone substantial progression toward greater user-friendliness and standardization, evolving from often arcane command-driven interfaces to point-and-click G(raphical) U(ser) I(nterfaces). Since the advent of CD-ROM databases first made enduser searching feasible, the interfaces for electronic databases have undergone similar progressions. The early DOS-based CD-ROM products relied on a set of often idiosyncratic and counter-intuitive menus and commands that were challenging even for professionals to use. With the development of the Windows operating system and GUIs came the possibility of greater user-friendliness and consistency. During the last few years, we have witnessed the mass migration of electronic databases to the World Wide Web, with the possibility of even greater consistency, given the properties of HTML, the easy identification of hyperlinks, and people's growing familiarity with the protocol of the web. However, the potential of consistency remains, to a large extent, elusive, since there are still substantial and often confusing dissimilarities and inconsistencies among the products of different vendors. Among the searching capabilities users have to learn for each product are what fields are searchable, how Boolean operators are applied, what the wildcard and truncation symbols are, whether or not the user has access to the thesaurus, and whether or not nesting is possible. All of these can vary considerably from product to product.

If we take just a brief look at the interfaces of popular products from three well-known vendors (InfoTrac, produced by Gale, WilsonWeb, by the H.W. Wilson Company, and WebSpirs by SilverPlatter), we can see that in each case the search screens are quite different. The terms that are used to identify the different types of searching available are different for each case, and they are not prominently defined. The user has to do some digging through the online help in order to get information.

Fig. 1 shows the opening search screen for the InfoTrac product, Expanded Academic ASAP. The default screen is a subject guide. However, since the user has no access to a thesaurus, he or she must simply guess what terms are descriptors.

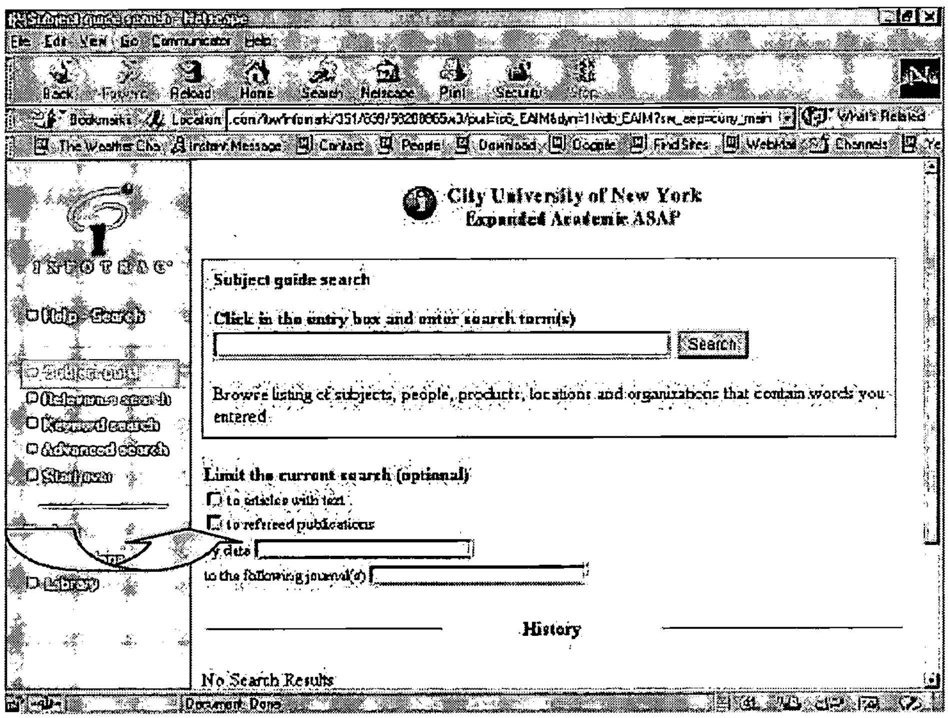


Figure 1: The default search screen for the InfoTrac databases. The arrow indicates the option available from this screen to limit the search to articles with full text and/or refereed publications

Now in the Wilson databases, the basic search screen does not give the user the option to limit the search, as we can see in Fig. 2.

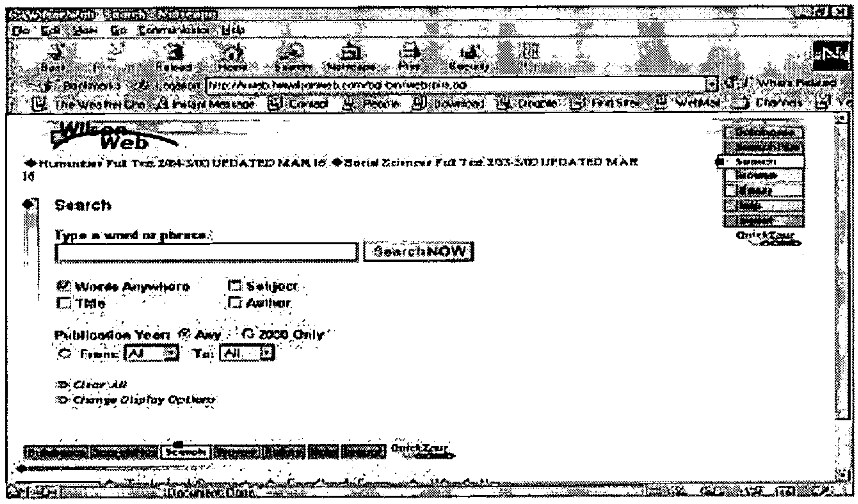


Figure 2: WilsonWeb Basic Search Screen

Finally, Fig. 3 shows the opening screen for SilverPlatter's WebSpirs databases, which has a completely different look and different options from either InfoTrac or Wilson Web. The user is presented with a Search Builder, and the option to "Set Other Limits," neither of which is defined anywhere.

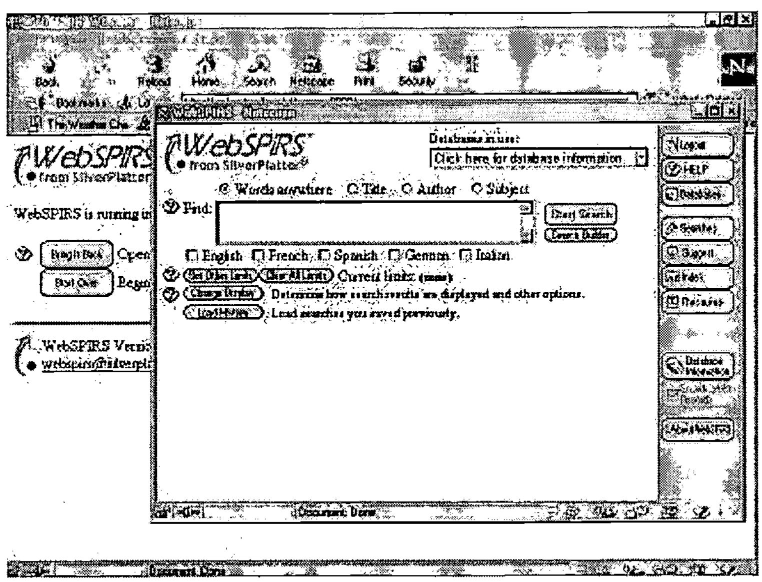


Figure 3: The opening screen for SilverPlatter's WebSpirs databases.

CONCLUSION

When sitting in front of a computer at home or in a dormitory room and visiting an academic library's web site, our user encounters an impressive array of resources that extend the walls of the library well beyond its physical limits. Nevertheless, as we have seen, there are significant obstacles that confront our user, obstacles that are all the more significant for someone who is under the impression (or who's professor is) that the challenges of the research process melt away in a brave new cyberworld. As noted above, the academic library has at the heart of its mandate the responsibility "to support teaching and research by acquiring and preserving materials in all formats, and by providing access to these materials through systematic organization." To this, it is appropriate to add a teaching responsibility: the responsibility to teach students how to locate, use and evaluate information in all formats for learning and research.

If we truly want to extend the walls of our libraries out to cyberspace, and to accommodate the researcher who is doing a literature search at 2 AM, it is essential that we design library web sites so that this researcher has a place to go for answers when he or she runs into obstacles. A library's homepage should be designed as a self-paced tutorial. It should provide convenient and easy ways to locate links to all of its services as well as to tutorials on how to use them. We should make it easy to locate information on the research process, from the formulation of a topic, to tips on how to develop search strategies, to principles and procedures for documentation. The library's web site should guide users on how to search electronic databases in general, as well as information on the unique characteristics of each one. We need to build on the efforts of some academic libraries to offer user-friendly, synchronous real-time reference that can guide users on database usage and selection. The library of the University of Edinborough, for example, lists on its web page the scheduled times that librarians who are experts on specific databases are available for interactive reference (see http://www.remote.lib.ed.ac.uk/). Building a digital library that is faithful to the finer traditions of librarianship requires not just that we develop technology, but that we deploy that technology in order to achieve excellence in connecting people with information.

REFERENCES

Buttenfield, B. (1999). Usability Evaluation of Digital Libraries. In D. Stern (Ed.), *Digital Libraries: Philosophies, Technical Design Considerations, and Example Scenarios* (pp. 39-59). New York: The Harworth Press Inc.

Day, C.W. (1998). The Library of the Future. *American School & University*, 71 (1), 48-49.

Denton, B. & Redmond, M. (1994). From Librarian to Cybrarian: Reinventing Our Profession. In S. B. Ardis (Ed.), *Library Without Walls: Plug In and Go* (pp. 193-202). Washington, DC: Special Libraries Association.

Herron, N. (1986). The Paperless Society. In *Encyclopedia of Library and Information Science* (Vol. 41, supplement 6, pp. 277-289). New York: Marcel Dekker Inc.

Jayne, E. & Vander Meer, P. (1997). The Library's Role in Academic Instructional Use of the World Wide Web. *Research Strategies*, 15 (3), 123-150.

Schulman, A. & Sims, R. (1999). Learning in an Online Format versus an In-Class Format: An Experimental Study. *T H E Journal (Technological Horizons In Education)*, 26 (i11), 54.

Seiler, L. & Surprenant, T. (1993). The Virtual Information Center: Scholars and Information in the Twenty-First Century. In F.W. Lancaster (Ed.), *Libraries and the Future: Essays on the Library in the Twenty-First Century* (pp. 157-180). New York: The Harworth Press Inc.

Shaw, E. (1996). Real-Time Reference in MOO: Promise and Problems. [Online]. University of Michigan School of Information. Available: http://www-personal.si.umich.edu/~ejshaw/research2.html [2000, March 15].

Sloan, B. (1998). Service Perspectives for the Digital Library: Remote Reference Services. *Library Trends* 47 (1), 117-143.

Stern, D. (1999). New Search and Navigation Techniques in the Digital Library. In D. Stern (Ed.), *Digital Libraries: Philosophies, Technical Design Considerations, and Example Scenarios* (pp. 61-80). New York: The Harworth Press Inc.

Virtual Study Groups (VSG), an approach to networked collaborative learning

1. Introduction

The Open University of Catalonia (UOC) is a new university model that provides distance learning through a Virtual Campus. With the application of new information and communications technologies, the "virtual campus" becomes an alternative to traditional correspondence education. Students are in permanent contact with University services, professors and other students from their own home, via a Virtual Campus and a personal computer. In the distance learning system that UOC offers, students have a wide range of institutional elements to stimulate, guide and help them during their process of learning: counsellors, tutors, and support centres. They also have other common virtual spaces where to pose and solve doubts: the community forum, a space for debates and a classroom forum.

In this context, one of the student's critical problems is the feeling of isolation. Lacking every day's feedback, contact with other students and teaching staff, student's motivation level can decrease substantially. Moreover, not having someone with whom to share impressions, difficulties, and projects around the studies, can diminish the desire for learning. During their studies, students need a considerable amount of support. They need aid with the understanding of study goals, clarification of doubts, problem resolution, evaluation activities, and keeping up the level of motivation.

From this point of view, collaborative work could be considered as a strategic tool to improve the study conditions and the quality of the learning context. In addition, collaborative work can be an important element of support and motivation front of the challenges students face at the beginning of theirs university life. In a broad sense, through a process of collaboration, students could share the discovery of a new virtual environment and build together a new reality that will surround them along their studies. This support between equals will allow the construction of social interactions and co-operative networks that will be basic to break the isolation that often implies distance learning systems.

In this particular scenario, our research focuses on co-operative learning in virtual environments. Our experience about VSG seeks to improve the formalisation of models of collaboration in virtual spaces of communication. The main goal of this paper is to describe the concept of virtual study groups (VSG) as the key element of our virtual learning system, as well as a central piece of the backup system for keeping student's motivation high. A Virtual Study Group is created because students with similar types of needs form groups with the overall purpose of supporting each other educational needs, and, jointly, collaborate in solving learning problems.

2. Virtual Study Group

Collaborative learning methods were developed within the social-psychological tradition based on the idea that students working together are responsible not only for their own learning but for the learning of others students as well. From this perspective, we seek a methodological approach that will allow students give support and advice to each other as well as increase the degree of involvement in sharing knowledge and expertise. Different models and strategies have been proven in the past in pursuing the same goals. The aims and work distribution of the Virtual Study Group are in part similar to the ones described by Slavin for the group-investigation (Slavin et alt., 1985).

The main goal of a VSG is to create a learning structure in which students can study the contents of a subject matter in a better and richer manner that they would do otherwise. We expect students working collaboratively improve their achievement outcomes. The virtual study team is created by the students that gather together with the shared objective of helping each other to find the resolution of a problem generated around a specific learning problem. The concept of VSG claims for concretions related to the number of students per team, group creation, working and dissolution rules, and procedures and collaboration strategies.

For practical purposes, within the learning environment of our Virtual Campus, we define a Virtual Study Group as a group between 2 and 5 students, who have a reserved space in the Campus where they can communicate between themselves and swap doubts, solutions, advises, recommendations, suggestions, notes, etc. In this learning environment, students have the possibility to work together even if they don't meet at the same space or time.

In that regard, our previous experience shows us that during the training time and previously to the definitive constitution of the team, it is essential to clarify the goals and the level of commitment in order to establish good collaboration practices. There is need for putting in place the correct strategies from the very beginning. This allows students to realise their strong or weak points, and build a positive attitude towards their role in the new virtual study group. In this work we describe the useful strategies we have put into practice so far.

Our research aims to design instructional and learning systems that could allow students creating groups been fully aware of the advantages and disadvantages of it, and of the whole meaning of that way of learning. Student centred models of learning vary in their degree tutoring is centred on student, that is on the amount of intervention and guidance provided by the tutor.

The VSG could be situated in a continuum that ranges from high self-management by the students to high group control by the tutor. The table below illustrates the different models that could be employed in order to facilitate students' collaborative learning in the virtual environment:

Type	Level of Tutor's Involvement	Details of process
1	High	Tutors present a structure for the teaching/learning process. This includes detailed identification of the purpose of each section, the duration of each session, detailed readings that the students are required to have read prior to each session, definition of the extension activities from each session that students will be involved in and a clear description of the outcomes that are expected from each session.
2	Medium	Tutors identify the broad structure of the content of study. They provide an initial set of readings and other sources of information. Students become aware of their role in the learning process and the tutors' expectations of them. Throughout the teaching/learning process, tutor is not in charge but takes notice of the thinking of the students and seeks, where possible, to incorporate their contributions into her or his teaching.
3	Low	Tutors identify the broad focus of the content of study. Students with the support and guidance (where appropriate) of the tutors define the initial structures that they will use in order to approach the subject. Tutors act as sources of expertise and mentors or facilitators. Tutors only intervene where there is a crisis in the process, this crisis may, for example, be where students step outside the natural boundaries defined by the subject or where there is tension in the collaborative process.
4	No	Students organise their study in groups by themselves without requiring the

	involvement	tutor's intervention. That is, students choose whatever learning activities suit better to their learning needs and objectives.

The main benefits for the students working co-operatively in a virtual environment can be twofold. First of all, co-operative learning creates the potential for cognitive and metacognitive benefits. On the one hand, it reinforces and improves the study and learning of the subject-matter contents. On the other hand, it engages students in a situation that requires them to make explicit both the process followed to carry out a learning activity and the strategies applied to resolve a problem. Making these facts available to everybody in the group can give rise to further discussion and reflection about issues of the learning process itself.

Second, co-operative learning promotes affective and social benefits. In particular, it increases the student interest and value that gives to the subject matter. It also increases positive attitude and social interactions among students, which results very positive and enriching for students with different knowledge levels and others characteristics.

Next section describes the two experiences we carry out in the subjects of Multimedia and Communication (MiC) and Information Structure (IS) in the OUC. The first of them involves high self-management by the students whether the seconded one is highly conducted by the tutor.

3. Initiating Virtual Study Groups within the subjects of MiC and IS

Multimedia and Communication at the UOC

Multimedia and Communication at the UOC is a specific, transversal and compulsory subject to any student that joins the university. This subject has a double value for the students: it reflects on Information and Communication technologies and promotes the strategies and tools students need in order to study in the virtual campus. This is fundamental for searching, organising, sharing and communicating information.

The main objective is that the students improve the conditions of study by collaborating in the process of learning in order to obtain the objectives of the subject. The creation of study groups is suggested to help themselves in the resolution of the inherent difficulties to the practical work of the subject.

The characteristics of the subject are:

- The students have just entered the university and the Virtual Campus is new for them.
- They do not know the implications of studying in a virtual environment, and they do not know how to use its resources.
- They have probably never met before. Consequently, interaction and collaboration level is really low.
- Students lack strategies for virtual work. In addition, they show a reserve attitude towards helping others with the resolution of problems.

In MiC students use the Campus v3 group tools. For information exchange purposes, students access two spaces called Forum and Debate. They also have access to a workspace where to send and download files and a link to a web page that can be modified as they work progresses. This web page can also be used as a tool to link the workspace files and organise information.

The VSG main objective is to support the achievement of the subject goals. The group self-manages and creates its own dynamics. The group is only an instrument for giving to each other support for solving individual activities. The work produced by and within the group is not evaluated. The tutor doesn't propose concrete activities to develop in-group. Depending of students' level of autonomy, tutor plays an important role in helping the group with study questions and guiding its dynamics. The procedure to start a VSG is the following:

- **Creation of groups:**

The tutor makes a proposal in a face to face meeting, and also in the teacher virtual board. For creating groups students just introduce themselves using the virtual forum and not a concrete study activity is suggested. Students exchange information and explain proposals in the Forum. Once a group is created, one of its members informs the tutor.

- **Cohesion and development of the group:**

The tutor informs about strategies, clarifies the conditions and promotes feedback. During that phase, students should:

- Share experiences, create a common culture, develop common rules and construct frameworks in which create a new reality. Moreover, the group should develop activities specifically directed to reinforce the interaction among members.
- Reinforce group cohesion as a factor to increase internal solidarity and decrease tensions and problems between group members.

While they consolidate themselves as a virtual study group, they reach the objective of helping each other studying the subject. In order to "pass" the subject of MiC, students have to complete five long evaluation activities. Although these activities are to be done and presented individually, VSG should be a tool for helping students with the difficulties that may arise during the resolution of these educational practices. In other words, students do not have a functional group goal, but to help each other to reach their personal goals within the subject.

Information Structure

In this section, we describe the methodology followed to implement the pilot experience of VSG in the course of Information Structure. First, we describe the tool used for its implementation.

Based on our previous experience with cooperative learning and problem-solving in virtual environments (Guitert, M. et alt., 1999), we chose the BSCW tool (http://www.gmd.gd/bscw). BSCW is a tool for cooperative work that offers a range of possibilities such as: group management, asynchronous discussions, document management and an automated daily workspace activity report. It also provides a help which explains how to use the tool (Bentley R. et alt., 1997; Horstmann T. and Bentley R., 1997). In addition, we also provided the students a brief help document with the most important functionalities of BSCW so that to facilitate a faster and easier interaction and involvement with the tool.

Given the above conditions, we propose a methodology which consists of a sequence of actions that we believe necessary to realise the experience. The type, goals and the way these actions are performed specify the organisation, content and structure of the interactions that take place in the shared workspace. The planning of the actions is explicitly presented to the whole class by means of a work schedule which describes the type, goal and the timing of each action planned. Next, we describe the three main phases of the approach followed to carry out the experience: *initiating, forming and performing.*

- **Initiating: set up a debate of a case about virtual study group**

The realisation of a case study constitutes the first action of our approach and its main goal is to initiate the students into the new experience. To that end, a specific case is presented to the students for asynchronous discussion. In fact, this discussion constitutes an initial, practical step towards the realisation of a group activity through an exchange of opinions and ideas, which can further motivate and push the students to be engaged in the real group study afterwards.

- **Forming: arrange group formation**

This phase involves three main actions: introducing, negotiating and norming. In particular, students first introduce themselves by presenting information that their classmates could use to reach a decision about making a contact to possible candidate group members. Then, an interaction between possible candidates begins in order to form a group. The purpose of this discussion is to reach an agreement of the definite group normative (rules about group functioning, organization and planning of the work). If the negotiation phase has been sincere and effective, establishment of an accepted normative can be an easy and fast process.

- **Performing: virtual study group realisation**

After a group is formed and its normative is clearly specified, it is the right time for performing: group members should be engaged in a collaborative study and learning of the subject matter. The first goal is to make students carry out learning activities that include the elaboration and resolution of assignments related to the concepts and notions of the theory to be studied. The second goal is to realise a learning task (a small project); this is the case of a practical problem-solving whose purpose is to demonstrate that the students have assimilated the conceptual contents of the subject matter and are able to apply them in a real problem.

Moreover, the timing and the order of carrying out these learning objectives is a very important factor for the success of the group study and for obtaining the benefits drawn from it.

Finally, cooperative learning methods are most likely to enhance learning outcomes if they combine group goals with individual accountability. That is, each group member will be held accountable for accomplishing the learning goals of an activity or task. For example, students should know that any member of the group may be called on to answer anyone of the group's questions. For this reason, to increase and make explicit students responsibility in group study, a particular workspace, called Reflection/revision of group work, has been designed and put at the disposal of all groups. This utility gives students the chance to be involved in follow-up reflection activities, which manifest and clarify the way students study in group, contribute to the group and learn. Making this explicit, it helps students critique and revise the process followed and thus it proves valuable as a way of engaging students in meaningful learning.

4. Reflections from the experience

We are at the initial phase of experiencing with VSG. The research we are doing is based on a methodological procedure of Research - Action and, consequently, we are taking decisions while the experience is going through, paying a special attention and reflecting on the following elements:

- **Group Objectives**: What is the objective of the group. It has to be concrete and precise and should imply a concrete formalisation level shared by all members of the group.
- **Level of tutors and students involvement**: Depending on the group objective, tutor's role may change: managing, democratic, making easy, etc., which at the same time will imply a student's role, more or less self-managing.
- **Cohesion level of the group**: The commitment level, the intensity of the interaction and the type of communication can influence or determine the achievement of the group goals.
- **Work methodology**: In a virtual work context, the notions of planning, task distribution, the tool used and the way it is used are the key elements for efficient group working.
- **Effects on the learning process**: Since improvement of learning and achievement of better outcomes are key elements for every student, it is necessary to investigate how virtual study groups affect and promote effective learning. For this reason, it is important to keep in mind the following influencing factors: motivation, satisfaction, support, accomplishment of learning objectives.

Bibliografy

- Guitert M., Giménez F., Marquès J.M., Daradoumis T., (1999). Asynchronous Collaborative Learning: The Case of the UOC. In: Proceedings of the 17th International Conference on Technology and Education (ICTE Tampa). http://www.icte.org Tampa, Florida, USA, October 10-13, 1999.

- Guitert M., Giménez F., (1999). Colleague: Collaborative Learning in Virtual Environments. In: Sòcrates european project number 56603-CP-1-ES-ODL-ODL. Work in progress.

- Bentley R., Appelt W., Busbach U., Hinrichs E., Kerr D., Sikkel K., Trevor J. and Woetzel G. (1997). Basic Support for Cooperative Work on the WWW. In: International Journal of Human-Computer Studies 46(6): Special issue on Innovative Applications of the WWW, Academic Press, Cambridge, pp. 827-846.

- Bentley R., Horstmann T., and Trevor J., (1997). The World Wide Web as enabling technology for CSCW: The case of BSCW, In: Computer-Supported Cooperative Work: Special issue on CSCW and the Web, Vol. 6, Kluwer Academic Press.

- Horstmann T. and Bentley R., (1997). Distributed Authoring on the Web with the BSCW Shared Workspace System, In: ACM Standards View 5(1), ACM Press.

- Slavin, R. (1985). La enseñanza y el método cooperativo. México: Edamex

Visual Navigation for the Curriculum Based Learning Process

Ruibiao Guo Claude Frasson Marc Kaltenbach Jan Gecsei
Department of Computer Science and Operational Research
University of Montréal, Montréal, Canada
Email: rubyg@nortelnetworks.com, {frasson, kaltenba, gecsei}@iro.umontreal.ca

Abstract: This paper proposes a comprehensive model for editing and exploiting curriculum based ITS, relying strongly on visual information properties. In this system, a curriculum is a capability transition network that consists of two kinds of nodes: capability nodes representing teaching outputs and transition nodes organizing tutoring activities. The bridge between capability nodes and transition nodes is the prerequisite links from capability nodes to transition nodes and the output links from transition nodes to capability nodes.

Based on the domain capability transition network built by a curriculum author, a learner can visually view the domain knowledge structure and establish learning goals. The system then creates multiple alternative paths, each permitting the achievement of the learner's learning goals. After the learner chooses his/her preferred course to learn, the system dynamically identifies necessary tutoring activities and orders these activities according to the current context.

1. Introduction

A curriculum is an essential component of recently proposed ITS (Intelligent Tutoring Systems) architectures (Gauthier 89, Frasson et al. 92, Gecsei & Frasson 94, Nkambou, 96, Guo et al. 98a, Zhou et al. 96). In essence, it is a structured representation of all kind of knowledge needed in the course of a tutoring session (Gagné 92, Merrill 87, 91, 93, Finch 86). In their work, the curriculum becomes the prominent part of the ITS.

The traditional GUIs (Graphic User Interfaces) are not well adapted to the exploitation of complex information structures such as a curriculum. Visualization technology (Gershon & Eick 95) (Gershon & Brown 96) points to interesting alternatives. Curriculum authors and students alike now require much more understanding of the information structures they are manipulating.

This paper describes interactive visual ways of guiding learning process including establishing learning goals, creating alternative courses for the learning goals, and dynamically guiding the learning process. In the first part we briefly describe the actual structure of a proposed curriculum model. In the second part we address specifically the visual properties for guiding learning process.

2. Representation and Organization of the Curriculum

This section briefly introduces a model for organizing various types of knowledge in a curriculum. In this model, we combine Gagné's capability and instructional event theory with Bloom's objective theory to define a kind of transition nodes that organize tutoring activities to achieve domain capabilities (Guo 98).

2.1. Tutoring Outputs: Capabilities and Capability Levels

Based on the analysis of human learning processes, Gagné classified human knowledge into following five kinds of capabilities: Intelligent Skills, Verbal Information, Cognitive Strategies, Attitudes, and Motor Skills (Gagné et al. 85, 92, & 93). The usability of such classification lies in that different teaching strategies can be used to teach them respectively. This theory is the foundation of our further discussion.

- *Capability Levels*

The capabilities defined by Gagné point to the general goals of topic teaching. In fact, teaching and acquisition of any capability contain some gradual sub-processes. For example, in the context of a course on Web page design, "Recognizing a Web page" is a capability. Some gradual sub-processes to teach the capability may be (1) teaching the Web definition, (2) teaching basic Web features, and (3) teaching advanced Web features. Corresponding to these sub-processes, the mastered degree to the capability may be divided into three incremental levels including (1) stating Web definition, (2) stating basic Web features, and (3) stating advanced Web features.

Our model associates tutoring activities with mastering levels of capabilities and students can choose any specified capability level as their desired learning goal.

2.2. Tutoring Activities: Transition Nodes

A major task in curriculum modeling is to organize tutoring activities effectively to support the achievement of teaching outputs. We define a kind of transition node for this purpose, which combines well-known instructional theories from Gagné and Bloom. Bloom (Bloom 69,78) proposed six levels of teaching objectives, including acquisition, comprehension, application, analysis, synthesis, and evaluation. These objective levels can be used to define various educational levels and position sub-processes of capability acquisition at a certain educational level.

Gagné (Gagné et al. 85,92) defined nine instructional events for capability transition. They are (1) gaining attention, (2) informing the learner of the objective, (3) stimulating recall of prerequisite learned capabilities, (4) presenting the stimulus material, (5) providing learning guidance, (6) eliciting the performance, (7) providing feedback about performance correctness, (8) assessing performance, and (9) enhancing retention and transfer. This theory outlines detailed sub-processes of human teaching. Gagné uses these events for individual capabilities.

In order to support the acquisition of multiple level and aggregated capabilities, we use Bloom's objective level theory to organize tutoring units. For each objective level, Gagné's instructional event theory is a good way to organize sub-units. Our transition nodes are defined based on both theories.

- *Transition nodes*

A transition node is a sequence of tutoring units (Fig. 1). Each tutoring unit consists of a sequence of sub-units and relates to certain output capability levels. These units correspond to and are not limited to Bloom's objective levels. Each sub-unit contains one or more groups of resources and is where the actual teaching is taking place.

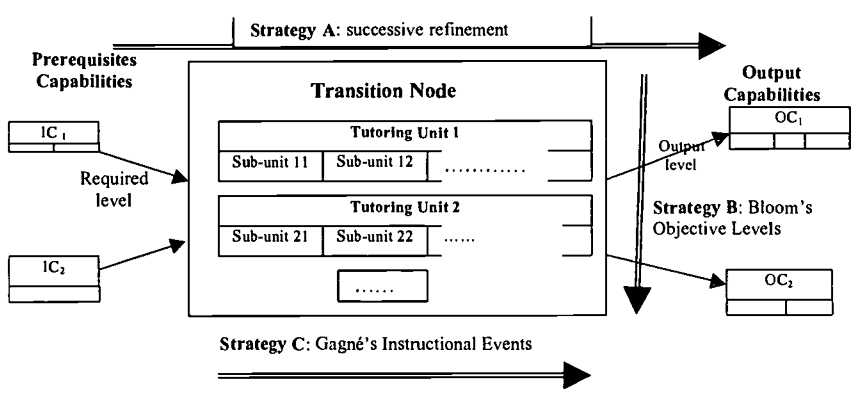


Figure 1 Organization of a transition node

One activated condition of a transition node is that all its prerequisite capabilities be mastered at the required levels. When a tutoring unit is activated, a series of interactive activities takes place. The output of these activities is the acquisition of some output capability levels.

The Fig. 2 is an example of transition node for teaching "Stating what is a Web browser". This transition node consists of three tutoring units that are "Teach browsers' description", "Teach browsers' job" and "Teach popular browsers". Each unit contains a sequence of sub-units. The prerequisite capability of the transition node is "stating Web" with 3 mastered levels: "stating Web description", "stating basic Web features:, and "stating advanced Web features". The output capability of the transition node is "stating Web browsers" up to 3 levels: "stating description of browsers", stating job of browsers" and "stating popular browsers".

In a transition node, each tutoring sub-unit contains one or more groups of didactic resources that consist of various organized media, simulation programs and guidance programs.

Teach Web Browsers						
Teach Web browsers' description						
Present description	Elicit description	Test description				
Teach browsers' job						
Present job description	Elicit browsers' job	Test browsers' job				
Teach popular browsers						
Present introduction	Present Netscape	Present Mosaic	Present Lynx	Present Explorer	Elicit pop browsers	Test pop browsers

Figure 2 Example of transition node

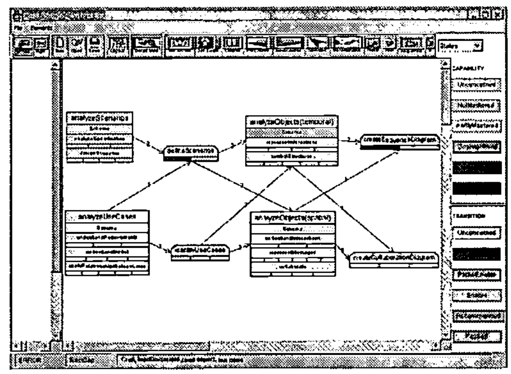


Figure. 3 Capability transition network for teaching a part of UML

2.3 Capability Transition Networks

A curriculum author can use prerequisite links to establish the relationships from capability nodes to transition nodes and use output links to associate transition nodes with output capabilities. Such constructed network is known as a domain capability transition network, simply called *Tnet*:

The Fig. 3 is an example of capability transition network for teaching a part of UML. In the example, there are four transition nodes (big nodes in Fig. 3): "analyze Scenarios", "analyze Use Cases", "analyze Objects (temporal) and "analyze Objects (spatial). The four transition nodes support the achievement of four capability nodes (small nodes in the Fig. 3) respectively: "define Scenarios", "Identify Use Cases", "create Sequence Diagrams" and "create Collaboration Diagrams".

3. Visual Guidance in Learning Process

The originality of the visual representation in our curriculum model lies in the visual properties associated with the various graph components. These properties are highly dynamic, changing for instance with a student's learning progress and with alternative information requests.

3.1. Visually Declaring Known Capabilities and Establishing Learning Goals

In our curriculum model, a learning goal is a specific level of a capability. For example the capability (shown in the Fig. 4) "Applying Links in HTML" contains four incremental levels: "creating links", "linking local documents", "linking other Web documents" and "linking specific place within a document". A learner can choose any one of the levels as one of his/her learning goals.

Applying Links in HTML			
Creating Links	Linking LocalDocuments	Linking OtherWebDocuments	LinkingSpecificPlace WithinADocument

Figure 4 A capability in HTML curriculum

In order to help students declare their known capability levels and establish their learning goals, the system defines a group of rules for dynamically infer students' current knowledge states.

Another group of rules is defined for setting learning goals. An example for setting a goal capability and its levels is as follows. Let C be the overall cell of a capability icon, L be the ordered set of all level cells in the capability, Li ($i = 1, \ldots, n$) be a level cell, and Lg be the index of the goal level in the capability icon, one of the rules for the state transformation of goal capabilities is defined as:

Rg5: if C is not a goal &
Li ($i < n$) is clicked &
C.state == *CAP_UNCONCERNED*
then C.state ← *CAP_NOTHING_MASTERED* &
Li.state ← *LEVEL_GOAL* &
for all $j \neq i$, $j <= n$, Lj.state ← *LEVEL_NOT_MASTERED*.

3.2 Visualizing Alternative Courses

In order to individualize domain capability transitions, we define a course as a sub-network of the domain capability transition network, in which only the selected learning goals (i.e. some capabilities and levels) and some necessary prerequisite capabilities are included. Our curriculum model provides an approach to create alternative courses for the same group of learning goals (the details of course generation will be discussed in a separated paper.).

As soon as the learner selects a course, the system assigns the selected course as the learner's current course. With the help of tutoring delivery module in ITS, the learner, then, can leaner the course.

The following Fig. 5 presents an example of creating multiple alternative courses based on the previous *Tnet* in the Fig. 3. A learner sets the first level of the output capability "create Sequence Diagrams" as his learning goal. The learner can choose one of the four alternative courses as his/her current course to learn, according to the information about effort, resource types and involved sub-goals provided by the system.

3.3 Sequencing Tutoring Activities by State-Driven Reasoning

In order to identify the availability of a tutoring unit in a learning process, we define five kinds of states for transition nodes, tutoring units and sub-units, which are *recommended*, *enabled*, *partlylEnabled*, *disabled* and *passed*. If a unit or sub-unit's state is *recommended*, it is the best tutoring unit or sub-unit for the learner to learn immediately. If its state is *enabled*, it is not the best tutoring unit or sub-unit though it can be learned currently. If its state is *partlyEnabled*, only parts of the unit or sub-unit may be learned. If its state is *disabled*, the learner cannot learn the unit or sub-unit immediately. If its state is *passed*, the unit or sub-unit has been passed successfully by the learner.

- ***States of Transition Nodes***

We define 19 rules to identify the states of tutoring units and sub-units, in which, for example, let U be a tutoring unit, the rule No. 5 is

Ra5: if U is *enabled* & U and the last executed unit have the same parent goal, then U is *recommended.*

Based on these rules, the system dynamically refers the current state of teaching activities and guides the learner with rich visual properties.

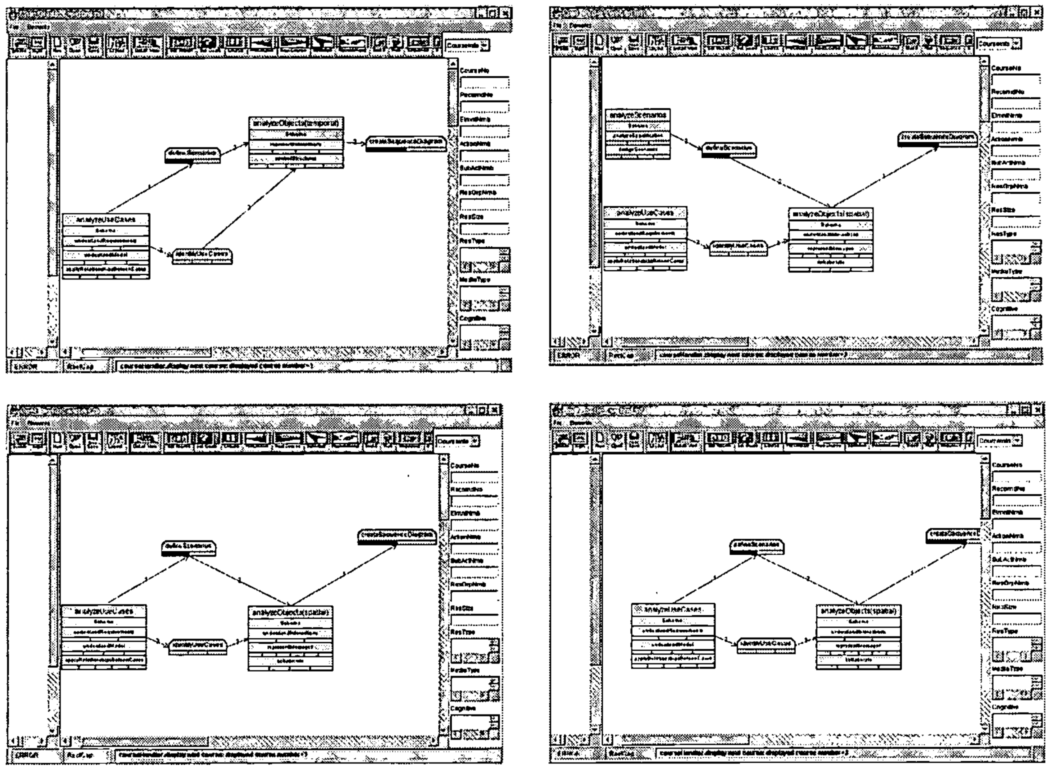


Figure 5 Four alternative UML courses

- ***State of Capability Nodes***

The states of capability nodes reflect the mastering degree of domain knowledge of a learner. We define two groups of states for capability nodes and their levels respectively, in which each group consists of five states: UNCONCERED, NOTHING_MASTERED, PARTLY_MASTERED, GOAL_MASTERED, and FULL_MASTERED. Based on the evaluation to the results of teaching activities, the system uses a group of rules to dynamically change the states of capabilities and their levels. Meanwhile, a group of visual properties related to capabilities and their levels are used to guide the learners.

Conclusion

The paper focuses on the visual navigation for learning processes based on a curriculum model proposed. The model supports aggregated domain capabilities so that it simplifies the overall system structure. Its visualization properties and the integration of well-known instructional theories achieve a practical and useful application of these theories.

A student can use various visual properties to establish his/her learning goals. The system, then, creates and displays multiple alternative paths to achieve these learning goals. In the learning process, the system dynamically catches and displays the learner's current states and displays the next recommended step. The proposed approach is implemented as a Java application called *VITCAM* (Guo et al. 98b).

Acknowledgements: We'd like to thank Dr. Roger Nkambou for his previous work in the project. We also thank Ministry of Industries and Education of Quebec Government and The Telelearning Network Center of Excellence for their supports.

References

Bloom, B. S. (1969). *Taxonomie des objectifs pedagogiques. tome 1: domaine cognitif.* Education Nouvelle, Inc.

Bloom, B. S. (1978). *Taxonomie des objectifs pedagogiques. tome 2: domaine affectif.* Education Nouvelle, Inc.

Finch C.R. & Cukilton, J. R. (1986). *Curriculum Development in Vocational and Technical Education: Planning, Content and Implementation.* Allyn and Bacon, Inc. 2nd Edition.

Frasson, C. Gauthier, G. & Imbeau, G. (1992). Architecture d'un systeme tutorial intelligent base sur un curriculum. Gegie educatif, Vol. 1. No. 4.

Gagné, R.M. (1985). *The conditions of learning and the theory of instruction.* CBS College Publishing, 4th edition, 1985.

Gagné, R.M., Briggs, L. & Wager, W. (1992). *Principles of Instructional Design.* Harcourt Brace Jovanovich College Publishers, Orlando, FL. 4th edition.

Gagné R.M. (1993). Computer-based instructional guidance. In Spector, M., Polson P.C. & Muraida D.J. (eds): Automating instructional design: concept and issues, pp133-146. Educational Technology Publications, Engleword Cliffs, NJ.

Gauthier, G. & Imbeau, G. (1989). Un systeme tutorial intelligent: modele theorique et realisation. In 6e Symposium Canadien sur la Technologie Pedagogique. Halifax, NS, Conseil National de Recherche du Canada,, 110-113.

Gecsei, J. & Frasson, C. (1994). SAFARI: an environment for creating tutoring systems in industrial training. *Proc. of the World Conference on Educational Multimedia and hypermedia (ED-Media).* Vancouver, BC, Canada., 15-20.

Gershon, N. & Brown, J.R. (1996). The role of computer graphics and visualization in the GII. *IEEE Computer Graphics and Applications.* Vol.16, No.2 (March), 61-63.

Gershon, N. and Eick, S. G. (1995). Visualization's new tack: making sense of information. *IEEE Spectrum* Nov., 38-56.

Guo, R., Kaltenbach, M., Frasson C. & Gecsei J. (1998a). Visual Manipulation for Development of Curriculum, *Proceeding of NTICF'98,* INSA de Rouen, France, Nov., 85-96.

Guo, R., Frasson, C., Kaltenbach, M. & Gecsei, J. (1998b). *VITCAM*: A Visual Interactive Management System for Curricula, *Abstracts of Demo in TeleLearning'98*, Nov. 14-17, Vancouver.

Guo, R. (1998). Knowledge Transition in Curriculum, *Proceedings of ICCE'98*, Oct., Beijing, China, 57-66.

Merrill, M. D. (1987). An expert system for instructional design. *IEEE Expert.* Vol.2., No. 2, 25-37.

Merrill, M. D. (1991). An introduction to instructional transact theory. *Educational Technology.* Vol. 31, No. 6, 7-12.

Merrill M. D. (1993). An integrated model for automating instruction design and delivery. In Spector, M., Polson, P. C. & Muraida, D. J. (eds) Automating Instructional Design: Concept and Issues. Educational Technology Publications, Englewood Cliffs, NJ, 147-190.

Nkambou, R. (1996). *Modélisation des connaissances de la matiere dans un systeme tutorial intelligent: modeles, outils et applications.* Ph. D. thesis of DIRO, University of Montreal, Canada.

Zhou, G., Wang, J. T.-L. & Ng P.A. (1996). Curriculum Knowledge Representation and Manipulation in Knowledge-Based Tutoring Systems. *IEEE Transaction on Knowledge and Data Engineering*, Vol. 8, No.5, 679-689.

Expert Review at a Distance: A Hybrid Approach

Al Byers
College of Human Resources and Education
Virginia Polytechnic Institute and State University
Blacksburg, VA USA
abyers@vt.edu

David Halpin
College of Human Resources and Education
Virginia Polytechnic Institute and State University
Blacksburg, VA USA
dhalpin@vt.edu

Abstract: This paper describes a distance-based collaborative process undertaken to evaluate an asynchronous web-based course designed to teach web design skills to students enrolled in a distance-based Master's program. Several forms of collaboration were used to allow two expert reviewers to share their opinions on the course without actually meeting face to face. Comments and suggestions were passed between the reviewers and the course designer, culminating in a comprehensive review document containing aggregated suggestions for revision of the course. Although the process proved successful, care should be taken when undertaking such a process to avoid stumbling blocks brought about by the psychological distance involved.

Introduction

The purpose of this paper is to describe a distance collaborative evaluation method employed to analyze an asynchronous web-based course. This course is offered through the Instructional Technology department at Virginia Tech as part of a distance education Master's program. An initial Expert Review of the course was commissioned by the Virginia Tech Instructional Technology department as part of an assignment for a graduate course in product evaluation. A first year doctoral student from Virginia Tech followed specific guidelines provided by the department to complete the review process. Several leading instructional design models were utilized to conduct this initial review and will be described below. After completion of this initial review, a second doctoral student, this one from the University of Georgia, reviewed both the web-based course and the first reviewer's comments. The cumulative review of the first two students was then passed on to the course developer. The course developer added his own comments and incorporated student feedback into this collaborative review. All of the information was then re-circulated and a consensus reached that incorporated all the information into a collective list of evaluative recommendation. All correspondence between the three reviewers was accomplished using a variety of distance-based collaborative processes, including phone, email and videoconferencing. The background behind the initial online course offering will now be discussed.

Background

With the recent adoption and mandate of the Virginia Standards of Learning (SOLs), k-12 instructors throughout the state are now required to take coursework for re-certification that demonstrates a set of core technology competencies. In efforts to support this statewide endeavor, Virginia Tech developed and implemented an Instructional Technology Distance Education Masters Program (ITMA). This online program consists of 13 unique ITMA modules that can be taken independently of each other as needed to satisfy Virginia SOL re-certification requirements, or in total toward the Virginia Tech Master's degree program. The instructional delivery methods Virginia Tech utilizes employ an assortment of strategies such as intensive workshop-style courses offered within individual school districts (on-site); interactive television courses offered through a number of state-wide facilities; web-based courses; week-long, on-campus summer courses; open-studio development; and individual computer-based programs.

Our evaluation concerned itself specifically with "Module 4: Web Site Development" (available at http://psyche.ed.vt.edu/module04/). The intent of this module is to provide learners with basic HTML design skills using Netscape Composer, such that they develop a 7-8 page standalone web site. Should the learners not be taking this module independently, but as part of the overall Virginia Tech ITMA program, their product will be integrated into a larger electronic portfolio. There were 51 students who participated in the first iteration of the module. These students were divided into three cohort groups based on their geographic location within the state of Virginia. They constituted a diverse mixture of elementary and middle school teachers, librarians, and instructional technologists in the public school system. The initial Expert Review evaluation process will be discussed next.

The Initial Review Process

The overall model of the Expert Review was patterned after the procedure outlined in the book *Planning and Conducting Formative Evaluations* (Tessmer, 1998). Tessmer delineates the steps and values behind conducting the following types of reviews: One-to-One, Expert Review, Small Group Evaluation, and Field-testing. The Expert Review conducted on Module 4 focused specifically on the following areas: General product description, instructional components, instructional contexts and functions, and overall instructional message display. A brief description of these areas will now follow.

The general product description delineated the developers, clients, module objectives, learning environment and media characteristics incorporated in Module 4. The "instructional components" section evaluated the overall structure of the module from a Walt Dick and Lou Carey instructional design perspective (1996). In addition, several other ID research theories were employed which will be discussed later. The instructional context of the module was examined to evaluate the synergism between all the factors influencing the appropriateness of context chosen and under what functions it was intended to facilitate instruction. The overall message display was additionally evaluated with respect to the following: layout, color, density of information, perceived units of information, rate of information presentation, and appropriateness of images and/or audio used. Now that an understanding of evaluation components has been described, an elaboration of the ID research models employed will be discussed.

To evaluate the overall module from a "Big Picture" perspective the Walt Dick and Lou Carey model was used (Dick & Carey, 1996). The following components were examined in the module for their inclusion of appropriate sub-component characteristics: Introduction, activity, practice & feedback, review, assessment and transfer. Within this overall structure, the individual instructional objectives were examined using the methodology cited in Sullivan & Higgins 1983 book: *Teaching for Competence*. Thus, instructional objectives were examined with respect to observable and measured behaviors, with proper attention to conditional givens and standards.

The work of Tessmer & Richey (1997) was used to classify and evaluate the module with respect to the appropriateness of context and its function within the overall design stages of orienting, instructional, and transfer (Tessmer & Richey, 1997). Module 4 employed the contexts of "Real" and "Tutorial" appropriately. J.M. Keller's ARCS model of instructional design was utilized to evaluate the module from a motivational perspective, attempting to identify if the following strategies were implored: Attention, Relevance, Confidence, and Satisfaction (Keller, 1987). Finally, the work of Gagne and Driscoll was utilized to measure the appropriateness of instructional objectives to specific tasks or lessons at hand (Gagne & Driscoll, 1998). Now that the research behind the initial Expert Review has been presented, the process of the distance collaborative Expert Review model will be discussed.

The Collaboration Process

The original Expert Review (ER) paper was circulated to the second distant expert reviewer. The second reviewer then visited the Module 04 web site, reviewed the ER paper, and evaluated the initial reviewer's criteria against the originally commissioned guidelines and the actual module, inserting comments into the original ER paper using a different colored font. The updated ER paper with comments was then circulated to the module developer and the initial reviewer.

Next the developer's implementation perspectives were incorporated as a separate section at the bottom of this evaluation paper, describing the technical difficulties encountered during the module's first field test, including student impressions of Module 4's effectiveness. This updated document was then sent to both reviewers who additionally commented on the developer's implementation analysis. Finally, having now seen both sets of Expert Review comments in a single document, the developer offered his impression of the expert reviews. Needless to say, this asynchronous distance evaluation approach involved several iterations of circular review, providing a thorough analysis of the module from an ID Expert Review perspective.

The techniques employed in the collaboration process utilized several forms of distance communication. The review document was created in Microsoft Word and passed between reviewers via email attachment. Discussion and debate between the reviewers took place using email, teleconferencing, and videoconferencing. The important realization to come out of this process is that without in-person, face-to-face contact there is a higher probability for miscommunication to occur between participants, especially when those participants have never met face-to-face. At several points during this collaborative project there was confusion due to misunderstandings created by the psychological distance between the three reviewers. Next discussed will be a synopsis of the aggregated conclusions found between the three independent reviews.

Aggregated Conclusions

Both expert reviewers agreed that overall the site was exemplary. The module was well designed, easy to understand, implement and execute. The site was additionally aesthetically pleasing from a graphical design standpoint. Most importantly the asynchronous module was successful in its instructional goal of facilitating the learner with the creation of standalone web sites. Both the director of the ITMA module, Dr. Greg Sherman, and the participants commented favorably in survey reviews at the completion of the module.

From an instructional design standpoint, only a few suggestions were put forth, which may improve the effectiveness and efficiency of the module. The comments that follow were the collective agreement from all three parties. First, there may be a benefit to incorporating an official assessment for each sub lesson within the overall unit by way of a rubric. This rubric would specify evaluation criteria, thus providing a way for the learner to check their work prior to submission. In addition, the Composer tutorial should include instruction specific to the Macintosh platform. This could be done by incorporating Macintosh examples in the existing tutorial, or by creating a new tutorial specific to the platform.

Also, a separate lesson dealing specifically with tables may be warranted, incorporating additional instruction and a student-2-student collaborative constructivist model. Finally, the overall module may be made more effective should all lessons utilize more examples of student work tied to reflective collaboration. It should be made clear though that these suggestions are unproven at this juncture, and their success must still be borne out in future revisions through evaluative field-testing.

References

Dick, W., & Carey, L. (1996). *The systematic design of instruction.* New York: Harper Collins College Publishers.

Gagne, R., & Driscoll, M. (1998). *Essentials of learning for instruction.* Englewood Cliffs, NJ: Prentice Hall.

Keller, J. M. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development, 10*(3), 2-10.

Sullivan, H., & Higgins, N. (1983). *Teaching for competence.* New York: Teachers College Press.

Tessmer, M. (1998). *Planning and conducting formative evaluations.* Philadelphia: Kogan Page Limited.

Tessmer, M., & Richey, R. (1997). The role of context in learning and instructional design. *Educational Technology Research and Development, 45*(2), 85-115.

Prototypical Development of Multimedia Explorations with Preventative Medicine as an Example

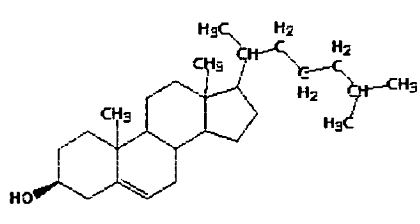
Thorsten Hampel, Thomas von der Borch
Heinz Nixdorf Institut
Computers and Society
Fürstenallee 11
33102 Paderborn
Germany
hampel@uni-paderborn.de

Abstract: Explorations evolve from the concept of developing modular designed learning software. As the prototype modules are for a specific subject field, they represent an interactive environment, which—independent of a didactical global concept—can be flexibly embedded in currently available web-based learning environments. Unlike a classical simulation, one has the possibility whilst carrying out given experiments, medical processes or technical construction problems to individually customise the structure or even produce one's own constructions or parameters—not only to adjust parameters. With it, an instructor is able to set constraints in order to achieve a specific learning goal, and in turn their adherence can be proven. The immediate response allows the learner to gather experience in an easy and playful way, and it guarantees direct and clear access to a region of imparted knowledge.

Introduction

A very important problem, for which a need of information exists that should not be underestimated, is the hardening of arteries. According to a number of statistical surveys growing prosperity in the industrial nations gives rise to heart and circulation diseases, which represent the most common cause of disease and death in such countries. Damage to the artery system is usually the culprit, where in such cases cholesterol (see Roche, 1998) has been the major cause of the contraction of the artery.

An excessive intake of the "nasty" cholesterol "LDL" (Low Density Lipoprotein) cannot be counteracted fast enough with the good cholesterol "HDL" (High Density Lipoprotein), and thus it lingers in the internal layer of the artery (Initima), and, after a short period of time, it is modified by a chemical oxidation. HDL is no longer able to transport modified LDL away, and so the so-called "eat-cells" (macrophages) must absorb the modified LDL through a process called phagocytosis. If the macrophages absorb too much of the modified LDL, they die and mutate into Xanthom-cells and deposit plaque on the walls of the arteries. The balance between LDL and HDL is crucial, which should not rise the limit of 3.5. Malnutrition, smoking, lack of physical exercise and an excessive consumption of alcohol give rise, among other things, to a dangerous surplus of LDL.



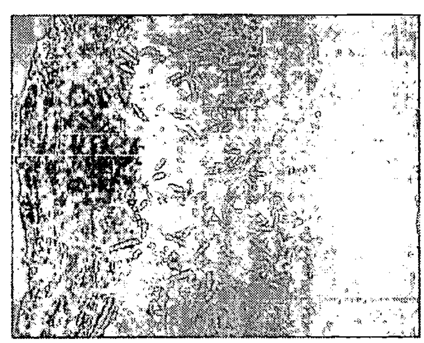


Figure 1: Cholesterol, $C_{27}H_{46}O$ (left) from (Emsley 1996), right picture (CPRRC 1999): "Cross section (right) is that of an artery wall showing atherosclerosis plaque (middle layer) with cholesterol 'clefts'. The cholesterol 'clefts' are shown as the white streaks throughout the plaque layer"

A second fundamental cause of the hardening of the arteries is the natural deposition of calcium in the arterial system. It is possible to dissolve the calcium attached to the artery wall with particular injections. The calcium is then broken down in the kidneys and later excreted. A risky surgical operation, involving the pumping up of the artery with the use of, for example, a balloon, is thus unnecessary.
With high blood pressure over 150 mmHG the danger exists that apertures form in the artery walls. A large amount of blood platelets (thrombocytes), which are responsible for the blood clotting, travel to the apertures and attempt to close them up. The accumulation of the thrombocytes leads to a so-called thrombus, where a blood clot forms within a blood vessel and remains attached to its place of origin, hindering the blood flow.
Over time these causes lead to an artery blockage, which can then lead to an insufficient supply of oxygen to the organs. If arteries attached to the heart or near to the brain are affected, in the worst case it can lead to an acute myocardial infarction or stroke.
Information for people affected and for those interested in effective preventative measures is ample. Due to its degree of complexity and current relevance this medical application is ideal to use for the development of a three-dimensional exploration (for the concept of explorations see (Hampel & Nowaczyk 1999) and (Hampel 1999)).

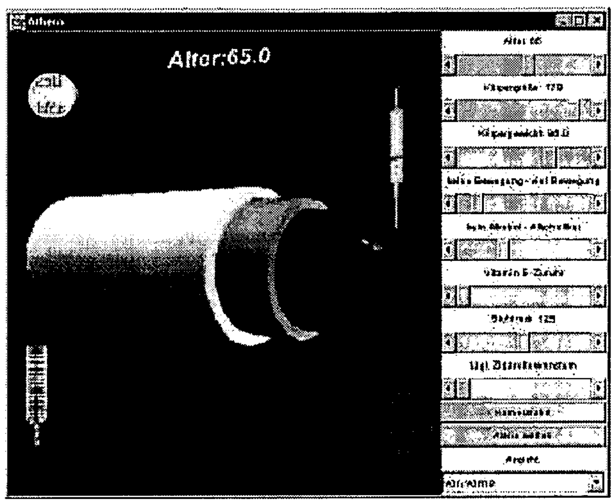


Figure 2: The Athero main window

Developing a three dimensional exploration

The exploration environment "Athero" developed from this specification can provide information about a person at any time. Thus exploring with the system is made possible, in which the user is able to input the initial situation and continuously adapt it to his/her way of life during the simulation at their will. Finally, the user is able to observe which processes within the arteries are provoked, depending on the input parameters. Through interactive intervention in the scene, the user is able to gather information about single blood components in the form of HTML texts and images as well as in the form of audible documents. These forms of media are opened in an additional browser window. It is expected that the provision of a greater number of interactive possibilities will provide the user with a better understanding of the problematic nature.
To ensure that the public at large have unrestricted access to "Athero", it should be made available via the internet. In order to do so it was necessary to develop "Athero" in such a way that it could be loaded into a Web-Browser such as "Netscape" or "Internet Explorer" (At the moment with a Java plugin as current browser do not support the newest Java-version (see Java Plugin).
In order to provide a clearer understanding of the 3D-System, and to reach a suitable speed, at which the complex 3D-scenes will be displayed, the visualisation is limited to the effects of the LDL, such as the natural hardening of the arteries at age of 40 and the creation of thrombocytes in the case of endothelium related injuries. The information system can, however, be extended at any time. For example, additional objects could be inserted into the scene, which could also lead to arteriosclerosis, without sacrificing its clarity. The rules used to calculate the HDL and LDL concentrations, with relation to the other adjustable parameters, are easily interchangeable.

The model and the scene

One section of a pulsating artery is displayed in a graphic formation, in which different components of the blood flow; such as thrombocytes (responsible for clotting), erythrocytes (red blood cells, responsible for the transportation of oxygen), leucocytes (white blood cells, responsible for the repulsion to penetrate cells during an infection), macrophages (so called eat-cells) and LDL. The user can see that under normal external conditions, the erythrocytes, on which it mainly depends, as they supply the organs with essential oxygen, still flow unobstructed through the arteries. If there is an increase of artery blockage through the formation of calcium, plaque or thrombocytes, the flow of blood cells is restricted, and the cells are left to revolve on the spot for a while to allow a smaller number of erythrocytes to flow out the other end of the artery. This leaves the organs with a lack of oxygen. It is possible to influence the external factors such as appearance of age, height, weight, exercise, consumption of alcohol and cigarettes, and blood pressure. The individual parameters are analysed by the program and displayed accordingly in the 3D-scene with the increases and decreases of LDL and HDL. On the other hand this has an effect on the other components of the blood as well as on the artery walls.

With the use of the mouse the user is able to interact with the 3D-scene from, for example, expanding the artery to giving a virtual injection. With a single mouse click accurate information regarding individual objects can be obtained. In order to describe the physiological construction, the task and possibly the current condition of the selected object more closely, a text, graphic, video-sequence, or an internet link to a web-site will be displayed in the browser. In another control window the user has the possibility to select a number of different viewing positions for the artery. And finally, a "camera tour" can be initialised, in order to view some objects more closely.

As mentioned earlier, the LDL and HDL concentration is a very important factor for the development of arteriosclerosis. Unfortunately, it is not possible to draw up "ten golden rules" for the calculation of LDL or HDL concentrations, rather the values rise and fall, depending on the probabilities to be calculated. To determine the concentration of cholesterol details such as age, height, weight, physical behaviour, cigarette and alcohol consumption, blood-pressure, and a person's vitamin E content need to be given.

Depending on these parameters updates and "calculations" are carried out at regular intervals in an update method, which, in accordance, controls the processes in the artery.

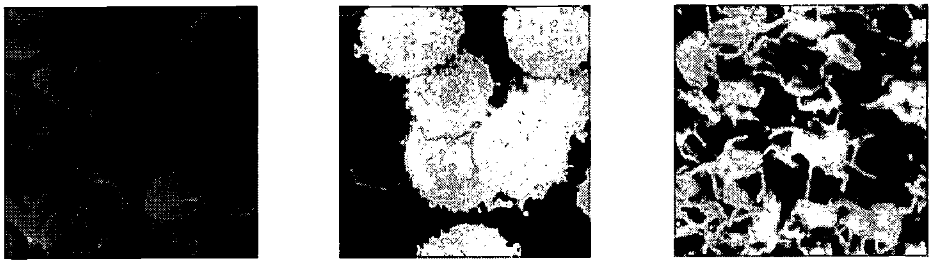


Figure 3: Erythrocytes (red blood cells, responsible for the transportation of oxygen), leucocytes (white blood cells, responsible for the repulsion to penetrate cells during an infection) and thrombocytes; from (DRK Lichtenstein 1999)

Establishing the factors that influence the rise in LDL by calculating the BMI value (Body Mass Index: determined from the age, height and weight and used to determine whether a person is overweight) is among the steps belonging to the updating process. Another is the evaluation of cigarette and alcohol consumption and adjusting the LDL values accordingly. Reducing the LDL values and increasing the HDL values through exercise as well as a low alcohol consumption leads to an LDL reduction which, in turn, leads to increased HDL values.

After adjusting the LDL and HDL values, the LDL-HDL relationship is calculated, and depending on the result a modification probability of the LDL particles that are momentarily present in the internal artery layer is calculated. The LDLs are then possibly modified, absorbed by the tissue or are taken away with the HDL. In the latter case the cholesterol concentration must be reduced in the tissue.

In addition to the LDL-HDL relationship, the probability for an endothelium-related injury caused by high blood pressure is calculated and an instruction to close the endothelium-related injury up is passed on to the thrombocytes. From an age of 40 years the probability for calcium deposits that occasionally need to be produced increases.

A serum can be administered with a virtual injection, which prevents the development and the growing of calcium deposits. If this serum is available in the blood it will be reduced over time.

Leucocytes, which are responsible for the transportation of bacteria, are produced when an infection exists in the body that gives a higher reading than 37.5 C on the thermometer. On transportation the body temperature is reduced

slightly, showing the fight that the leucocytes put up against the infection. If modified LDL is found in the blood, macrophages are produced, which eliminate them.
The demand for three-dimensional representations of objects, increased interaction, exploring with the system, publication in the internet and last but not least the possibility to develop the software in an object-orientated way has led us to the use of Java3D.

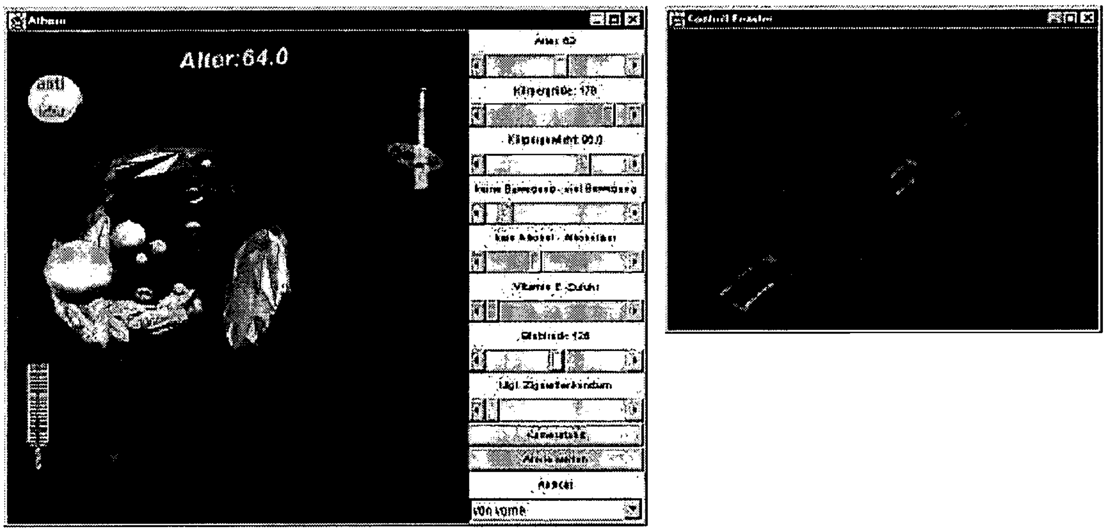


Figure 4: The Athero main and navigation window

Developing Athero in Java 3D

Ever faster processors and graphic cards offering ever more memory enable complex and detailed real-time three-dimensional universes to be displayed. Going under the idea of "Learning with multimedia" one can build virtual models, which provide the building blocks for three-dimensional exploration systems. Both Java3D (see (Java 3D API), (Brown & Petersen 1999) and (Sowinzal et al 1997)) and VRML (see Web3D Consortium) are suitable for the representation of these animations.
Java3D is a class library for Java. It makes an extensive range of commands and 3D-features available to the developer, as well as high- and low-level graphic programming to create interesting three-dimensional models. It should not be forgotten that VRML is a description language that is totally independent of a programming language. It is a file-format for 3D-data in WWW that allows complex fixed 3D-universes to be presented. The more animations, interactions and calculations are integrated into the 3D-models, the more suitable Java3D is.
The Java3D API (Application Programming Interface) is a library of Java classes for the presentation of 3D-universes. It contains a graphical run-time system that offers an object-orientated, high-level programming model to the developer, with which they can develop sophisticated, interactive 3D Java applications and web-based applets.
As Java3D is a class library of Java it offers the developer all graphical support within the three-dimensional area, with which they are able to construct 3D-objects as well as different structures, with which the objects are rendered ready.
On the one hand it is a matter of suitable data structures, while on the other hand it is matter of methods used to display data. The fundamental concept of this implementation is to cover the hardware specific details with a general interface. Java 3D relies on low-level technologies such as OpenGL (see SGI OpenGL), Direct3D (see Microsoft DirectX) and inherits ideas from QuickDraw3D (Apple's implementation of a 3D graphics library, see (Apple Quicktime)).
Java3D fits seamlessly into the whole concept of Java. A great advantage of this programming-language is the flexibility offered by such platform independence. Implementation is currently provided for Windows, Solaris and Linux. During the development a lot of weight was placed upon the performance, which was achieved with parallel rendering. In addition, Java3D was optimally designed for the future development of hardware such as cluster and multiprocessor systems, as one stays on a comparatively abstract level whilst programming and allows Java3D to do the optimising.
Another advantage is the support of different file formats. For this purpose, among others, the portfolio-package by NCSA (see NCSA Portfolio) offers loader-classes of all current 3D-graphic formats, such as 3D-Studio, True-Space,

Digital Elevation Map, Lightwave 3D and many more. During run-time in the 3D-scene additional complex VRML-universes can be loaded with a so called VRML-loader (see VRML loader) available from Sun Microsystems. Java3D is not exclusively for laying out static 3D-universes, it also explicitly supports the drafting of dynamical 3D-scenes. Applications are able to react to user inputs, perform calculations, construct 3D-objects, manipulate them in any way, and add or delete them, all during run-time. These objects (3D-models and sounds) are placed in an virtual universe, which is then rendered functional. To increase the multimedia quality of the applications they can be fitted, without great effort, with extra characteristics such as video sequences and pictures.

Apart from its "Write once, run anywhere" philosophy 3D API has other advantages. Because it is a member of the Java family it is entirely designed in an object-orientated way. Although the object-orientated design usually offers itself to the programming of graphics, in previous packages such as Open GL this aspect was generally dealt with in a secondary fashion. Thus the job of development, servicing and the extension of existing software has been enormously relieved.

The scene graph based 3D-modell, which is based on Java3D, helps even the inexperienced developer with the integration of multimedia and graphic programming and 3D-effects into its applications. Despite the wide scope of functions offered by Java3D an experienced Java programmer will find it easy to learn—in contrast to low-level, procedural APIs such as Open GL. The rendering of objects is handled in an automatic way and with the insertion of threads it is possible to work on different functions in parallel. They can also be carried out with the use of different computers. Apart from simplifying the development of software with Java3D, the package also offers sufficient performance for computers currently available. This is quite remarkable if you stop to think, that Java belongs to the interpreted languages.

A Java3D program creates Java3D objects and places them in a scene-graph. The scene–graph resembles a tree data structure constructed by different objects; it describes both the content of the virtual universe as well as the rendering of it. In order to optimise the scene-graph it is possible to compile it after its creation. In order to manipulate the scene-graph during run-time, so called capability bits are used, which define the manipulations that are allowed to be made.

As a result Java3D is ideal to be used in interactive 3D-environments such as games, simulations and explorations. Effective animations can be produced with the Java3D class within a short time.

While experimenting with Java3D a simple driving program was programmed within a few hours. The Java3D program creates a street with an asphalt texture and with median strip that moves to the direction of the viewer. Street poles pass rapidly on both sides of the street to give the impression that the user is really driving. To give the appearance of driving around curves the horizon moves from side to side of the street; just like the horizon created by a cylinder is produced with a scenery texture. The whole scene can be rotated, zoomed in or out and moved by the mouse on its axis. On a Pentium PC the animation runs astonishing fast. (A Java 3D program runs on Microsoft DirectX (see Microsoft DirectX) or OpenGL graphics devices and libraries installed).

To represent the street a simple rectangular plain was created with a 3D-geometry modelling program and converted according to VRML97. In order to reproduce the streets as true to life as possible, the street is given an asphalt texture, also showing the markings on the streets. Every single straight element on the street is given a "position behaviour", which moves the element on a straight route in the direction of the viewer. A number of elements lined up create an effect of driving.

The curves are also created with these street elements, but instead of being manipulated with a position behaviour, they are manipulated by a "rotation behaviour", which rotates them slowly from left to right. Because the elements of the curves are very close to the horizon, making them barely recognisable to the spectator, a shift in direction is avoided. The background is created with the help of a cylinder at the zero point. As a large enough radius and landscape texture are provided, the spectator receives the perfect illusion.

The architecture of Athero—overview

In Athero the 3D-capabilities of Java3D API were used extensively in order to develop an attractive exploration. The ever present object-orientated programming makes maintaining and extending the application considerably easier and simplifies the transferring of real objects with their tasks and characteristics to the computer model.

Extending is particularly important, as—out of time and technical reasons—the simulation is not limited to itself, rather continual development in the knowledge of hardening of the arteries is necessary. The possibility should exist to integrate, for example, new blood-particles that participate in the hardening of arteries in the simulation.

Moreover, it is possible to change the method, with which the LDL/HDL-concentrations are analysed, by current calculation possibilities. The behaviour of the single objects always tends to direct to this method.

The application has two frames. The main frame includes a panel with the 3D-canvas, on which the 3D-simulation is displayed, and beside it is a panel with sliders and buttons to adjust the parameters.
The second frame is equipped with a 3D-canvas, on which VRML-models of video-cameras are placed around a cylinder representing an artery. The cameras are situated at four different positions in the virtual room, from which the viewer can follow the scene at the main window. The use of a menu was avoided, as the influence of the simulation is limited to changing the parameters of different objects with the help sliders and buttons and also from mouse clicks.
All 3D-models used such as the artery, the erythrocytes, the leucocytes etc. are loaded as VRML-models and can therefore be replaced by the user. On slow computers for example 3D-objects can be exchanged with models with a low level of detail. Athero runs equally well as an applet in a web browser and as a stand-alone application in a DOS-Box.

Outlook

In the future smaller exploration systems, in which constructive theories are transferred, can be used for teaching in schools or in universities. Due to the ease and quickness of production, not everything depends on developing lifelong simulations. If an application proves to be useless, it can be simply done away with.
It is realistic to imagine that pupils and students will develop applications on their own with the help of Java3D explorations or work with them to gain a better understanding of complicated issues. The availability over the net also offers an advantage. People wanting to learn have the possibility to do it simultaneously without being restricted to a specific place and through it gain experience with mutual interaction and a better learning affect. These kinds of exploration environments could find an application in the school classroom or in local or even intercontinental seminars.
The use of such systems, such as the simulation of the hardening of the arteries, is conceivable in hospitals or therapy centres. They could contribute to a better understanding of diseases and thus help a doctor or therapist to explain a diagnosis or its effects.

References

(Apple QuickTime) Apple Computer QuickTime: http://www.apple.com/quicktime/ (3/4/2000).

(Brown & Petersen 1999) Brown, K., Petersen, D.: Ready-to-Run Java 3D, May 1999, John Wiley & Sons.

(CPRRC 1999) Cardiac Prevention and Rehabilitation Research Centre (CPRRC): http://adminweb.ucis.dal.ca/cprrc/cholest.htm (3/4/2000).

(DRK Lichtenstein 1999) Deutsches Rotes Kreuz Lichtenstein: http://www.neckar-alb-online.de/priv/drkrtl/main/index.html (3/4/2000).

Emsley, J., The Consumer's Good Chemical Guide, Corgi 1996. Available online at the Department of Chemistry, University of Oxford: http://www.ncl.ox.ac.uk/mom/cholesterol/default.html (3/4/2000).

Hampel, Th., Nowaczyk, O. (1999). Explorationen für die Mechanikausbildung – eine neue Dimension interaktiver Lehrmaterialien. 44th International Scientific Colloquium, *3. Workshop Multimedia für Bildung und Wirtschaft*, 23. und 24. September 1999, Technische Universität Ilmenau, 101-103.

Hampel, Th., Keil-Slawik, R., Ferber, F. (1999). Explorations–A New Form of Highly Interactive Learning Materials. In de Bra, P., Leggett J.: *Proceedings of WebNet 99- World Conference on the WWW and Internet*, Honolulu, Hawaii, October 24-30, 1999, 463-468.

(Microsoft DirectX) Microsoft DirectX Web site: http://www.microsoft.com/directx/ (3/4/2000).

(NCSA Portfolio) NCSA Portfolio Object Library for Java3D: http://www.ncsa.uiuc.edu/~srp/Java3D/portfolio/index.html (3/4/2000).

Roche, H., 1998. *Roche Lexikon Medizin*, Urban und Fischer, Germany.

(SGI OpenGL) Silicon Graphics OpenGL http://www.sgi.com/software/opengl/ (3/4/2000).

Sowizral, H., Rushforth, K., Deering, M., 1997. *The Java 3d API Specification (Java Series)*, Addison-Wesley.

(Sun Java 3D API) Sun Microsystems Java 3D 1.1 API: http://java.sun.com/products/java-media/3D/index.html (3/4/2000).

(Sun Java Plugin) Sun Microsystems Java Plug-in Software: http://www.java.sun.com/products/plugin/ (3/4/2000).

(VRML loader) The Java3D and VRML working group: http://www.vrml.org/WorkingGroups/vrml-java3d/ (3/4/2000).

(Web3D Consortium) Web3D Consortium: http://www.web3d.org/ (3/4/2000).

Scenarios of a New Dimension of Learning by the Co-operative Structuring of Knowledge

Thorsten Hampel
University of Paderborn
Heinz Nixdorf Institute
Computers and Society
hampel@uni-paderborn.de

Abstract: The initiative sTeam—structuring of information within a team—in Paderborn is developing an open and co-operative platform in order to equally enable learners as well as lecturers and scientists to organise and structure knowledge in a co-operative way. The following article presents the possible use of such an environment in form of application scenarios. In this context special emphasis is placed on integrating the developed tools and methods into a way of co-operative teaching that will also work in everyday life, i.e. the development of the so-called learning supportive infrastructures will be accelerated.

Introduction

Since the emergence of the Internet the application scenarios of this new, exciting and constantly expanding medium have continuously increased. Apart from the most well-known application, the WWW, different technologies have been developed such as chats, video-conferencing or network-supported multimedia databases which have gained broad acceptance by users. Current developments such as the expansion of e-commerce solutions or extensive network-supported libraries are unfortunately characterised by a limited commitment of users to contribute individual abilities or actively participate in organising the presentation of information.
The WWW has emerged as mere medium of information providers for the consumer. What is less important for online shops and web performances of companies turns out to be the decisive criterion for the use of the WWW as teaching and learning environment. Today's WWW offers only marginal opportunities for the consumer to structure the presented information, to work on own documents or contribute them. Already at an early stage it had been realised from different angles that the possibility to contribute annotations and individual comments on the pages and texts is an important prerequisite for the successful application of such a medium in teachings (see Engelbart 1984). If the network is to be used as co-operation-supporting tool it will be essential for students and lecturers as well as for all users to have personal structures in the jungle of the WWW. Bookmarks as browser-dependent rudimentary structures are rather unsuitable procedures since it is neither easy nor unproblematic to provide them with annotations, pass them on (i.e. supporting co-operation) or structure them sufficiently. For this reason the so-called "lost in hyperspace" syndrome—a synonym for an inherent navigation problem in the network—is still omnipresent. It is true that the ever increasing number of Internet users has led to a shooting up of information, but the way of co-operation among users, i.e. the exchange of documents and information is furthermore limited to the sending of documents and web addresses (URLs) per e-mail.

sTeam—create an open and flexible platform for knowledge management

The following article aims at outlining new ways of using the Internet and its services (mail, news, ftp, WWW) to support teaching and is based on experiences of many years by the group "computers and society". This working group has dealt with questions concerning the organisation of infrastructures for an active support of human learning. Basing on a number of existing technologies the sTeam approach contains the claim that existing services and systems can be integrated—by justifiable efforts—into an open user-centered platform.

During the last two years essential efforts have been made to approach our target regarding an open and individually-made platform of existing and future technologies. The last paragraph of this article outlines the technological requirements to such an environment and makes clear that the only practicable way will be the implementation on an open-source basis.

In order to obtain an exact idea regarding the functionality of a platform that is supporting teaching at the university as well as scientific work, the focus of interest—as already mentioned in (Hampel 1999)—will not be the architecture of such a system, but rather a possible scenario of the application in everyday teachings whereas this scenario will function as guiding criterion for creating the conception of a core architecture of the sTeam approach—"structuring information within the team". Already existing prototypes of the sTeam system exactly aim at the fulfillment of the above-mentioned scenarios and will continuously be extended for realisation.

The lectures offered by the "computers and society" group such as "software ergonomics" aim at the active collaboration of students. Apart from lectures, students will—in interactive exercises—be encouraged to develop own software-ergonomic organisation processes and to evaluate existing systems. In the course of the work with a broad variety of sources of knowledge such as laws, standards, style-guides or scientific essays, a number of systems have to be evaluated according to a number of software-ergonomic criteria. Experiences that have been gained in events during the last years show that students are only able to actively understand and internalise the handling of a multitude of knowledge when they co-operatively use different media. In addition to this materials should be available at any learning places (see Keil-Slawik & Selke 1998). Already for some years sTeam has been working at the research of concepts and tools to ensure the availability of documents at each learning place for the support of the students.

Scenario of the application during lectures

In the scenario of the "software ergonomics" lecture the students are in the foreground. The lecture takes place as reference event in one of the interactive lecture halls (digital infrastructure for computer-supported co-operative learning) at the University of Paderborn[1]. sTeam as infrastructure and a number of co-operation-supporting tools provides so-called semantic spaces for the topic "software ergonomics lecture" (see Henderson & Card 1985). Semantic spaces contain all sTeam objects such as links, documents, texts, graphs, tools, annotations and any application objects (presentations, spread-sheet calculation etc.). In relation to the example of the software ergonomics lecture, current slide presentations as well as background information of the lecture can be presented, i.e. all documents, graphics and external resources the lecturer is referring to.

This inherently accessible stock of documents enables e.g. the lecturer to have direct access to a number of sources of knowledge during the lecture, to illustrate them actively or to react to checkbacks and suggestions of the students by additional illustrations or modifications of the material. Participating students are able to make annotations, i.e. adding personal notes to slides and documents or write down own texts or simultaneously link documents by hyperlinks.

The process of developing own mental structures during lectures has to be actively supported by sTeam and can—in contrast to most other available systems—also take place co-operatively. The hierarchy of groups and rights that refers to all objects within the sTeam system allows a complex specification of the access to annotations, links and documents. Such a concept allows students to meet in smaller groups and to more easily obtain specific information or to write down notes co-operatively as learning group. Apart from being a presenting event, the lecture also actively integrates spatially absent participants by means of communication mechanisms such as audio-, video chats, that have to be integrated into sTeam in advance. Thus students or lecturers are able to ask questions, make comments or contribute documents to the lecture within the sTeam room via Internet. However, the sTeam approach will be most efficient if synchronous procedures change to asynchronous procedures, e.g. on supporting scenarios of practising individuals or groups, whereas the system—with all the documents and structures stored serves as basis for individual and group work. The students have access to learning material and their personally written down texts from different places (practising room, library, personal working place).

Application scenarios during practising include a fluent change of teamwork and individual work phases. The procedure of practising software ergonomics today, includes the active commitment of students to organisational mat-

[1] DISCO (digital infrastructure for computer-supported co-operative learning), an advanced infrastructure in Paderborn, supports teaching and learning by means of multimedia. It comprises interactive lecture and seminar room, places of production for multimedia documents as well as working places that are connected with each other via networks, servers and services (more details in Keil-Slawik 1999).

ters. Solution proposals concerning exercises such as the software ergonomical evaluation of user interfaces can smoothly be performed by the sTeam concept.
Students insert their solution proposals into the system in advance or find solutions by linking existing documents, e.g. screenshots of user interfaces or criteria catalogues with personal solution proposals within the learning and document environment. This process can be realised individually or even better in a co-operative way by combining different solution alternatives. The actual practising can be described as interrelation of presenting and discussing solution alternatives. After a short presentation of different alternatives and mutual constructive criticism and evaluations the found solution proposals will be linked as well as stored permanently and archived within the sTeam system.
In order to facilitate preparations for the exam later on, it will be very important to permanently store the found structure. Thus the students are e.g. able to evaluate co-operatively different e-commerce solutions of the WWW (e.g. by a shared browser) during practising "software ergonomics" whereas comments will only be visible for the participants. In a parallel working step links are installed to software ergonomical criteria or available laws and standards of the learning environment (e.g. European Union ergonomic guidelines). Important passages out of textual chats can be used, i.e. translated as annotations or new documents by means of drag&drop mechanisms. Organisation proposals done by the students can be filed in the same way and without difficulties in personal and mutual working fields (semantic spaces). Thus the students are able to develop drafts and prototypes of user interfaces in Java by using tools for organising the surface (interface builder, e.g. by visual programming) and file them in context to corresponding lecture documents.
The concept of the so-called semantic maps (see Klemme et al. 1998) which was developed by the group "computers and society" has proven to be one further indispensable instrument to media-supported learning and has also been integrated into scenarios of the sTeam concept.
Students use semantic structures—provided by the lecturer—to navigate or make cooperatively semantic survey maps of the software ergonomics as part of an instructed exercise or for their own orientation. These maps may e.g. serve as criteria catalogues for the design of interactive systems or to point out the integration of this special field into other disciplines of the "Human computer interaction HCI" while the procedure itself demonstrates essential coherences. Further application scenarios are the realisation of virtual office hours as periods of presence of responsible persons within documents and communication environments. The virtual office hours will as a consequence be able to contribute to an unproblematic clarification of content and organisation matters.

A close linkage of the synchronous communication mechanisms to an awareness information and the world of documents creates a new quality concerning computer-supported communication. Thus co-operative partners can be ascertained at any time while taking essential personal rights into consideration (all mechanisms are available on a voluntary basis), as well as documents and sources of knowledge they are currently working on or (by consulting the temporal history) who has performed which action (see Nomura et al. 1998). [Parallel to this it is possible to directly address individuals—by presenting the so-called Avatars[2]—or a group of participants, thus encouraging discussions.]
(The term "Avatars" is not necessarily connected with the concept of "spatial navigation"[3], which is a spatial real-world navigation). A shared-whiteboard supplies documents, tools or graphical elements to participating students. The students are able to transfer elements of their desktop, graphs, links and documents by drag&drop to a synchronous desktop without any difficulties, i.e. this desktop will—in virtual space—be visible for all participants at the same time. Designed to be an object-oriented whiteboard, i.e. some kind of desktop that acts with plain objects, such an approach allows to work with any digital media and resources within the team. Thus the dragging of a link from a browser leads directly to installing a link object within a sTeam space that has been assigned to the whiteboard or documents will directly be transferred to the database and are available to other users—in dependence of their documents—for co-operative processing and editing.

[2] The term "Avatars", i.e. the image of a user in a virtual world is—by sTeam—not understood as three-dimensional representation of users as it is in so-called Avatar-worlds (see Damer 1998).
[3] The concept of "spatial navigation" has experienced formative influence by Greenhalgh and Bendford and their treatises concerning the MASSIVE system. It is about a three-dimensional world where Avatars move in "natural", real-world forms and communicate by textual- and audio chat. This communication is controlled by the "spatial model of interaction", i.e. communication will be conducted by the so-called "focus", "nimbus" and "aura" of objects, i.e. their relative position and direction to one and another. The so-defined directions and spheres of activity of user awareness establish concrete fields of interest as well as differentiate between communicating groups and interactive persons (see Greenhalgh & Benford 1995).

Scenario B: sTeam as working place for scientists

The sTeam approach also offers new qualities regarding the use of the system as prospective working place for scientists. Analogous to the support of learning processes, certain functionalities concerning the filing, semantic structuring and linking of articles, publications, essays and documents are useful for the daily work of scientists. The discussion of different positions (articles and treatises) and its linkage beyond the limits of one server as well as the inclusion of any other sources of knowledge of the scientific network like other national and international research institutes permit a new form of high-quality co-operation in research and science.

In support of such co-operations it will be essential to have the opportunity to annotate different sources of knowledge in close connection to network-supported synchronous and asynchronous communication forms. Besides the co-operative processing of documents, the essential criteria for the acceptance of the tool strived for are conceptions of the development of different views within the sources of knowledge, i.e. the possibility of dividing a text into different paragraphs in order to sort them and make individual sections available for colleagues and co-operation partners. The individual marking of texts ("textmarks") is also an essential criterion to guarantee the acceptance of the tool. Facilities exist to work with texts and graphics actively[4] and connect forum discussions and textual online communication forms to the capabilities of document management.

Approaches have been made in the field of graphical navigation and orientation maps (see supportive learning scenarios). These maps represent the semantic structure of learning materials and help to give learners and teachers orientation in various sources of knowledge. Therefore they also compensate the inherent problem of losing orientation in large hypertext structures such as the WWW.[5]

Our approach–sTeam–as open-source initiative

The spectrum of concepts and approaches that have to be considered is very large when taking into account an open platform with a multitude of services, tools and architectures. Due to this, the following representation of current technological aspects only provides a brief and incomplete outline. The architecture of sTeam is based on a CVE—Collaborative Virtual Environment—and can neither be characterised as a mere synchronous CSCW (Computer Supported Cooperative Work) tool (see (Roseman & Greenberg 1996), (Patterson et al. 1990) or (Chabert et al. 1998)), nor as mere management of documents or workflow-oriented tool.

At the same time sTeam combines important concepts concerning the structure of paths through existing contents of networks—thus aims at the navigation support of the user (concerning other similar approaches compare (Wexelblat 1999) or (Furuta et al. 1999)). By coupling one or several databases, managing abilities of users and objects will be supplied. In this sense sTeam impresses less as closed application but rather by its open and expandable framework architecture.

In this connection programming interfaces to individual tools and objects as well as a broad adaptability will be supplied to the users. Objects will—in sTeam—be provided with access rights and filed in this database while being able to access them by the network. sTeam offers the possibility by different access tools (frontends, clients) to file—in a structured way—objects such as documents, graphics, annotations or tools like shared whiteboards or message boards in semantic spaces. Within semantic spaces users are able to create their own links, modify any object and insert it again in dependence of their access rights. It is important that all abilities concerning the annotation of documents and inserting of links do not refer to locally filed documents within the sTeam databases. For this purpose solutions are searched that allow to include most technologies of the Internet. Thus it will be very important to intensify the integration of existing Internet formats and services. Within the application spectrum of the supplied communication mechanism, the conception of sTeam will on the one hand be designed for a mere asynchronous use (working with documents, supplying information by annotations) and on the other hand also for an intensive synchronous use (online co-ordination and online discussion, chat). In order to meet this requirement the supplied awareness information also has to be adjusted to this situation. The information degree that users reveal and receive

[4] This process e.g. intends to integrate different functionalities out of the field of office systems such as data processing, picture processing or spread-sheet calculation by providing Java-based, i.e. browser-oriented services (e.g. the StarPortal approach of the SUN company: http://www.sun.com/products/staroffice/starportal/)

[5] Compare the "lost in hyperspace syndrome", e.g. (Theng et al. 1996) "*In general, the lost in hyperspace phenomenon refers to any of the following conditions: users cannot identify where they are; users cannot return to previously visited information; users cannot go to information believed to exist; users cannot remember what they have covered; and users cannot remember the key points covered.* "

of other users (where they are, what they perform at present) has to be designed for flexible use and adjusted to the application context of the corresponding client.

An open platform requires the realisation of different clients and the use of specific tools within semantic spaces, both in dependence of the users' needs. Thus tools for accessing materials have to be designed with different appearances and functionalities with regard to the number of users co-operating at the same time. The appearance of the client concerning the integration into a conventional Internet browser as well as the adjustment of a working environment and its fusion with the client (drag&drop of application objects into the sTeam environment) also have to fulfil the above-mentioned prerequisites. The procedure of realising the idea of sTeam can briefly be outlined as follows:

In the last two years the first step was taken by developing prototypes for the scrutiny of the conception. On the one hand these prototypes try to realise the idea of semantic spaces in practice or to discuss details of the performed coupling of a CVE with a database and its network-supported access. On the other hand these prototypes are to guarantee the suitability of such an architecture for everyday use in teaching and research. Parallel to first pilot applications the creation of an open-source-initiative (-community)—concerning sTeam—is planned in expectation of a broad integration of existing standards and tools. Moreover an open-source community concerning sTeam seems to be a permanent alternative to commercial solutions and to guarantee constantly the topicality of the developed platform. Under the aspect of topicality, expectations exist to place sTeam on a broad basis with co-operating and discussing project partners as well as collaborating developers and thus being able to come up to the rapid development of current Internet standards. Corresponding examples are the document format XML[6] or the ISO-standard "Topic Maps"[7] which provides a standardised notation for interchangeably representing information about the structure of information resources used to define topics, and the relationships between topics.—These new technologies have to be considered within the conception.

In order to realise an open-source initiative it will be essential to define interfaces carefully and to write sufficient documentations to be able to co-ordinate a high number of developing initiatives. This can be pointed out as primary tasks for the next months. In this sense the expectations are to break with usual practices of clarifying research questions by prototypes and the consequences of not being available for a wide range of users. The bundling of ideas and efforts within the community of developers of computer-supported co-operative work tools and Internet technology can only be realised by synergies of an open-source community. From this point of view sTeam represents a consistently open platform for bundling the released energy.

Acknowledgements

For help with this paper I would like to thank Barbara Kraus and Harald Selke.

References

Chabert, A., Grossman, E., Jackson, L.S., Pietrowiz, S. R., Seguin, C. (1998). Java object-sharing in Habanero, *Communications of the ACM*, Volume 41 , Issue 6 (1998), 69-76.

Damer, B. (1998): *Avatars! – Exploring and Building virtual worlds on the internet*, Peachpit Press.

Engelbart, D.C. (1984). Collaboration Support Provisions in AUGMENT, OAC '84 Digest: *Proceedings of the AFIPS Office Automation Conference*, Los Angeles, CA, February 20-22 1984, 51-58.

Furuta, R., Shipman III, F.M., Francisco-Revilla, L., Hsieh, H., Karadkar, U., Hu, S. C. (1999). Ephemeral Paths on the WWW: The Walden's Paths Lightweight Path Mechanism, *Proceedings of WebNet 99–World Conference on the WWW and Internet Honolulu*, Hawaii; October 24-30, 1999, 409-414.

[6] For obtaining a description of the Extensible Markup Language (XML) see http://www.w3.org/XML/

[7] At present efforts are made to standardise the format of the semantic orientation aid within the ISO/IEC Standard 13250 "Topic Maps". It offers an exchange format on the basis of SGML or XML databases in which different types of elements, so-called "topics", and associations between them are defined. However, presenting tools or editors for the maps are not supplied at the moment.

Greenhalgh, C., & Benford, S. (1995). MASSIVE: A Collaborative Virtual Environment for Teleconferencing, *ACM Transactions on Computer-Human Interaction*, Vol. 2, No. 3, September 1995, 239-261.

Hampel, Th. (1999). sTEAM –Cooperation and Structuring Information in a Team, *Proceedings of WebNet 99 – World Conference on the WWW and Internet Honolulu*, Hawaii; October 24-30, 913-918.

Henderson, A.J., & Card, S.A. (1985). Rooms: The Use of Multiple Virtual Workspaces to Reduce Space Contention, *ACM Transactions on Graphics*, Vol. 5, No 3, July 1985, ACM Press.

Keil-Slawik, R., & Selke, H. (1998). Der Aufbau von lernförderlichen Infrastrukturen. Bibliothek 22(1), 51–59.

Keil-Slawik, R. (1999). Evaluation als evolutionäre Systemgestaltung. Aufbau und Weiterentwicklung der Paderborner DISCO (digitale Infrastruktur für computerunterstütztes kooperatives Lernen). Kindt, M. (Hrsg.): *Projektevaluation in der Lehre – Multimedia an Hochschulen zeigt Profil(e).* Reihe: Medien in der Wissenschaft, Band 7, Münster New York München Berlin: Waxmann, 11–36.

Klemme M., Kuhnert R., Selke H. (1998). Semantic Spaces. In: K. Höök, A. Munro, D. Benyon (eds.): *Workshop on Personalised and Social Navigation in Information Space.* SICS Technical Report T98:02, Kista, Sweden, March 1998, 109–118.

Nomura, T., Hayashi, K., Hazama, T., Gudmundson S. (1998). Interlocus: workspace configuration mechanisms for activity awareness, *Proceedings of the ACM 1998 conference on Computer Supported Cooperative Work*, November 14-18, 1998, Seattle, WA, USA, 19-28.

Patterson, J.F, Hill, R.D., Rohall, S.L. Meeks, S.W., (1990). Rendezvous: an architecture for synchronous multi-user applications; *Proceedings of the Conference on Computer-Supported Cooperative work*, 317-328.

Roseman, M., Greenberg, S. (1996). TeamRooms: Network places for collaboration, *Proceedings of the ACM 1996 Conference on Computer Supported Cooperative Work*, November 16-20, Boston United States, 325-333.

Theng, Y.L., Thimbleby, H., Jones, M. (1996). 'Lost in hyperspace': Psychological problem or bad design?, AP-CHI'96, Singapore, 387-396.

Wexelblat, A. (1999). MIT Media Laboratory History-Based Tools for Navigation, *IEEE's 32nd Hawaii' International Conference on System Sciences*, (HICSS'99), Hawaii, USA.

Interactive Analogies Prime Learning From Visualizations

Steven R. Hansen and N. Hari Narayanan
Intelligent & Interactive Systems Laboratory
Department of Computer Science & Software Engineering
Auburn University, Auburn, AL 36849
Phone: (334) 844-4330
Email: stevenh@maxwell.af.mil, narayan@eng.auburn.edu

Abstract: If a "picture is worth a thousand words," then why have attempts over the past decade to use pictures and animations to replace or supplement traditional instructional methods for teaching algorithms produced such disappointing results? In an earlier paper (Hansen et al. 1998) we described a research project based on the premise that a rethinking of algorithm animation design is required in order to harness its power to enhance learning. The key insight was that for algorithm animations to be effective, they had to be "chunked" and embedded within a context and knowledge providing hypermedia information environment. In this paper, we report on studies designed to discover which aspects of the prototype hypermedia visualization system that was developed (called HalVis) contributed to student learning. These preliminary studies led to a surprising discovery that interactive and animated analogies appear to significantly prime learning about abstract and dynamic algorithm behaviors from subsequent visualizations. This paper briefly describes the interactive features and learning modules of HalVis, then presents the results of two series of experiments conducted using HalVis that give insight to the use of animated analogies to enhance learning.

Introduction

Over the past decade, numerous studies and experiments have been conducted to evaluate whether graphically animating algorithm behavior improved student learning of this dynamic, abstract, and difficult subject (e.g. Byrne et al. 1996; Stasko et al. 1993). While the addition of pictures and animations are enthusiastically received by students, these studies have not proven conclusively that algorithm animations actually improve learning (see Hundhausen 1996 for an excellent survey).

We believe that previous attempts at using algorithm animations as learning tools were unsatisfactory not due to any flaw with animation as a technique, but because of the approach used to convey information using the animations. Animations by themselves, even when accompanied by some textual feedback and interactive control, may not be enough. In earlier papers (Hansen et al. 1998, Hansen et al. 1999), we presented research projects aimed at rethinking algorithm animation design. The prototype visualization system we designed is called HalVis (for Hypermedia Algorithm Visualization System). It is not a mere animation presenter in the mold of prior algorithm animation research prototypes. In some ways, its architecture resembles that of the algorithm animation system described in (Recker et al. 1995) containing multiple representations in addition to the animation itself. Following the design principles outlined in (Narayanan & Hegarty 1998), HalVis incorporates four unique features: (1) Providing three kinds of animations to illustrate different views of algorithm behavior - an animated analogy that illustrates the operational characteristics of an algorithm, a micro-level animation that focuses on details of the algorithm's behavior on small data sets, and a macro-level animation that shows the algorithm's aggregate behavior on large data sets; (2) Embedding animations within a hypermedia visualization that also employs textual descriptions, audio narratives and static diagrams to provide contextual information; (3) Presenting animations in discrete chunks accompanied by explanations of the specific actions being accomplished; and (4) Encouraging student participation by allowing rich interactions with the animations and using probes or questions to stimulate critical thinking.

Two empirical studies demonstrated that students using HalVis significantly outperformed those learning from a traditional textbook. Later, a third experiment compared learning about an algorithm from HalVis to learning from a compilation of the best algorithm descriptions and illustrations (generated by examining 19 textbooks published between 1974 and 1997) and subsequently solving a set of typical problems on the algorithm. In this case no significant differences were found between the group of students who learned by interacting with HalVis and the group which perused the printed materials and then solved several exercise problems, though the HalVis group had a higher post-test mean score. Two subsequent experiments compared learning by interacting with HalVis against learning from a typical classroom lecture and learning from an algorithm animation typical of prior research on this topic (Stasko 1997). In both cases statistically significant performance improvement was found for the groups of students working with HalVis. Thus, five empirical studies (summarized in Hansen et al. 1999) involving 133 undergraduates have thus far demonstrated that the HalVis system significantly improves student learning.

These results led us to ask the question: Which individual or combinations of features are producing the observed learning benefits? This paper describes the results from two experiments we carried out to help answer this question. These studies led to a surprising discovery that interactive and animated analogies appear to significantly prime learning about abstract and dynamic algorithm behaviors from subsequent visualizations. First, we present the interactive features and learning modules of HalVis. Then we describe the experiments conducted on HalVis. Finally, we conclude with a discussion of the implications of the results of these experiments.

Architecture of HalVis

HalVis is structured as three primary modules and two secondary modules. The primary modules are called the Conceptual View, Detailed View and Populated View. The secondary modules are called Fundamentals and Questions. The Fundamentals module provides basic knowledge and a context for understanding the algorithm being presented by the primary modules using illustrated and (in some cases) animated explanations of basic algorithmic concepts such as complexity, recursion and iteration. This module is accessible from all of the primary modules via hyperlinks. For example, if the primary modules are presenting a recursive algorithm, all appearances of the word "recursion" in these modules will appear as underlined hyperlinks to the corresponding descriptions and depictions in the Fundamentals module. The Questions module provides the learner with an opportunity to assess understanding of the algorithm by posing a series of questions and providing immediate feedback. These two modules were not the focus of the studies described in this paper.

The Conceptual View (CV) introduces a specific algorithm in very general terms using a real world analogy. The analogy is interactive (students can manipulate it), animated, and accompanied by text and audio explanations. Each analogy highlights the central conceptual elements of the corresponding algorithm. For instance, the analogy for the Merge algorithm (Figure 1) is animated playing cards which are divided into stacks and merged to create a sorted sequence of cards. A gaming mode is provided for the student to try to 'merge' the cards with fewest errors and minimal time. The animated analogy for the QuickSort algorithm is that of a coach ordering a set of players by height, using a series of moves illustrated through smooth animation that capture the essence of the QuickSort algorithm in terms of its fundamental operations. The Shortest Path algorithm used an analogy involving airfares between various cities, a typical problem facing travelers.

The analogies in HalVis can be described in several dimensions: (1) dynamics, referring to the sophistication of the animition; (2) fidelity, referring to how closely the features of the analogy maps to the central characteristics of the algorithm; (3) interactivity, referring to the level of immersion allowed to the user, ranging from simple pacing to competitive simulation; and (4) familiarity, referring to how common the objects of the analogy tend to be. The notion is that more is better for each of these dimensions to reduce the cognitive load imposed by the analogy. The more dynamic, the better the fidelity, the more interactive, the more familiar, the better.

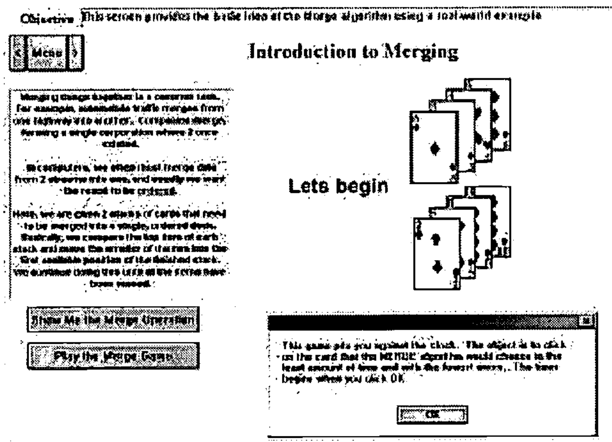


Figure 1. The Conceptual View Screen of the Merge Algorithm

The Detailed View (DV) is a module that takes the multiple representation approach to presenting detailed information about how the individual steps of an algorithm, when executed in sequence, manipulate data and accomplish a specific task (e.g., sorting a set of numbers). It presents four windows containing information that are synchronously updated as the algorithm processes user-selected input data sets: (1) the Execution Animation window shows how steps of the algorithm modify data structures using smooth animation of micro-level operations; (2) the Execution Status Message window provides comments and textual feedback to the student about key events and actions occurring in the animation, also available as an audio commentary; (3) the Pseudocode window shows statement-level algorithm operations by highlighting the statement being executed; and (4) the Execution Variables window contains a scoreboard-like panorama of the variables involved in the algorithm and their changing values. These four windows are shown in Figure 2a, which is a screen capture of one frame of the DV micro-level animation s for the Shortest Path algorithm. The Execution Animation Window appears on the upper left (below the control buttons) of this figure, the Pseudocode window appears on the upper right, the Execution Variables window appears on the lower left, and the Execution Status Message window appears on the lower right

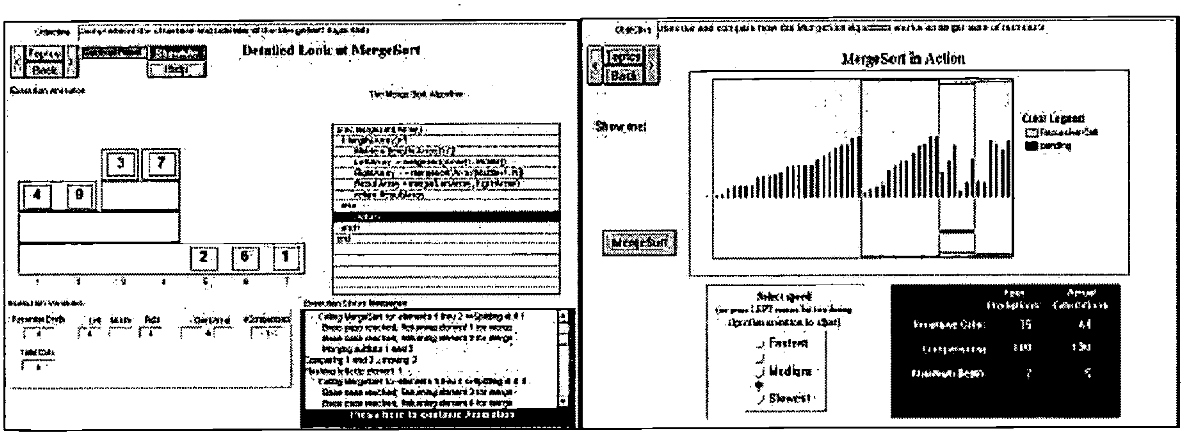


Figure 2. The Detailed View and Populated View Screens of the MergeSort Algorithm

The Populated View (PV) module presents a macro-level animated view of the algorithm's behavior on large data sets. A novel feature of this module is a facility for the student to make predictions about different parameters of algorithm performance, and then compare those against the actual performance when the animation is running. A sample screen of this module appears in Figure 2b.

Experiments

The number of novel features and modules that distinguish HalVis from prior algorithm animation approaches led to encouraging results but begged the question: Which individual or combinations of features produced the observed learning benefits? Our approach to answering this was to build different versions of HalVis by selectively disabling individual or groups of related features, and experimentally evaluate student performance using these versions against the original. We designed and carried out two such studies. The first experiment disabled one of the three views, giving the student two views with which to learn the algorithm. The second experiment disabled two of the three views, providing the student with only one view, as shown in Table 1. Each experiment is described below.

	Experiment 1 Groups (1-view removed)					**Experiment II Groups** (2 views removed)			
	CDP	**CD**	**DP**	**CP**		**CDP**	**C**	**D**	**P**
Conceptual View	Y	Y		Y		Y	Y		
Detailed View	Y	Y	Y			Y		Y	
Populated View	Y		Y	Y		Y			Y

Table 1. Views Available to Groups for Experiments I and II

Experiment I Procedure: The first experiment involved 32 undergraduate computer science students enrolled in a third year algorithm analysis course at Auburn University. Four matched groups of students interacted with one of four versions of HalVis illustrating the QuickSort algorithm: (1) a complete version with all three primary modules/views enabled (referred to as the CV-DV-PV group or CDP for short); (2) a version with the CV disabled (referred to as the DP group); (3) a version with the DV disabled (the CP group); and (4) a version with the PV disabled (the CD group). A pre-test/post-test combination measured individual learning and improvement with questions that probed conceptual and procedural knowledge about the algorithm. Students were tested on their ability to recognize and reorder pseudocode descriptions of algorithms, mentally simulate algorithmic operations, and predict resulting data structure changes. Each group received a brief, navigation-only orientation to the version of HalVis they were to use, then were assigned to a computer and instructed to interact with the visualization until they felt they understood the algorithm. No time limits were imposed for the tests or the visualization.

Experiment I Results: Our hypothesis was that the most important view was the most information rich view – the Detailed View—and the groups that interacted with this view would outperform any group that was denied this view. Furthermore, we expected the Populated View would follow in significance and that the contribution of the Conceptual View would be the least. Figure 3 (left side) shows the average group improvement. As expected, the group that received all three HalVis views performed the best. However, these results also reveal a surprising impact of the Conceptual View. Contrary to our expectations, the groups that performed best were not the ones exposed to the Detailed View but rather the groups that interacted with the Conceptual View. The improvements of the groups that received the Conceptual View with another view were more than twice the improvement of the DP group. Table 2 shows a statistical summary of this experiment, presenting data for pairwise comparisons between each of the groups with access to the Conceptual View and the one group –DP – that did not have this access. Note that all comparisons yielded statistically significant results. Perhaps the most noteworthy observation from the results of this experiment was the effect of the Conceptual View in priming the learning of information presented in subsequent views. The groups that interacted with the Conceptual View in any combination with other views performed better than the group that lacked the Conceptual View. The impact of the Conceptual View was examined further in the next study that elided two views at a time.

CDP	55%	CDP	55%	CP	45%	CD	47%
DP	21%	CP	45%	DP	21%	DP	21%
F(1,14)	16.7	F(1,15)	1.45	F(1,11)	8.99	F(1,12)	7.16
p	<.001	p	<.25	p	<.01	p	<.02

Table 2. Statistical Summary for Experiment I

Experiment II Procedure: This experiment was designed to isolate each of the three views of our algorithm visualization framework to measure their respective impact and effectiveness. Procedurally identical to experiment I, twenty-seven undergraduate students enrolled in a third year algorithm analysis course at Auburn University participated in four matched groups: (1) the CDP group worked with a full version of HalVis illustrating a graph algorithm to find shortest paths between nodes; (2) the C group worked only with the Conceptual View of this algorithm; (3) the D group worked only with the Detailed View of this algorithm; and (4) the P group worked only with the Populated View of this algorithm. Our hypothesis was that the Detailed View would prove to be the most valuable because of the amount of information it provided. We were uncertain how the performances of the other views would get ranked, since neither the Populated View nor the Conceptual View contained the volume or depth of information available in the Detailed View.

Experiment II Results: Figure 3 (right side) shows average improvements observed in each of the groups. As expected, the CDP group outperformed the others, followed closely by the D group. Interestingly, the C group outperformed the P group by 21%. It is illuminating to note how well the C group did with the limited amount of information that they received. Table 3 summarizes the various statistical comparisons between the full-version group and groups with individual views, and between groups with individual views. Except for the CDP/D comparison, the results are all statistically significant.

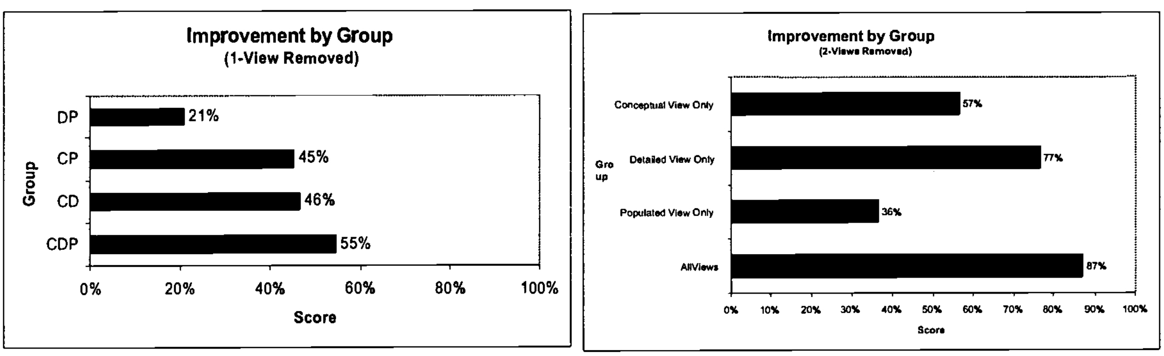


Figure 3. Improvement by Group for Experiments I and II

CDP	87%	CDP	87%	CDP	87%	C	57%	D	77%	C	57%
C	57%	D	77%	P	36%	D	77%	P	36%	P	36%
F(1,11)	14.5	F(1,11)	2.55	F(1,11)	51.8	F(1,12)	5.8	F(1,12)	28.3	F(1,12)	5.4
p	<.003	p	<.14	p	<.0001	p	<.03	p	<.0002	p	<.039

Table 3. Statistical Summary for Experiment II

The importance of the Detailed View was confirmed, as was the value of the Conceptual View. We were surprised at the level of improvement observed in the group that only interacted with the Conceptual View, and this suggests that having a good analogy can produce surprisingly positive results. The performance of the Populated View group lagged behind the others. Yet the interaction logs we collected revealed that in each of the experiments, the animation in this view was executed about the same number of times as the animations in the other two views. Perhaps this serves as confirmation that some animations are merely 'candy for the eyes' in that they are entertaining to observe but not particularly informative. It should also be noted that the animation in the Populated View closely resembles algorithm animations developed in prior research. Interestingly, students generally commented most favorably about the animation in the Populated View. It appears that they thought they were learning more from the Populated View than was actually the case.

Conclusion

While we initially believed that the analogy/real-world example was a minor educational addition and feature of our framework, it appears to have a pronounced effect in peaking student interest and priming them for learning from subsequent views of greater detail. There exists a significant body of psychological literature on the role of analogies in communicating a target concept (e.g. Gentner 1989). Researchers have also investigated the educational value of paired interactive simulations as analogies which complement each other (Brophy & Schwartz 1998). However, we believe this is the first time that the role of animated analogies in understanding computer algorithms from visualizations has been empirically studied. The power of animated analogies in this domain arises from the fact that these provide conceptual bridges between familiar scenarios and abstract components of algorithms. It has been noticed that students tend to employ analogies in describing how algorithms operate (Douglas et al. 1995; Stasko 1997) and analogies can serve to provide a form of scaffolding (Hmelo & Guzdial 1996) for subsequent learning. Results reported here lead us to speculate that concrete dynamic analogies can prime students to learn better from visualizations of abstract dynamic phenomena. If confirmed by additional experiments, this has important implications for learning technology. Therefore, our future research is aimed at seeking additional empirical evidence regarding this conclusion. Finer grained ablation studies are being planned to examine the differential effects these features have on the ability of analogies to prime subsequent learning. Additional studies looking at the other features – animation chunking, animation embedding and rich interactivity – are also on the drawing board.

References

Byrne, M., Catrambone, R., & Stasko, J.T. (1996). Do algorithm animations aid learning? TR GIT-GVU-96-18. Georgia Institute of Technology, Atlanta, GA.

Brophy, S. P. & Schwartz, D. L. (1998). Interactive Analogies. Proc. Int'l. Conf. of the Learning Sciences, 56-62.

Douglas, S., Hundhausen, C., & McKeown, D. (1995). Toward empirically-based software visualization languages. Proc IEEE Symposium on Visual Languages, pp. 342-349.

Gentner, D. (1989). The mechanisms of analogical reasoning. In S. Vosniadou & A. Ortony (Eds.) Similarity and Analogical Reasoning. Cambridge University Press.

Hansen, S., Schrimpsher, D., & Narayanan, N. H. (1998a). Learning algorithms by visualization: A novel approach using animation-embedded hypermedia. Proc. Int'l. Conf. of the Learning Sciences, 125-130.

Hansen, S., Schrimpsher, D., & Narayanan, N. H. (1999). From algorithm animations to animation-embedded hypermedia visualizations. Proc. ED-MEDIA'99, AACE.

Hmelo, C. E. & Guzdial, M. (1996). Of black and glass boxes: Scaffolding for learning and doing. Proc. Int'l. Conf. of the Learning Sciences, 128-134.

Hundhausen, C. (1996). A meta-study of software visualization effectiveness. A working paper available at http://www.cs.uoregon.edu/~chundhau/research.

Narayanan, N. H., & Hegarty, M. (1998). On designing comprehensible interactive hypermedia manuals. International Journal of Human-Computer Studies, 48: 267-301.

Recker, M., Ram, A., Shikano, T., Li, G., & Stasko, J. (1995). Cognitive media types for multimedia information access. Jnl. Educational Multimedia & Hypermedia, 4(2/3):183-210.

Stasko, J.T. (1997). Using student-built algorithm animations as learning aids. Proc. ACM Technical Symposium on Computer Science Education, 25-29.

Stasko, J.T., Badre, A., & Lewis, C. (1993). Do algorithm animations assist learning? An empirical study and analysis. Proc. ACM INTERCHI'93 Conference, 61-66.

Designing Interactive Learning Environments to include construction tools for personally meaningful artefacts

Barry Harper, University of Wollongong, Australia
John Hedberg, University of Wollongong, Australia
Rob Wright, University of Wollongong, Australia

Designers of interactive learning environments, applying contemporary views of learning, are now employing design models that incorporate the variety of ideas that are based on constructivist frameworks. Designers are attempting to give learners control over their actions and place them into worlds that can be manipulated and interrogated. These environments, if well designed, can support learner construction of knowledge through structured or ill-structured problem solving experiences. Such frameworks are based upon arguments that learners should be placed in authentic environments that incorporate sophisticated representations of context through such constructs as "virtual worlds". Within these modern constructions, learners are often given a rich set of resources to construct artefacts which reflect their problems solutions.

However, researchers such as Seymour Papert have long called for more open environments drawn from a theoretical view of learning termed constructionism which is based on two different senses of 'construction'. It is grounded in the idea that people learn by actively constructing new knowledge as well as asserting that learners are particularly likely to create new ideas when they are engaged in 'constructing' personally meaningful artefacts. Multimedia authoring tools have long been used to address the latter component of constructionism. The challenge for researchers and developers is to find the balance between resource rich 'virtual worlds' with embedded tasks and open ended construction that may not be goal driven, both resulting in personally meaningful artefacts, ie are we designing for learning, or are we learning by designing? This paper examines three projects that demonstrate these issues.

Mariner—A 3-Dimensional Navigation Language

Janet D. Hartman
Applied Computer Science Department
Illinois State University
Normal, IL. USA
hartman@katya.acs.ilstu.edu

Joaquin A. Vila
Applied Computer Science Department
Illinois State University
Normal, IL. USA
javila@ilstu.edu

Abstract: In recent years, virtual reality (VR) has become an increasingly powerful and inexpensive tool for developing interfaces for a variety of applications. Even though there has been an increase in the use of virtual reality (VR), there is a lack of software that bridges the gap between existing application programs and VR. This type of middleware is needed to manage the navigational interaction between existing application programs and VR. This paper describes a language for describing navigation behaviors in 3-dimensional worlds that could potentially serve as middleware. The formal language described in this paper permits precise navigation path specification and can be used as the means of mediation with application programs. The language can be used in achieving tasks such as exploring virtual worlds, programming the navigation and routing strategies for avatars, simulating the trajectories of virtual objects, and providing a formal description language for documenting user navigation in VR environments.

Introduction

In recent years, virtual reality (VR) has become an increasingly powerful and inexpensive tool for developing interfaces to applications such as architectural modeling, computer-aided design, data visualization, telecommuting, and environments for simulation and entertainment. Interaction in applications that incorporate VR as an interface is dynamic by nature. Users immerse themselves in 3-dimensional (3D) environments using specialized peripheral devices including head-mounted displays, data gloves, 3D-trackers and body suits. These devices enable users to experience rich stimuli and give them control over where they go and what they do within the confines of an application. This freedom is enabled by the ability to navigate in the world.

Navigation is an aspect of behavior that causes an object to change its location, orientation, and/or relationship to other objects in its environment (Matsuba, 1996). User interface designers have previously investigated navigation in 2-dimensional (2D) spaces and developed design principles that guide them in the development of effective and efficient interfaces (Beasley, 1992; Beccue, 1994). As designers work with 3D worlds, it will be useful to know whether the principles and findings of research related to two-dimensional navigation can be applied and extended. Since virtual worlds represent real worlds, the impact of real world navigational behaviors on interface design must also be studied.

A review of the literature related to navigation patterns in human computer interfaces indicates that research on navigation in 3D environments focuses on three areas: navigational awareness, spatial ability, and wayfinding (purposeful, oriented movement during navigation) (Satalich,1995). Darken and Sibert found that the organization of elements in a virtual world and the provision of an absolute frame of reference improved navigation performance (Darken, 1995). In a subsequent study, Darken and Sibert also reported an improvement in the performance of navigation tasks in virtual worlds that had been created using environmental design principles (Darken, 1996). Among their observations were that (1) path following (a form of wayfinding) is a natural spatial behavior, (2) the lack of adequate directional cues inhibited wayfinding performance, (3) a structure must be imposed on large complex worlds in order to navigate in them, and (4) a conceptual coordinate system is often imposed on the world in an attempt to structure it. Each of these studies required that the researcher track the users' navigational patterns in a virtual world. Vila, et al. (Vila, 1997) reported on a tool that provides a template and efficient data collection capabilities for studying the navigational behaviors of users. Additional efforts to improve navigation performance by addressing issues such as the psychology of navigation, the use of navigational aids (e.g., maps), the effects of different types of worlds on navigation, and the design of an environment for navigability were the subject of discussions at the 1997 ACM Computer Human Interaction Conference (Furnas, 1997). In reviewing the literature, the authors found virtually no reports on tools for connecting an existing application program to a virtual world. This could be resolved with the development of middleware to manage the navigational interaction between an application program and a virtual world.

The purpose of this paper is to describe the prototype for a language for navigating in 3D worlds that has the potential to serve as a mediator between an application and a virtual world. *Mariner*, the language discussed in this paper, was designed using formal language specification techniques and implemented in a Web environment using Javascript and Virtual Reality Modeling Language (VRML).

Virtual worlds provide a forum for developing simulations of real world situations for education and training that are less costly than real experiences. Applications like these need to be able to interact with a virtual world. *Mariner* provides an initial step in connecting existing applications and VR worlds. Because *Mariner* provides a formal method for specifying navigation, it may also prove useful to researchers in the field of human computer interaction who are interested in describing and studying navigation behaviors in 3D worlds by documenting how users navigate in VR environments.

Development of the *Mariner* Language

The authors' objectives in the design and implementation of *Mariner* were to:

(1) define the specific navigation behaviors in a 3D virtual world that need to be modeled,
(2) use formal language specification techniques to define the syntactic and semantic structure of *Mariner*,
(3) implement a prototype for an interpreter using standard compiler design techniques that would translate *Mariner* language statements into VRML statements allowing the visualization of an object as it navigates in a 3D world,
(4) determine the effectiveness of *Mariner* by evaluating the accuracy of programs in *Mariner* that generate navigation actions for an object defined in a VRML world.

Defining Behaviors

The first step in developing *Mariner* was to determine what type of navigation behaviors occur in 3D worlds. The authors identified *movement*, *rotation*, *collision detection*, *conditional behavior* and *repetitious behavior* as the behaviors to model in the language.

Movements in a 2D world are usually expressed using a grid coordinate system. Movements can either be direct (e.g., moveto 138,34) or relative (e.g., move forward 10). Some parameters to commands may be implied; "move forward 10" implies that the object is facing in a specified direction and will continue to move in that direction when it moves. In a 3D world, some 2D concepts have the same meaning. For example, movements may also be expressed using a grid (now a 3D grid) and the concept of moving forward a specified number of units remains the same. However, the movement of objects is no longer defined in a plane; objects have the freedom to move (and rotate) in all of the directions that can be defined by a 3D space.

Whether in a 2D or 3D world, objects have relationships to other objects in the world. An object may be to the right of another object or in front of another object. As an object navigates, its relationship to other objects changes. Correct and incorrect behaviors must be defined. In navigating within a world with multiple objects, for example, it would not be correct for an object to move forward "through" another object as if it did not exist. An object should be able to detect and avoid an impending collision with another object.

Objects in virtual worlds often exhibit repetitive behavior or behavior that is based on conditions that must be evaluated before performing the behavior. For example, not to move if there is an object directly in front of the object to be moved. Hence, control structures that allow for conditional or repetitious behavior are also needed.

Syntax and Semantics

After defining the behaviors to model, the syntax and semantics of the *Mariner* were specified. Because languages that have been unambiguously defined using Backus Naur Form (BNF) can often be easily implemented using recursive, top down analysis techniques and automatic compiler development tools, the syntax for *Mariner* was specified using BNF (Alblas, 1996). The BNF for *Mariner* appears on page 5.

The semantics were implemented as paragraphs of text describing the behavior of each statement. For the most part the meaning of program statements can be inferred from their syntax. While developing the semantics, it proved useful to identify potential errors in syntax and behavior so that error handling routines could be later developed.

Currently, the syntax represents a language in which small programs can be written to manipulate a limited number of objects in a 3D world. The objects that can be manipulated include a sphere, cone, cylinder and cube. The current syntax and semantics will form the base for implementing the language as a form of middleware to interact with other applications. An example of a small *Mariner* program is shown in Figure 1. Note that the object that has been defined is a cone and all subsequent movements apply to that object. In its current form, there are no variables in *Mariner*, so there is no way to reference the cone in later segments of code that are separated from its initial definition.

```
Cone:
        Size = 2
        Height = 4
        Color =120  0  0
Movement 1
        Move 5 Units Along X Axis
        Move 0.0 Units Along Y Axis
        Move 0.0 Units Along Z Axis
        Rotate Counter ClockWise Along Z Axis by 90 Degrees
Movement 2
        Move 0 Units Along X Axis
        Move 5 Units Along Y Axis
        Move 0.0 Units Along Z Axis
        Rotate ClockWise Along Z Axis by 90 Degrees
```

Figure 1: Program Example

The *Mariner* Language Development Environment

The *Mariner* language development environment, shown in Figure 2 below, has two components, the *Mariner* code generator and the *Mariner* interpreter. The *Mariner* code generator allows the user to define objects and their navigation paths within a virtual world through a user-friendly interface. The user can select pre-defined options for each object for which *Mariner* statements will be generated and displayed in the text area, or he/she can type *Mariner* language statements directly in the text area. The language development environment was constructed as a Web page using Javascript and VRML 2.0.

The code generator permits the user to define an object geometry that includes traditional VRML nodes such as cones and cubes. In addition, the user can define navigational movements for each defined object using translation and rotation transformations. All object dimensions and movement distances are specified in pixel units. After completing a *Mariner* program, the user can choose to have it interpreted into VRML statements which can be executed in a Web browser.

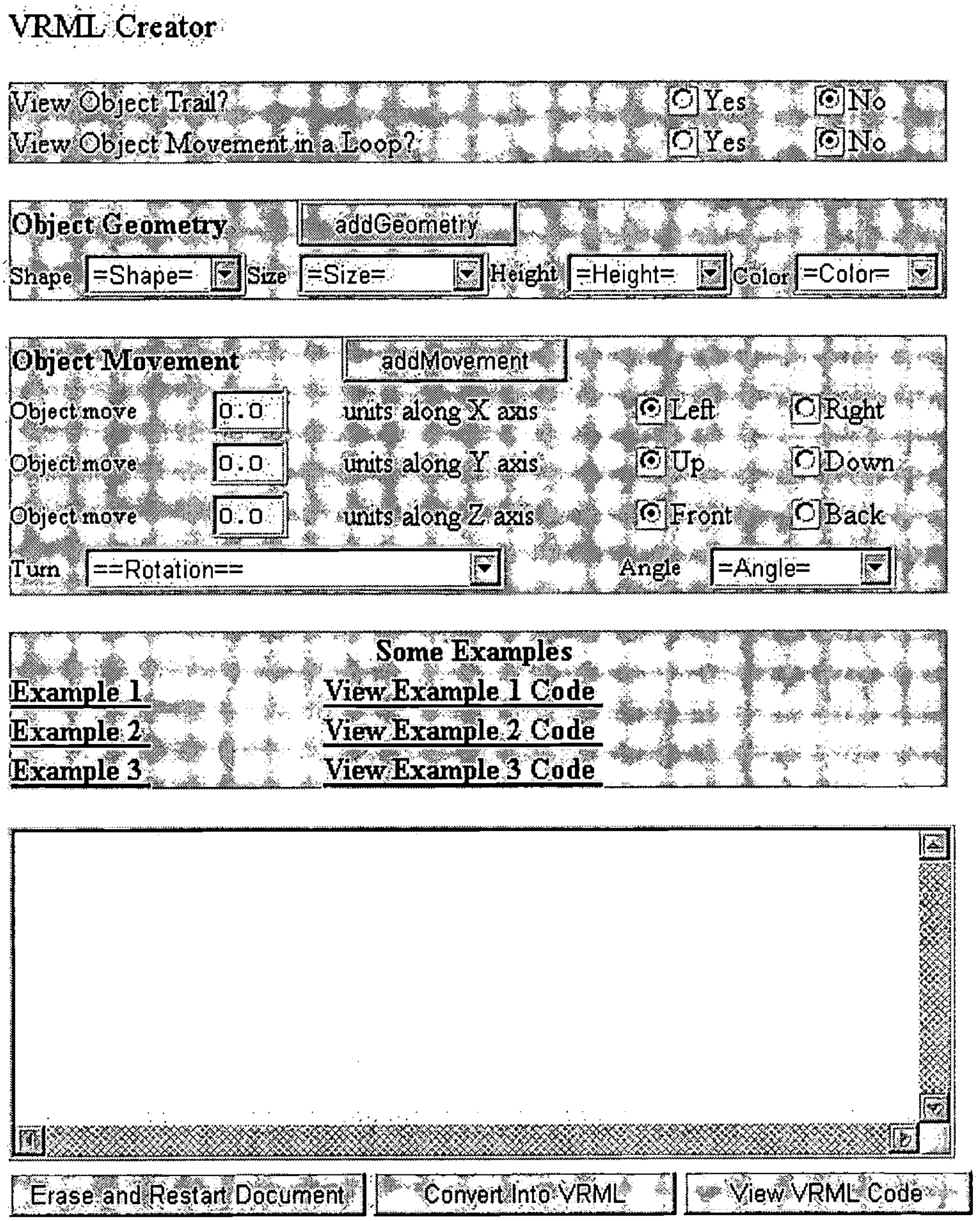


Figure 2: Language Development Environment

Summary

A prototype for a 3D navigational language, *Mariner*, was described in this paper which has the potential to serve as a link between 3D worlds and software applications. The language, written in Javascript and VRML, currently generates VRML code which can be viewed within a Web browser. Future development includes the transformation of the language into code segments that can be embedded within an existing 3D world and act upon existing or newly created objects within the world.

Mariner BNF

<Program_Unit>	→ <Object_Declaration> <Statement_Sequence>
	| <Object_Declaration>
<Object_Declaration>	→ <Cone>
	| <Cylinder>
	| <Box>
	| <Sphere>
<Cone>	→ **Cone:** <Base_Measurement> < Height_Measurement> <Color_Measurement>
<Box>	→ **Box:** <Base_Measurement> <Color_Measurement>
<Cylinder>	→ **Cylinder:** <Base_Measurement> < Height_Measurement> <Color_Measurement>
<Sphere>	→ **Sphere:** <Base_Measurement> <Color_Measurement>
<Base_Measurement>	→ **Size =** <Number>
<Height_ Measurement>	→ **Height =** <Number>
<Color_Measurement>	→ **Color =** <Color_Number>
<Statement_Sequence>	→ <Statement_Sequence> <Statement>
	| <Movement_Number> <Statement_Sequence> <Statement>
	| <Movement_Number> <Statement>
	| <Statement>
<Movement_Number>	→ **Movement** <Number>
<Statement>	→ <Move_Statement>
	| <Rotation_Statement>
	| < If_Statement>
	| <While_Statement>
	| <For_Statement>
<Move_Statement>	→ <Move_Statement_X>
	| <Move_Statement_Y>
	| <Move_Statement_Z>
	| <Moveto_Statement>
<Move_Statement_X>	→ **Move** <Number> **Units Along X Axis**
<Move_Statement_Y>	→ **Move** <Number> **Units Along Y Axis**
<Move_Statement_Z>	→ **Move** <Number> **Units Along Z Axis**
<Moveto_Statement>	→ **Moveto** <X_Coord> <Y_Coord> <Z_Coord>
<Rotation_Statement>	→ **Rotate** <Spin_Mode> **Along X Axis by** <Number> **Degrees**
	| **Rotate** <Spin_Mode> **Along Y Axis by** <Number> **Degrees**
	| **Rotate**<Spin_Mode>**Along Z Axis by** <Number> **Degrees**
<Spin_Mode>	→ **ClockWise | Counter ClockWise**

```
<If_Statement>        → if <Condition> then
                            <Statement_Sequence>
                          endif
                        | if <Condition > then
                            <Statement_Sequence>
                          else
                            <Statement_Sequence>
                          endif
<While_Statement>     → while (<Condition>)
                            <Statement_Sequence>
                          end loop
<Condition>           → Path_Clear
<For_Statement>       → for (<Number>) to <Number>
                              <Statement_Sequence>
                        | for (<Number>) downto <Number>
                              <Statement_Sequence>
<X_Coord>             → <Number>
<Y_Coord>             → <Number>
<Z_Coord>             → <Number>
<Number>              → <Number><Digit>
                        | <Digit>
<Digit>               → 0|1|2|3|4|5|6|7|8|9
<Color_Number>        → <Color_value><Color_value><Color_value>
<Color_Value>         → 0/1/2/3.../255
```

Bibliography

1. Alblas, H., & Nymeyer, A. (1996). *Practice and Principles of Compiler Building with C,* Prentice-Hall.
2. Beasley, R., & Vila, J. (1992). The Identification of Navigation Patterns in a Multimedia environment: A Case Study, *Journal of Educational Multimedia and Hypermedia*, 1, (2), 209-222.
3. Beccue, B., & Vila, J. (1994). AIT: An Analytic Tool for Identifying User-Preferences in a Multimedia Environment, *International Conference Proceedings of PRIISM-94.* Maui, Hawaii, 24-31.
4. Darken, R.P., & Sibert, J.L. (1995). Navigating in Large Virtual Spaces, *Journal of Human-Computer Interaction.*
5. Darken, R.P., & Sibert, J.L. (1996). Wayfinding Strategies and Behaviors in Large Virtual Worlds, *Proceedings of the ACM Special Interest Group Conference on Human-Computer Interfaces Conference.*
6. Furnas, G. (1997). Workshop on Navigation in Electronic Worlds, *ACM Computer Human Interaction Conference.*
7. Matsuba, S. N., & Roehl, B. (1996). *Using VRML*, Que Corporation.
8. Satalich, G. A. (1995). *Navigation and Wayfinding in Virtual Reality: Finding the Proper Tools and Cues to Enhance Navigational Awareness.* (Thesis: Washington University)
9. Sebesta, R. W. (1999). *Concepts of Programming Languages*, Addison-Wesley.
10. Vila, J., Beccue, B., & Furness, G. (1997). User Interface Design for Virtual Reality: A Research Tool for Tracking Navigation, *Proceedings of the Hawaii International Conference on System Science.*

Cognitive Flexibility Hypertext and the Role of the Learning Task

Douglas M. Harvey
The Richard Stockton College of New Jersey
Box 195
Pomona, New Jersey, United States of America 08240
harveyd@loki.stockton.edu

Roy Clariana
The Pennsylvania State University
Great Valley Graduate Center
30 E. Swedesford Road
Malvern, Pennsylvania, United States of America 19355
rclariana@psu.edu

David H. Jonassen
University of Missouri
School of Information Science and Learning Technologies
20 Rothwell Gym
Columbia, Missouri, United States of America 65211

Abstract: This study investigated how differences in task affected learner navigation choices, transfer of knowledge, and attitude toward the topic when using hypertext materials about sexual harassment that were designed using cognitive flexibility theory as a theoretical basis. Based upon the findings of the study, it appears that the two tasks (juror verdict and policy creation) did not have significant impact upon learner criss crossing or transfer. Therefore, it was also apparent that task had no relationship to transfer. Post hoc analyses on other variables, including learner beliefs about knowledge, were also not significantly related to the outcomes regarding navigation and transfer. However, there did appear to be a relationship between task type and learner attitude changes from the beginning to the end of the study, suggesting a possible affective dimension to the use of cognitive flexibility hypertexts that has not been previously reported or considered in the research literature.

Introduction

This study investigated the practical application of cognitive flexibility theory (Spiro, Vispoel, Schmitz, Samarapungavan, & Boerger, 1987) as the basis for designing case-based hypertext learning materials. Results of this research could aid in furthering the utilization of this approach for facilitating learning within instructional settings.

Cognitive flexibility theory posits that effective learning of complex knowledge in ill-structured domains cannot be supported by those cognitive theoretical frameworks that support learning in well-structured domains (Spiro et. al., 1987). This is due to the fact that those frameworks focus more on the retrieval of information and necessitate fairly rigid structuring of the domain knowledge, compartmentalization of concepts vs. interconnecting concepts, simplification of complex concepts for instruction, and assume knowledge will be applied consistently within the domain. These approaches inhibit the new transfer of learning within ill-structured domains where flexible knowledge assembly is required based upon the context of the situation in which the knowledge is applied (Spiro et. al., 1987).

Cognitive flexibility theory assumes that in order to affect the optimal cognitive processes for near transfer within the learner, instruction must stress "flexible reassembly of pre-existing knowledge to adaptively fit the needs of the new situation" (Spiro et. al., 1987) by mirroring that flexibility within the instructional materials. This is done using a case-based approach in which learners are shown multiple representations and perspectives on each domain-specific case, with cases interconnected across themes and perspectives. The theory contends that this prepares the learner for transfer through a complex understanding of the complexity of the domain and the interconnectedness of the domain knowledge (Spiro et. al., 1987). This more complex understanding comes from learners reconciling the perspectives and contexts of the cases, and theoretically should support the construction of individual knowledge representations that are flexible and adaptable to new situations (Jonassen, Dyer, Peters, Robinson, Harvey, King, & Loughner, 1997).

Transfer in cognitive flexibility literature is considered the application of new knowledge in new situations (Spiro et. al., 1987). Spiro et. al. (1987) argue that the problem with applying new knowledge in ill-structured domains is that the original presentation of that knowledge is usually simplified, thus resulting in simple understandings of the domain by the learner. The problem is that such simple understandings do not readily allow for application when the domain is inherently complex. Therefore, it is necessary to present the domain knowledge in a form that retains the complexity of the domain. Complex understandings, the theory holds, should then be more flexibly reassembled, or reinterpreted, in order to address a wide range of new situations based upon the context of each situation. Transfer in ill-structured domains, according to cognitive flexibility theory, is then considered to be a product of the learner being able to think about and structure domain knowledge in accordance with the new situation

To date the research has supported the transfer claims of cognitive flexibility theory by showing an improved transfer of knowledge application, as measured by essay answers given by learners, when approaches based on cognitive flexibility theory which emphasize complexity and the goal of flexible assembly of knowledge are compared to other instructional techniques which promote simpler understandings and outcomes such as retrieval of knowledge (Spiro et. al., 1987; Jacobson & Spiro, 1995; Jacobson, Maouri, Mishra, & Kolar, 1996). However, the learners had to be managed through the instruction by providing a list of only those thematic links that were considered by the designers to be relevant to the particular case being viewed From a design and implementation viewpoint, it would seem that managing the learner would be unnecessary if the learning task could promote criss crossing by the learner as effectively.

While research has provided some additional theoretical justification for the potential benefits of cognitive flexibility hypertexts, it is necessary to extend understanding of the application of the theory through research into the methods through which cognitive flexibility is applied to the design and implementation of hypertext/hypermedia learning materials. The research study conducted sought to accomplish this goal by examining the combination of cognitive flexibility hypertexts with two general types of learning tasks, one which promoted looking at cases individually and another which was believed to promote cross-navigation of cases.

Task and Learning Outcomes

The relationship between the nature of the learning task and learning outcomes has been shown to be significant in several studies of text processing. Pichert and Anderson (1977) found that asking learners to take a certain perspective when reading a story improved the memorization and retrieval of information. Pichert and Anderson concluded that the improvements were the result of the learner placing an emphasis on certain ideas presented in the text based upon the perspective they were taking. Wittrock and Alesandri (1990) studied the impact of generating summaries and analogies and found that learners were more analytic in their understanding of text passages than if they only read the passages with no specific task. The body of research on text processing suggests task plays a primary role in how people learn when reading.

However, the analysis of some of the findings regarding task are flawed in the view of cognitive flexibility theory. While text processing researchers have looked at the task as impacting information processing and/or schemata, Spiro et. al. (1987) posit that in ill-structured domains there is a need for flexible schema organization. Rather than merely "matching the information in the message to the slots in the schema" (Pichert & Anderson, 1977), the learner needs to gain an understanding of the situational nature of the information in order to reassemble their knowledge to fit a given instance within the domain. Therefore, task is important not because it cues relevant schemata, but facilitates construction of relationships between domain knowledge and situations.

Description of the Study

Specifically, the present study sought to identify the effects of two different types of task on the navigational paths of learners using a cognitive flexibility hypertext concerning issues of sexual harassment. In addition, the effects of the navigation path on transfer of learning were also examined. Finally, the type of task, navigation path, and transfer test scores were studied for significant interactions. In this manner some of the primary assumptions of cognitive flexibility theory were be tested, including the role of criss crossing navigation as a primary component for improving transfer, and the constructivist nature of the theory in terms of using a meaningful task to promote active learning.

The hypotheses of the study were that:

1. The two tasks would facilitate two different types of navigational paths, either a non-criss crossing path the juror task, or a criss crossing path for the policy task.
2. Learners taking a criss crossing navigation path through the hypertext would significantly enhance their transfer of learning as compared to learners who take a non-criss crossing path.
3. Difference in transfer would be the result of the policy task engendering a more criss-crossed navigation path through the hypertext than the juror task.

In order to test the hypotheses, the study was designed as an experimental study with subjects grouped by task. The participants were adult graduate management students enrolled in a course on business. Learners were randomly assigned to one of two task types. One task involved the learner in the role of juror, in which they were instructed to look at each individual case and render a decision as to whether it involved sexual harassment. The jury verdict task was expected to facilitate a linear, case-by-case path since it directed the learner to examine each case in its own context. The second task asked the learner to devise a policy for dealing with sexual harassment within a fictitious company, and directed the student to develop a complete picture of the issue as it relates to the workplace. This was expected to facilitate a less linear, and broader investigation of the case information by the learner due to the comprehensive nature of the task.

Attitude Factor

Attitude regarding sexual harassment was measured both just prior to the treatments and again prior to the transfer test. Beauvis (1986) considered attitude to be a combination of knowledge, sensitivity, and awareness of the issue of sexual harassment. In her study attitude changes were scored by comparing participants answers to how they matched the answers that would be expected based upon the desired goals and outcomes of the training program. In the present study, a similar method was used for scoring attitudinal differences between pre and post treatment answers on an attitude survey, comparing participant answers with those of an expert from the Affirmative Action Office of a university who was highly knowledgeable, sensitized and aware regarding the issue of sexual harassment. The resulting difference was used for statistical analysis of the impact of treatment variables on attitudes towards sexual harassment.

Measuring Criss Crossing

Using the description of "criss crossing" as entailing "revisiting the same material, at different times, in rearranged contexts, for different purposes, and from different conceptual perspectives" (Spiro et. al., 1992), it was decided that criss crossing would be evident from any navigational choice which resulted in one of three types of criss crossing:

- Within case criss crossing – revisiting the same information on a case previously viewed immediately after viewing other information about the same case.
- Internal criss crossing – revisiting any part of the case information immediately after reading case specific theme, perspective, or legal commentary related to the same case.
- External criss crossing – revisiting case information or case specific commentaries immediately after viewing overall theme commentaries or information in other cases.

Using the three types of criss crossing to determine how many of the participants' navigational choices were characteristic of criss crossing, the next step was to determine what methodology to use in order to measure navigation style for further statistical analysis. The most direct and appropriate measure was considered to be the total number of criss crossing choices made by the participant. This represented the simplest and most direct measure of the basic premise of cognitive flexibility theory that criss crossing impacts transfer. Statistically, it allowed the entire sample to be maintained as a single group for the purposes of measuring transfer. Using the raw number of criss crossing, analysis of the data was conducted regarding each of the hypotheses of the study, beginning with the effect of task on criss crossing.

Measuring Transfer

Transfer was measured using essay questions that presented new cases and asked the learner to apply what they had learned to make a determination regarding the case. Three independent raters, including the primary researcher, rated the transfer question essays according to a five point rubric. The final transfer score for each learner was the combined total points for each question, with a maximum possible score of 10 points. Interrater reliability for the transfer scoring was 91.8 percent between raters 2 and 3, 91 percent between raters 1 and 3, and 93 percent between raters 1 and 2.

Summary of Results

The results regarding the primary hypothesis revealed no significant impact for task type. Specifically, the results for each hypothesis were:

- An ANOVA revealed no significant relationship between task and criss crossing ($F=1.61$, $P>.05$, $N=34$), which means the hypothesis that the type of task would affect navigational style in this study was not proven.
- Analysis showed no significant effect between criss crossing and transfer ($F=.083$, $P>.05$, $N=34$). Therefore, the total number of times that a student criss crossed the hypertext had no statistically significant impact on the transfer of knowledge.
- An ANOVA was run which showed task had no significant relationship to transfer ($F=.324$, $P>.05$, $N=34$).

However, the findings regarding attitude did show a significant effect for task type. A repeated measure statistical analysis revealed that there was a significant interaction between pre-treatment to post-treatment attitude survey scores and the type of task ($F=4.86$, $DF=1,33$, $MS=2.431$, $P<.05$). Inspection of the data revealed that the policy task group ($N=16$) showed a mean positive change of 1.25 points on the attitude survey from pre-treatment to post-treatment, while the juror task group ($N=17$) had a mean negative change of -0.41.

Discussion of Results

Task and Criss Crossing

It is possible that the lack of differences can be attributed to the policy and juror tasks being equal in how they were perceived by the learner. It seems clear from the navigation data that a learner was just as likely to criss cross if they were engaged in the juror task as they were in the policy task. In fact most of the learners in the study chose a relatively low amount of criss crossing (average of only ten criss crosses out of fifty total navigational choices) regardless of task type.

A more theoretical explanation of the results is that learners have a predilection towards certain kinds of navigation patterns. The findings of Lawless and Kulikowich (1996) support this interpretation. In their study, hypertext learners appeared to fall into three types; those who explored the navigational options of the hypertext, those who were concerned primarily with seeking out particular information, and apathetic users who simply did not spend time in the hypertext. Beasley and Waugh (1996) also reported that learners seemed to approach hypertext systems with a general navigation pattern in mind, one that emphasized coverage of material rather than underlying structures or important information. In the present study, it is possible that, regardless of the nature of the task and the navigation options of the hypertext, learners used their preferred style of navigation to study the hypertext information and complete the task instead of adapting their navigation to the task and/or the prevalent hypertext structures.

Task and Transfer

As was the case for task and criss crossing navigation, it is likely that the tasks were not different enough in nature or importance to engender strong changes in learner reactions or understandings. This explanation is in keeping with previous research regarding task and perspective. Pichert and Anderson (1977) used two very different perspectives (home owner vs. burglar) and found that learners attended to different information when reading. In the present study, it may be that learners simply took a very similar perspective, perhaps viewing the cases from a legal viewpoint, in both tasks.

Other hypertext studies involving task differences have also had difficulty showing a significant link between task impacts on transfer via navigation variables. Beasley and Waugh (1996) found no differences in learner scores based upon the number of times they revisited information when given the goal of reviewing material. Given equal goals, but different amounts of return visits in a hypertext, it appears that learners scored relatively equally regardless of navigation. Jonassen and Wang (1993) found that without tasks that focused learners on different aspects related to the structure of the knowledge being studied, no significant differences could be found

Task and Attitude

An apparently strong relationship existed between the pre-treatment and post-treatment scores on the survey of attitudes towards sexual harassment. Students who engaged in the jury task actually appeared to become somewhat less sensitive to the issue, while policy makers gained a greater understanding of sexual harassment. One possible rationale for this difference is that the natures of the tasks, while not different in terms of learning transfer, were different in terms of affective outcomes.

Beauvis (1986) notes that sexual harassment training is designed to change attitudes by challenging trainees' opinions on the issue. The goal is to make participants more aware and more sensitive, which means they may need to be exposed to information contradictory to their beliefs. Some research regarding the exposure of learners to information inconsistent with their prior knowledge suggests that the accommodating of the contradictory information is a necessary step in learning through attitude change.

Chinn and Brewer (1993), based upon a study of adults presented with contradictory information regarding physics concepts, theorized that learners take four different approaches to dealing with contradictory information. One was to simply reject the new information, while another was to reinterpret it to make it fit with their present beliefs. Both of these meant that the person was unwilling to move from their beliefs as a result of the exposure to the new knowledge. The final two methods were partially changing their beliefs so as to allow for the new information without totally giving up old beliefs, and finally to restructure their beliefs around the new information.

In explaining the results of the present study, it seems reasonable that perhaps the two tasks were different in how participants encountered contradictory viewpoints on sexual harassment. Learners asked to provide a verdict in each case were perhaps more likely to hold on to their beliefs in the face of new information, since they were stating and defending their personal opinions in light of legal standards. This could be construed as meaning they were forced to either accept or reject new information on the basis of their personal understandings regarding sexual harassment law.

On the other hand, the learners developing policy may have been taking a more open perspective on the information they encountered, since developing a comprehensive policy meant taking into account as many different possibilities and perspectives as possible. In order to do this, these learners may have been acting less on personal belief than those in the juror group, and therefore they were more willing to accommodate information that contradicted their beliefs.

Considering that ill-structured domains tend to involve a great degree of variability, with no true "right" or "wrong" answers, then the findings suggest a possible new direction for studying cognitive flexibility theory. Findings of previous CFH research examined beliefs regarding the nature of knowledge (Jacobson & Spiro, 1995; Jacobson et. al., 1996), but not specifically the nature of the domain being studied. For ill-structured domains in which the learning outcomes may be affective, it may be that the nature of the task could play a significant role in learning by virtue of how the learner approaches information contradictory to their beliefs.

Conclusion

Cognitive flexibility theory has been widely touted as a strong basis for the design of hypertext learning environments. However, to date little research has been conducted on this claim. One contribution of the study is to begin to examine the importance of the type and nature of the learning tasks associated with CFH implementation. It appears that the amount of criss crossing that occurs is not by itself an important variable in achieving the learning outcome of transfer that the theory supports. In this study it has been suggested that perhaps the task must be meaningful to the learner, such that they are intentional in their navigational choices. This implication may extend to other theory-based hypertext designs, in that if learning is intentional then the task must fit the goals and contexts of the learner as well as the theoretical basis for the hypertext structure.

Perhaps the most significant finding of the study was that task might be very important when considering the types of ill-structured domains for which a CFH is developed. When dealing with domains which involve strong emotional opinions, and are perhaps controversial for learners, then the task may need to be devised such that learners remain open to the complexity and ill-structured nature of the knowledge being represented

References

Beasley, R. E., & Waugh, M. L. (1996). The effects of content-structure focusing on learner structural knowledge acquisition, retention, and disorientation in a hypermedia environment. *Journal of Research on Computing in Education*, 28(3), 271-281.

Beauvis, K. (1986). Workshops to combat sexual harassment: A case study of changing attitudes. *Signs: Journal of Women in Culture and Society*, 12(1), 120-145.

Chinn, C. A., & Brewer, W. F. (1993). The role of anomalous data in knowledge acquisition: A theoretical framework and implications for science instructions. *Review of Educational Research*, 63(1), 1-49.

Jacobson, M. J., Maouri, C., Mishra, P., & Kolar, C. (1996). Learning with hypertext learning environments: Theory, design, and research. Journal of Educational Multimedia and Hypermedia, 5(3/4), 239-281.

Jacobson, M. J., & Spiro, R. J. (1995). Hypertext learning environments, cognitive flexibility, and the transfer of complex knowledge: An empirical investigation. *Journal of Educational Computing Research*, 12(4), 301-333.

Jonassen, D. H., Dyer, D., Peters, K., Robinson, T., Harvey, D., King, M., & Loughner, P. (1997). Cognitive flexibility hypertexts on the Web: Engaging learners in meaning making. In B. Khan (Ed.), *Web-Based Instruction* (pp. 119-133). Englewood Cliffs NJ: Educational Technology Publications.

Jonassen, D. H., & Wang, S. (1993). Acquiring structural knowledge from semantically structured hypertext. *Journal of Computer-Based Instruction*, 20(1), 1-8.

Lawless, K. A., & Kulikowich, J. M. (1996). Understanding hypertext navigation through cluster analysis. *Journal of Educational Computing Research*, 14(4), 383-399.

Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1992). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In T. M. Duffy & D. H. Jonassen (Eds.), *Constructivism and the technology of instruction* (pp. 57-75). Hillsdale, NJ: Lawrence Erlbaum Associates.

Spiro, R. J., Vispoel, W. P., Schmitz, J. G., Samarapungavan, A., & Bocrger, A. E. (1987). Knowledge acquisition for application: Cognitive flexibility and transfer in complex content domains. In B. K. Britton & S. M. Glynn (Eds.), *Executive Control Processes in Reading* (pp. 177-199). Hillsdale NJ: Lawrence Erlbaum.

An Interactive Course-Support System for Greek

Trude Heift {heift@sfu.ca}
Janine Toole* {toole@cs.sfu.ca}
Paul McFetridge {mcfet@cs.sfu.ca}
Fred Popowich† {popowich@cs.sfu.ca}
Stavroula Tsiplakou {tsiplakou@sfu.ca}
Department of Linguistics, Computing Science†, and Natural Language Laboratory*
Simon Fraser University, Burnaby, B.C., Canada V5A1S6

Abstract

This paper reports on a course-support system for English learners of Greek which is built around an Intelligent Language Tutoring System (ILTS). Meaningful interaction between the learner and the system is achieved by a number of means: First, students provide natural language input rather than selecting exclusively from among pre-defined answers. Second, the ILTS uses Natural Language Processing to analyze the learner's input and to provide error-specific feedback. Third, the system contains a Student Model which keeps a record of students' performance histories. The information about each learner in the Student Model determines the level of specificity of feedback messages, clues, and exercise difficulty. In addition to vocabulary and grammar exercises, the system also contains oral dialogues with translations, a glossary, and cultural information. The system is designed for introductory learners of Greek and is implemented on the World Wide Web.

1. Introduction

As the Web begins to mature and technologies for adapting existing content in language learning converge with increased bandwidth, the desire grows to develop uniquely Web-based applications. Convenient access, currency and variety of material, and integrated multi-media can extend traditional language instruction, but truly new forms require a more profound degree of interactivity than provided by conventional forms.

Interactivity has become a key term in Hyper/Multimedia and although it is used extensively, its definition and scope is still not precisely determined. However, Laurel [1991] provides a useful definition by making a distinction between *frequency*, *range*, *significance*, and *participatoriness*. With respect to *frequency* and *range*, we may count the number of times a user can interact with a system and how many choices are available, respectively. *Significance* and *participatoriness* both require a qualitative analysis to determine how the user's choices affected matters and to which degree the user is participating in ongoing system decisions [Ashworth 1996]. But to achieve a high degree of interactivity with respect to *significance* and *participatoriness*, the software requires intelligence to consider user's individual differences. For example, students learn at a different pace and have different sets of skills. These student variables need to be considered for a system to be highly interactive.

The course-support material described in this paper differs from others in that it is built around an interactive Intelligent Language Tutoring System (ILTS). Interactivity is achieved in a number of ways. The system provides a wide range of exercises covering vocabulary and grammar practice. For some tasks, students provide natural language input rather than selecting exclusively from among pre-defined answers. The tasks are independent of each other and the exercise types range from drill-and-practice to more game-like tasks. In addition, the system contains oral dialogues, a glossary, and cultural information. *Significance* and *participatoriness* is achieved through Natural Language Processing (NLP) and Student Modeling. The system consists of a grammar and a parser which analyzes student input and provides error-specific feedback. The system also maintains a Student Model which keeps a record of students' ongoing performance, alters system decisions accordingly, and provides learner model updates.

In the following, we will first discuss the goals of the system and address the grammar, parser, and Student Model components. We will then describe the modules involved in analyzing student input. Further we will illustrate the exercise types of the system and provide examples of learner modeling for each of them. Finally, we will conclude with suggestions for further implementations.

2. Goals and System Requirements

The goal of the ILTS for Greek is to provide meaningful and interactive vocabulary/grammar practice for English learners of Greek. Meaningful tasks and interactivity require intelligence on the part of the computer program. Unlike existing course-support systems which use simpler grammar practice and feedback mechanisms, the ILTS for Greek emulates two significant aspects of a student teacher interaction: it provides error-specific feedback and allows for individualization of the learning process [see also Heift, 1998]. In example [1] the student provided an incorrect Greek sentence:

(1) Ολος ο κοσμος μαθαινεις Ελληνικα.
Ολος ο κοσμος μαθαινει Ελληνικα.
The whole world is learning Greek.

In such an instance, the system will detect an error in subject-verb agreement and, in addition, will tailor its feedback to suit the learner's expertise. Tailoring feedback messages according to student level follows the pedagogical principle of guided discovery learning. According to Elsom-Cook [1988], guided discovery takes the student along a continuum from heavily structured, tutor-directed learning to a point where the tutor plays less of a role. Applied to feedback, the pedagogy scales messages on a continuum from least-to-most specific guiding the student towards the correct answer.

There are three learner levels considered in the system: novice, intermediate, and advanced. For example (1), the novice will receive the most detailed feedback: "You have made a subject-verb agreement error.", while the intermediate learner will be informed that an error in agreement occurred. In contrast, the advanced learner will merely be told of an error in the sentence. The central idea is that the better the language skills of the learner, the less feedback is needed to guide the student towards the correct answer. This analysis, however, requires:

a) an NLP component which can analyze ill-formed sentences, and
b) a Student Model which keeps a record of the learner.

The NLP component consists of a grammar and a parser. The system is written in LOPE, an ALE style extension of Prolog [see Carpenter and Penn, 1994]. LOPE is a phrase structure parsing and definite clause programming system in which the terms are typed feature structures. Definite Clause Grammars (DCGs), like other unification-based grammars, place an important restriction on parsing, that is, if two or more features do not agree in their values, a parse will fail. However, in a language learning system, these are the kinds of mistakes made by learners. To parse ungrammatical sentences, the Greek grammar contains rules which are capable of parsing ill-formed input (buggy rules) and which apply if the grammatical rules fail (see also [Schneider & McCoy, 1998], [Liou, 1991], [Weischedel, 1983], [Carbonell & Hayes, 1981]). The system keeps a record of which grammatical violations have occurred and which rules have been used but not violated. This information is fed to the Student Model.

The Student Model is a representation of the current skill level of the student. For each student the Student Model keeps score across a number of error types, or nodes, for example, grammar or vocabulary. For instance, the *grammar* nodes contain detailed information on the student's performance on subject-verb agreement, case assignment, clitic pronouns, etc. The score for each node increases and decreases depending on the grammar's analysis of the student's performance. The amount by which the score of each node is adjusted is specified in a master file and may be weighted to reflect different pedagogical purposes.

The Student Model has two main functions:

First, the current state of the Student Model determines the specificity of the feedback message displayed to the student. A feedback message is selected according to the current score at a particular node. A student might be advanced with regard to vocabulary but a beginner with passive voice constructions. Hence, a feedback message about vocabulary would be less detailed than a feedback message about passive-voice constructions.

Second, the difficulty of the exercises presented to the student is modulated depending on the current state of the Student Model. For example, if a student is rated as advanced with respect to vocabulary, then some of the vocabulary exercises are made more challenging. The same thing can be found with some of the grammar exercises.

In the following, we will discuss the error-checking mechanism performed by the system in analyzing student input.

3. Error-Checking Mechanism

In addition to the grammar and the parser, the system contains additional error-checking modules which get evoked when processing a student answer. For example, consider the task in (2a) where the student was asked to make a sentence with the words provided.

(2a) ισπανικα μιλαω Νικη
(2b) Νικη μιλαει ισπανικα
niki – speak – Spanish

The student answer given in (2b) contains a number of mistakes: an error in subject-verb agreement, a spelling mistake, and a missing article. While the grammar will detect the agreement error, the remaining mistakes will be discovered by additional modules of the system. Figure [1] illustrates the modules of the Natural Language Processing system.

Student input

|

Spell Check

|

Answer Check

|

Extra Word Check

|

Word Order Check

|

Grammar Check

|

Match Check

|

Feedback Message to the Learner

Figure 1: Error-checking Modules

The first module in analyzing student input is a spell check. During the spell check, the system also extracts the base forms of each word from the grammar. The uninflected words are needed to determine whether the learner followed the task, that is, whether the student answer contained the words which were provided. Such errors cannot be determined by the grammar and the parser because the parser can only judge whether a sentence is correct or not.

In defining an exercise, we store possible answers of a given task and the Answer Check module determines the most likely answer (MLA) the student intended. The Answer Check module further matches the extracted base forms with the MLA. If any of the words in the task are not contained in the student answer, the system will report an error.

The following two checks, Extra Word Check and Word Order Check, refer to additional words in the student answer and errors in word order, respectively. While these two checks are commonly handled by the grammar [Schwind, 1995], preliminary testing of our system showed that the system performs faster if these two error types are treated outside the grammar. Naturally, the speed is also influenced by the grammar formalism used.

The Grammar Check is the most elaborate of the modules. Here the sentence is analyzed by the parser according to the rules and lexical entries provided in the Greek grammar. Currently, the grammar covers a wide range of grammatical concepts, from early beginner constructions (verb 'to be' and the concept of null subjects) to fairly advanced structures (passive voice). Development is still ongoing to achieve a complete coverage of Greek grammar.

The Match Check looks for correct punctuation and capitalization by string-matching the student answer with the MLA. By this time in the evaluation process, it is very unlikely that the sentence still contains any errors other than punctuation or capitalization. If the sentence passes the Match Check successfully, the sentence is correct. If not, an error is reported to the student.

The system is organized in a way that if a module detects an error, further processing is blocked. As a result, only one error at a time will be displayed to the learner. This was implemented mainly to avoid overloading the student with extensive error reports in the case of multiple errors. According to van der Linden [1993], displaying more than one feedback message at a time makes the correction process too complex for the student. After correcting the error, the student restarts the checking mechanism by clicking the CHECK button.

In the last section, we will briefly describe the six exercise types implemented in the system and discuss the role of the Student Model for each.

4. Exercise Types

The system consists of three vocabulary and three grammar exercise types: Guess the Word, Find the Word, Which Word is Different, Word Order Practice, Fill-in-the-Blank, and Build a Sentence, respectively. Student performance in each exercise contributes to the Student Model. However, the nodes that get updated for each exercise differ. In addition, there are two ways in which this information is used by the system:

1) feedback messages tailored to student expertise
2) difficulty of exercise presented to student

In the following, we will discuss the nodes which get updated and illustrate the feedback message and exercise difficulty modulation for each exercise type.

Vocabulary

Guess the Word

This is a slight variation of the vocabulary game 'Hangman' where students guess a word by entering one letter at a time. To avoid making this a purely guessing game, a clue is provided for each word. This clue may be the English equivalent of the answer, or a picture or sound representing the answer. For each correct word, there is an increment for the vocabulary node, for each word missed, the system registers a decrement. In this exercise type, the feedback messages are the same for all users. However, advanced students, that is, students with a high vocabulary score get fewer tries to complete the task.

Find the Word

In this exercise type, students need to find several words in a grid. The system increments the vocabulary node for each word found and decrements for each incorrect guess. The maximum increments and decrements per game are equal to the number of words in the table. The feedback messages are the same for all students. The exercise difficulty is modulated: advanced students receive clues in English, while other students receive clues in Greek.

Which Word is Different

This exercise displays a number of words all except one of which belong to the same category. The student task is to identify the one which differs from the others. The divergent word may differ syntactically, semantically or pragmatically from the remaining words. There is an increment for each correct word selected, for each incorrect selection a decrement is recorded. The feedback messages are the same for all students and there is no difficulty modulation.

Grammar

Word Order Practice

In this exercise, students practice Greek word order with a 'drag and drop' task: words have to be arranged in an appropriate order to form a grammatical Greek sentence. For this exercise type, the word order node in the Student Model is updated. For a sentence with incorrect word order, the system records a decrement, else an increment. There is no feedback or difficulty modulation for this exercise.

Fill-in-the-Blank

The student's task here is to complete sentences by filling in any blanks that appear in the example. The Student Model records each grammar node that is detected in the student input. For example, if students are asked to supply the correct conjugation of the verb, then the system records an increment/decrement for subject-verb agreement. The feedback messages are modulated according to the level of the learner. Also, advanced learners obtain more difficult tasks. For instance, novice and intermediate students will find only one blank per example. Advanced students may be presented with examples that contain more than one blank.

Build a Sentence

In this exercise type, students are provided with a set of words. Their task is create a grammatical Greek sentence using all the provided words. This was illustrated earlier in example (2). All grammar nodes activated during the processing of the student's input are updated in the Student Model. An increment is recorded if this aspect of the student's answer was correct. A decrement is recorded for any grammatical errors made by the student. Feedback messages reflect the current state of the learner's expertise, as represented by the Student Model. There is no difficulty modulation.

It becomes apparent that the modeling process has to be decided for each exercise type independently. Not only does it depend on the task but also the possibilities the exercise offers in adjusting the level of difficulty.

5. Future Work

We plan to extend the range of exercises available to students. Since students are particularly appreciative of the opportunity to practice grammar in such a constructive environment, we will focus on developing further exercises that exploit the Natural Language Processing and Student Model functionality that we have developed. Two exercises under construction are Dictation and Translation.

In the Dictation exercise, students listen to an audio file and then type the text they have heard. The student's input is analyzed by the grammar and feedback is provided for any grammatical errors. Feedback is modulated according to the current state of the Student Model. In the translation exercise, students are provided with an English phrase or sentence and are required to translate this into grammatical Greek. Again, feedback is modulated according to the current state of the Student Model.

6. Conclusions

In this paper, we discussed an interactive course-support system on the WWW. Interactivity is achieved by a wide range of exercise types which are arranged in an independent order. NLP and Student Modeling also contribute to the interactivity of the whole system by providing error-specific feedback and adjusting to different learners. The Student Model is based on the performance history of the student. The information about each learner is recorded in the Student Model and determines the level of specificity of feedback messages and exercise difficulty.

Preliminary testing of the content of two modules and the overall functionality of the system has taken place. While the performance of the system is accurate with respect to feedback and student modeling, student responses are currently being analyzed and results will be reported during the presentation. In the meantime, the system is being further developed by adding more content and implementing further grammatical constructions.

References

Ashworth, D. (1996). Hypermedia and CALL. In Pennington, M. C. (ed.). *The Power of CALL*. Athelstan Publications, Houston, USA.

Carbonell, J. G. and Hayes, P. J. (1981). Dynamic strategy selection in flexible parsing. *Proceedings of ACL 19th Annual Meeting*. 143-147.

Carpenter, B., and Penn, Gerald. (1994). *The Attribute Logic Engine: User's Guide, Version 2.0*. Computational Linguistics Program, Carnegie Mellon University, Pittsburgh.

Elsom-Cook, M. (1993). Student Modelling in Intelligent Tutoring Systems. *The Artificial Intelligence Review*, 7 (3-4): 227- 240.

Heift, T. (1998). *Designed Intelligence: A Language Teacher Model*. Ph. D. Dissertation, Simon Fraser University, Canada.

Liou, H.-C. (1991). Development of an English Grammar Checker: A Progress Report. *CALICO Journal*, 9: 27-56.

Pennington, M. C. (1996). *The Power of CALL*. Athelstan Publications, Houston, USA.

Schwind, C. B. (1995). Error Analysis and Explanation in Knowledge Based Language Tutoring. *Computer Assisted Language Learning*, 8 (4): 295-325.

Schneider, D. and McCoy, K. (1998). Recognizing Syntactic Errors in the Writing of Second Language Learners. *Proceedings of the 17th International Conference on Computational Linguistics*.

Van der Linden, E. (1993). Does Feedback Enhance Computer-Assisted Language Learning. *Computers & Education*, 21 (1-2): 61-65.

Weischedel, R.M. and Sondheimer, N.J. (1983). Meta-Rules as a Basis for Processing Ill-Formed Input. *American Journal of Computational Linguistics*, Special Issue on Ill-Formed Input, 9 (3-4): 161-177.

Acknowledgements

We would like to thank the Greek Ministry of Education for generously supporting this project.

Instructional Design Guidelines for Authentic Activity in Online Learning Units

Jan Herrington
School of Communications and Multimedia, Edith Cowan University, Perth, Western Australia
j.herrington@cowan.edu.au

Heather Sparrow
Learning Innovations and Future Technologies, Edith Cowan University, Perth, Western Australia
h.sparrow@cowan.edu.au

Tony Herrington
School of Education, Edith Cowan University, Perth, Western Australia
a.herrington@cowan.edu.au

Abstract: The current trend to use the World Wide Web as a vehicle for the delivery of distance education units has required educators to adopt innovative approaches to the design of learning materials for this medium. However, the temptation to place large tracts of text online is deeply entrenched. This paper describes a project where guidelines for the design of authentic activities have been derived from a broad literature base. The guidelines have been used in the development of Masters subjects, where authors are encouraged to use learning activities as the central focus of study—the activity does not supplement the unit, it *is* the unit. The emphasis is placed on the design of activities, integrated assessment of the activities, identification of resources and establishment of collaborative tools. Examples of activities, together with the instructional design guidelines, are provided, and the use of theory and research to inform the instructional design process is discussed.

Authentic activities

Activities, investigations and problems are at the heart of student involvement in meaningful learning contexts. Teachers provide such activities to enable students to interact with the learning environment, and to learn, apply and practice newly acquired skills. Activities are defined by Brophy and Alleman (1991) as: 'Anything students are expected to do, beyond getting input through reading or listening, in order to learn, practice, apply, evaluate, or in any other way respond to curricular content' (p. 9).

This paper describes the development of a university-based online project where activities are used, not only as opportunities for students to learn, practice, apply and evaluate, but also as central organising devices for the design of entire online units of study. Clayden, Desforges, Mills and Rawson (1994) point out that the kind of activities frequently used in education simply lead to an enculturation into the practices of classrooms rather than the real-world transfer teachers expect. They note that students' efforts to make sense of classroom experiences generally lead them to focus on working practices rather than abstract ideas. 'What they learn ... is how to do work, how to be neat, how to finish on time ... and how to tidy away' (p. 164). While these comments are most appropriate for school (and to some extent university) classrooms, the same conclusions may be drawn for the design of online learning environments. Students frequently learn to invoke 'sub-optimal' schemes to enable them to proceed, rather than deal with the content in a way that promotes true understanding. Many of these online programs are so 'well designed', they fail to account for the nature of real-world problem solving, where the solution is rarely neat and the salient facts are rarely the only ones at students' disposal. In contrast, a number of authors suggest that authentic activities should be ill-defined—students *find* as well as *solve* the problems. Learners need to have the opportunity to: explore a situation with all the complexity and uncertainty of the real world, have a role in determining the task and how it might be broken up into smaller tasks, select relevant information, and find solutions that suit their needs.

The Cognition and Technology Group at Vanderbilt (1990b) stress the importance of complexity and the necessity to provide an environment capable of sustained examination. They describe authentic tasks as 'generative' because the completion of the task requires the students to generate other problems to be solved. They draw a distinction between these authentic tasks and simple word problems that already define the problem, such as: 'If you travel 150 kilometres at 90 kph, how long will the journey take?' By comparison, Reeves and Laffey (1999) describe a complex learning environment where, for an entire semester unit, the students' task is to establish a research station on Mars, including designing an energy plant to sustain life once a station is established. Similarly, Pennell, Durham, Orzog and Spark (1997) describe a web-based environment where students learn business communication skills by accepting temporary employment in a virtual recording company. They are given a complex task to complete, and in order to do it, they make appointments and keep a diary, 'interview' the director and other employees, and write letters, memos and reports.

Several authors have attempted to delineate characteristics of authentic activities. For example, Jonassen (1991) defines authentic activities as tasks: that have real-world relevance and utility, that integrate those tasks across the curriculum, that provide appropriate levels of complexity and that allow students to select appropriate levels of difficulty or involvement (p. 29). Similarly, Bransford, Vye, Kinzer and Risko (1990) Young (1993) Lebow and Wager (1994) and Savery and Duffy (1996) among others have nominated criteria of authentic activities.

Recommended design features of authentic activities

It is possible to use these findings of the research and writing on authentic activities to produce guidelines for the design of learning environments. Accordingly, authentic activities:

- have real-world relevance (e.g., Brown, Collins, & Duguid, 1989a; Cognition and Technology Group at Vanderbilt [CTGV], 1990a; Jonassen, 1991; Resnick, 1987; Oliver & Omari, 1999)
- are ill-defined (e.g., Brown et al., 1989a; CTGV, 1990a; Young, 1993)
- comprise a single complex task to be investigated by students over a sustained period of time (e.g., Bransford, Vye et al., 1990; CTGV, 1990b; Jonassen, 1991; Savery & Duffy, 1996)
- require students to define the tasks and sub-tasks required to complete the activity (e.g., Bransford, Vye et al., 1990; CTGV, 1990b; Collins, Brown, & Newman, 1989; Young, 1993)
- provide the opportunity to examine the task from different perspectives, (e.g., CTGV, 1990a; Young, 1993; Spiro, Feltovich, Jacobson, & Coulson, 1991; Lebow & Wager, 1994; Savery & Duffy, 1996)
- enable students to detect relevant from irrelevant information, (e.g., CTGV, 1990; Savery & Duffy, 1996)
- provide the opportunity to collaborate (e.g., Young, 1993; Lebow & Wager, 1994)
- can be integrated across subject areas (e.g., Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990; Bransford, Vye et al., 1990; Jonassen, 1991).
- are seamlessly integrated with the assessment (e.g., Reeves & Okey, 1996; Herrington & Herrington, 1998).

These principals have been incorporated into the design of activities within online units currently being designed for a suite of Masters level courses.

The Masters Online project

Fifteen professionally oriented Masters courses are presently being developed, in areas such as health, teaching, business, finance, computing and information science. Students in these courses are mostly experienced in the workplace and authentic learning activities are likely to be highly valued by these students. Many of the students live geographically distant from the university, whilst others have such busy lifestyles that on-campus study is impractical. The university has an established tradition of providing external courses for these students. The use of computer technologies to offer enhanced learning environments to external students is a natural next step. However, it is a significant challenge to provide the required staff development to support such effective change.

In total, the 15 Masters courses offer over 250 subjects or units and involve over 150 academic staff, some of whom have limited experience of working in the online environment. The project has an initial development phase of three years. During the first three years, all units will be adapted for use online, but at differential levels:

1. New units receive the highest level of attention. Lecturers are funded through time release or additional payments to design the new unit. They are supported by an instructional designer and a multimedia development team. These units are designed to use authentic activities as a central focus of the unit. Authors are supported through: information workshops; demonstration, development, discussion and evaluation workshops; group and one-to-one consultations; and an information and example(s) web site.
2. Major revision units (existing distance units in print mode) where the focus is on developing sections of the unit to include authentic activities, and also encouraging students (and staff) to use the research and communication capabilities of the Internet.
3. Minor revisions (existing distance units in print mode) receive minimal content change but provide the staff and students with enhanced communications facilities (bulletin boards, chat rooms, Email, etc.).

Designing authentic online activities

As Salomon, Perkins and Globerson (1991) have pointed out: 'No important impact can be expected when the same old activity is carried out with a technology that makes it a bit faster or easier; the activity itself has to change, and such a change cannot take place in a cultural vacuum' (p. 8). The Masters Online project has a cultural history in the domain of the traditional printed distance education unit. The temptation for many of these authors is to produce blocks of text, similar to chapters of an external unit, and to design a variety of activities to accompany the text, with separate assignments. Encouraging the writers of new units not to put copious 'content' on the web generally requires a huge cultural shift, and a substantial rethinking of what they want students to achieve and how they could enable that learning to occur.

In designing the new units, a complex and sustained activity (with strong teacher support and peer collaboration) is the focus of the entire unit. Students use a purposeful activity to organise their study, to give meaning to their acquisition of information and to provide a framework for the creation of a realistic product. There is no attempt to divide the course into discrete fragments of easily digested information. In this sense, the activity does not supplement the unit—it *is* the unit.

The notion of the activities effectively being the unit is one that is quite foreign, and one that requires a major change in direction for these teachers. The first suggestion from an instructional design point of view has been to encourage the writers not to begin with the traditional scope and sequence, followed by the division of the content into chapters or modules. In the first instance, we ask the writers to plan the activities and to consider that their units might comprise one or two of these sustained and lengthy activities. In order to assist the design process, and to enhance the likelihood that the importance of the activity as a central organising device in the unit is prominent, the following design matrix (Table 1) is given to each writer, with its four main planning areas, together with space for them to jot down their initial ideas. These are then 'brainstormed' and refined in consultation with the instructional designer and the project team.

The design of the activities, and supporting resources and collaborative tools, in many cases require the authors to create scenarios which call for the students to adopt a role or persona. While the option of creating real problems, as recommended by Savery and Duffy (1996) is always preferable, simulated situations are also prepared and are considered an acceptable vehicle for authentic student learning (McLellan, 1994). Table 2 provides an example of a plan for a simulated activity together with its assessment, resources and communication strategies. The activities being designed for the units vary enormously (across 15 courses). Further examples of the kinds of activities being produced include:

- In a computer graphics unit, students produce a piece of software for a particular target group, together with documentation and users' manual. Each assignment represents a stage in the completion of the final product.
- In an environmental management unit, students evaluate and prepare a report on whether a proposed housing estate development will pose a risk to nearby ecosystems.
- In an educational theory unit, students write journal articles in groups and submit their articles to the editorial board of a journal (effectively the other student groups for peer review).

Table 1: Web-based learning activities: Instructional design guidelines

Process	Guidelines	Advice	Examples
1. Designing the activities	Design activities which: • have real-world relevance • are ill-defined • comprise a single complex task to be in-vestigated by students over a sustained period • provide opportunity to define tasks & subtasks	• Reflect the kind of problem students would face in real-life • Choose a problem which enables students to apply the knowledge you want them to learn in your unit • Let the task be the central organising device for the students' learning—don't provide explicit directions and sub-tasks	• Case studies and role play • Decision-making • Dilemmas • Presentations to stakeholders • Public defence of position • Reports and proposals
2. Designing the assessment	Design activities which: • provide the opportunity to collaborate • are seamlessly integrated with the assessment	• Try to integrate the task and assessment. • Set group tasks, and arrange students in collaborative groups where possible • Use whole student group to evaluate each other's work.	• Group tasks • Peer evaluation • Authentic assessment
3, Identifying, locating and/or producing resources	Design activities which: • provide the opportunity to examine the task from a number of different perspect-ives, and to be able to detect relevant from irrelevant information • can be integrated across subject areas	• Create your own resources where necessary, as appropriate to the task • Link to outside sources to provide different perspectives and access to expert thinking • Textbooks, other books and library journals may be necessary because you can find no online equivalent	• Video, audio • Online documents • FAQs etc • Websites • Online journals and databases • Textbooks • Books, journals
4. Selecting collaboration coaching and communi-cation tools	• Design activities which: • provide the opportunity for students to examine the task from a number of different perspectives, and to be able to detect relevant from irrelevant information • provide the opportunity to collaborate	• Encourage collaboration to enable students to support each other's learning • Participate in online discuss-ions so that your voice can be heard through this channel • Encourage students to participate in established list-serves to enable them to be part of worldwide discussions • Use current and emerging technologies to communicate with your distant students	• Email • Discussion boards • Chat sessions, • Online tutorials • Listserves

Lebow and Wager (1994) contend that 'Human learning is essentially a matter of self-regulation' (p. 239). However, this does not mean that students can be given complex and authentic tasks with no support or coaching to guide their learning. Wade (1994) points out that the promotion of learner autonomy means increased responsibility for the student which, if it is to succeed, requires 'a strong framework of support and guidance for the student from the outset' (p. 13). The support to be provided by the tutor of the online unit is also planned concurrently with the design of the learning activities, together with opportunities for students to collaborate with each other in their learning. It is hoped that development through group activity and dialogue will be more enjoyable, more meaningful and more effective.

Table 2: Example of plan for authentic online activity

Stage of development	Example activity: The ethics of research
1. Designing the activities	"For this activity, you are required to assess the ethical conduct of a proposed piece of research. You are to imagine that you are on the Committee for Ethical Conduct of Research with Human Subjects in your University. Members decide on whether research meets ethical standards, but the whole group never meet in person. You decide each case after an email discussion. (You will be on this committee and the other members are students from your group also studying this unit.) The committee receives an outline of a research proposal from a mature student, who is also a teacher in a primary or elementary school. The student will use her Year 6 class as subjects for the proposed research. The students' research proposal is given below: **Title of research**: The influence of stated teacher belief on student assignment writing **Subjects**: Entire group of Year 6 students in Social Science class **Research overview**: The researcher will adopt the position of participant-as-observer in order to conduct the research.. In order to test the effect of stated teacher belief (as opposed to a genuinely-felt belief) on the students' assignments, the researcher will conduct a short survey of students beliefs on the environment at the beginning of the school year. In the second term or semester, the teacher will state a strongly pro-logging position with regard to the logging of forests, prior to the commencement of a new topic area in social science class. The topic will include discussion of environmental issues relating to deforestation and its impact on ecosystems. The assignment given to the class will require an evaluation of the pros and cons of logging, together with an overall assessment of whether or not logging of old growth forests should be permitted. The influence of the teacher's stated belief will be tested against the survey results obtained earlier in the year. After reading the brief research proposal, you need to respond to the members of the group with a summary of the ethical issues involved and the conditions under which the research could be supported. Your task is to frame a considered response to the student."
2. Designing the assessment	"Because the Ethics Committee would otherwise be snowed under with responses, a word limit of 1000 words has been placed on all committee members for each response. "Send your evaluation to the Unit Online Discussion and participate in the discussion to decide as a group how the Ethics Committee should respond to the student. You will be assessed on your initial response and your final group response to the student."
3. Identifying, locating and/or producing resources	**Resources created, e.g.** • Create email message for members of the committee, and student's research proposal **Links to outside sources, e.g.** • Nuremberg and after:http://www.csu.edu.au/faculty/arts/humss/bioethic/resethic.htm • The Ethics Resource Center: http://www.ethics.org/ **Books and journals: e.g.** • American Psychological Association. (1993). Ethical principles in the conduct of research into human participants. *American Psychologist*, 57(1), 33-51. .
4. Selecting collaboration coaching and communi-cation tools	**Communication tools: e.g.** • Online threaded discussions board • Email **Established listserves: e.g.** • Ethics Update Discussion Forum: http://ethics.acusd.edu/kant.html

By the end of the initial three year phase, all units in the Masters courses will be available in an online mode and a significant number will use authentic activities: they will act as models for the future. Teachers will have developed the technical skills necessary for online teaching in a real but supported context, and engaged in a range of problem-based, reflective activities which seriously probe the nature of teaching and learning.

Conclusion

The adoption of online learning environments has frequently been an ad hoc affair in universities, often led by one or two computer enthusiasts or early adopters (Bates, 1999). While the individual approach has the advantage of commitment and speed towards implementation, there can be a tendency for early users to simply replicate existing teaching and learning practices in the online environment. Many staff development programs provide technical assistance to academic staff wishing to apply new communication and learning technologies to their teaching. Technical advice alone, however, seldom challenges teaching staff to reflect deeply on the nature of learning and to reconsider the learning goals and values which underpin their choice of teaching methods. The project described here was developed specifically to encourage academic staff to move beyond replication of existing ideas and to restructure their units according to the recent theory and principles of authentic learning.

References

Bates, T. (1999, June). *Thinking digitally: Restructuring the teaching environment for technological change.* Keynote address at EdMedia 99, Seattle, Washington, USA.

Bransford, J.D., Sherwood, R.D., Hasselbring, T.S., Kinzer, C.K., & Williams, S.M. (1990). Anchored instruction: Why we need it and how technology can help. In D. Nix & R. Spiro (Eds.), *Cognition, education and multimedia: Exploring ideas in high technology* (pp. 115-141). Hillsdale, NJ: Lawrence Erlbaum.

Bransford, J.D., Vye, N., Kinzer, C., & Risko, V. (1990). Teaching thinking and content knowledge. In B.F. Jones & L. Idol (Eds.), *Dimensions of thinking and cognitive instruction* (pp. 381-413). Hillsdale, NJ: Lawrence Erlbaum.

Brophy, J., & Alleman, J. (1991). Activities as instructional tools. *Educational Researcher, 20*(4), 9-23.

Brown, J.S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Clayden, E., Desforges, C., Mills, C., & Rawson, W. (1994). Authentic activity and learning. *British Journal of Educational Studies, 42*(2), 163-173.

Cognition and Technology Group at Vanderbilt. (1990a). Anchored instruction and its relationship to situated cognition. *Educational Researcher, 19*(6), 2-10.

Cognition and Technology Group at Vanderbilt. (1990b). Technology and the design of generative learning environments. *Educational Technology, 31*(5), 34-40.

Collins, A., Brown, J.S., & Newman, S.E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L.B. Resnick (Ed.), *Knowing, learning and instruction* (pp. 453-494). Hillsdale, NJ: LEA.

Herrington, J., & Herrington, A. (1998). Authentic assessment and multimedia: How university students respond to a model of authentic assessment. *Higher Education Research and Development, 17*(3), 305-322.

Jonassen, D. (1991). Evaluating constructivistic learning. *Educational Technology, 31*(9), 28-33.

Lebow, D., & Wager, W.W. (1994). Authentic activity as a model for appropriate learning activity: Implications for emerging instructional technologies. *Canadian Journal of Educational Communication, 23*(3), 231-144.

McLellan, H. (1994). Situated learning: Continuing the conversation. *Educational Technology, 34*(10), 7-8.

Oliver, R., & Omari, A. (1999). Using online technologies to support problem based learning: Learners' responses and perceptions. *Australian Journal of Educational Technology, 15*(158-79).

Pennell, R., Durham, M., Ozog, M., & Spark, A. (1997). Writing in context: Situated learning on the web. In R. Kevill, R. Oliver, & R. Phillips (Eds.), *Proceedings 14th Conference of ASCILITE* (pp. 463-469). Perth, WA: Curtin.

Reeves, T.C., & Laffey, J.M. (1999). Design, assessment, and evaluation of a problem-based learning environment in undergraduate engineering. *Higher Education Research and Development Journal, 18*(2), 219-232.

Reeves, T.C., & Okey, J.R. (1996). Alternative assessment for constructivist learning environments. In B.G. Wilson (Ed.), *Constructivist learning environments* (pp. 191-202). Englewood. Cliffs, NJ: ETP.

Resnick, L. (1987). Learning in school and out. *Educational Researcher, 16*(9), 13-20.

Salomon, G., Perkins, D. N., & Globerson, T. (1991). Partners in cognition: Extending human intelligence with intelligent technologies. *Educational Researcher, 20*(3), 2-9.

Savery, J.R., & Duffy, T.M. (1996). Problem based learning: An instructional model and its constructivist framework. In B.G. Wilson (Ed.), *Constructivist learning environments* (pp. 135-148). Englewood Cliffs, NJ: ETP.

Spiro, R.J., Feltovich, P.J., Jacobson, M.J., & Coulson, R.L. (1991). Cognitive flexibility, constructivism, and hypertext. *Educational Technology, 31*(5), 24-33.

Wade, W. (1994). Introduction. In W. Wade, K. Hodgkinson, A. Smith, & J. Arfield (Eds.), *Flexible learning in higher education* (pp. 12-16). London: Kogan Page.

Young, M.F. (1993). Instructional design for situated learning. *ETR&D, 41*(1), 43-58.

Computer Science Instruction in a Virtual World

Curt Hill
Mathematics Department
Valley City State University
Valley City, ND 58072
curt_hill@mail.vcsu.nodak.edu

Brian M. Slator
Computer Science Department
North Dakota State University
Fargo, ND 58102
slator@badlands.nodak.edu

Abstract: A novel system for teaching computer science online is presented. The ProgrammingLand MOO is a multiple user environment where students may learn content, exercise skills, collaborate with other students and demonstrate competencies. It is intended to deliver content in a learner centered fashion that is both engaging and attractive to students. The system is designed for distance education but has also been used with traditional classroom instruction. It has been used for introductory programming classes as well as for certain junior level classes.

Introduction

The ProgrammingLand MOO (Hill & Slator 1998; Slator & Hill 1999), is a computer aided instructional system to teach students the introductory ideas of Computer Science. It has been developed and used in conjunction with traditional classroom instruction. However, its goal is for distance learning and non-traditional classes. It is intended to deliver the content that would normally be obtained from a lecture or textbook, yet have many of the attractive qualities of games and other learner centered activities.

Content in ProgrammingLand

A typical session for a student starts with the execution of a client program. There are several applets that allow the student to use their web brower for this, as well as many good standalone clients. The student connects to the MOO and is registered for tracking purposes. The MOO itself is structured into rooms, with exits being the path from one room to another. Each student has a home that is usually the main entry way of the MOO, but the student may change their home if they desire. The MOO is built on Version 2.0.1 of the enCore database (Holmevik & Haynes 1997).

The motif of ProgrammingLand is that of an Exploratorium style museum. Therefore the term exhibit is usually used instead of room. Whenever an exhibit or room is entered, the MOO displays a description. Typically this is a paragraph or two of instruction on some topic. The MOO will also indicate what exits exist and where they lead. The student is always free to choose which path to take and what to look at next. Although an exit is a one way path from one room to another, they often come in pairs so that a student may return to an exhibit conveniently. The student entering the Compound Statement Room would see the following display.

The Compound Statement The compound statement is not a flow of control statement, however it is used in most flow of control statements and is essential to the Structured Programming model.

In the Structured Programming model there is the notion of a block. The block in C++ is the compound statement. It is a wrapper that binds several statements into one. It is also the block that greatly affects the scope of variables.
You may choose any of the following exhibits to consider next.
a) The syntax of the compound statement
b) Scope of variables in the compound statement
c) The compound statement and other statements
or
x) Return to the main exhibit on flow of control

Figure 1: The Compound Statement Room

In summary the student meanders through the museum, picking and choosing what they want to read and also choosing the order to consider topics. If this were the extent of the techniques used in the MOO it might be useful, but would not be superior to a series of web pages. What must be considered next are the objects that work together to make this experience more educationally beneficial.

Fundamental Objects

In a MOO every thing is an object. Rooms are objects, exits are objects, players are objects and everything else that we will later consider are objects. These objects have properties that may carry information and methods that may perform useful functions. The student is oblivious to most of this, they walk through the museum without much thought to the processing the server is doing. The first objects that need to be considered are the student's character and the rooms.

When a student logs into the MOO, the student's character is activated. This character is the object that the server uses to manage everything that is known about the player. There are several important properties that are attached to the student object that have an impact on the educational use of the MOO. The first is list of every room that the player has visited. There are certain objects that mark events and make awards. The student scores points in this way, either by visiting an exhibit, taking a quiz, or achieving some other accomplishment. Finally, a student has a goal, which is what they should be working on currently.

There are two types of room in the MOO. The first type is called the lecture room, since it delivers a paragraph or so of the virtual lecture. This is the object that tags the student character with the fact that it had been visited. Its description property contains the text displayed when entered. It also contains a property that holds quiz questions, discussed below. The second type is called a workroom. The lecture room is the only type of room that records a visit on the student character and is the most common type of room. A workroom is only used to house some other types of interactive object.

Currently there are two such objects that are frequently used in workrooms: the code machine and the workbench. At any one time any number of students may be present in the MOO. They may interact with each other, since every room of the MOO is a chat room. However, when two or more students try to use either of these types of machines at the same time there will be confusing results. Neither student will be able to see what the other has done. Therefore, a workroom only allows one student into itself at a time. Furthermore, when the student leaves the workroom, the workroom will reset the contained machine to its starting state. Most objects other than rooms, exits and players can be picked up and moved. Few students realize this, but those that do can move a machine far from its intended location. Therefore, if a student does pick up the code machine or workbench, the workroom will remove it, when they leave.

Interactive Objects

Some of the objects discussed in this paper could be generally used in many disciplines but the code machine and workbench are specific to the programming discipline. The code machine contains a piece of programming code, which it will display, explain or trace. The code machine may display the code with or without line numbers. The line numbers are important for the explanation and trace. The code without the line numbers allows the student to copy the code from the MOO client and then paste it into an edit window and actually compile the code. The explanation of the code works on a line by line basis. The numbered line is displayed with an explanation. The student then requests the next line. The trace of the code is a simulated execution. The code machine displays the lines that are executed along with a description of what is happening at run time, including the new contents of any variables that are changed. When a student completes either the explanation or trace of a code machine, an event is posted to their event property. The event captures the particular code machine in question and whether this was an explanation or trace.

The MOO is not used to compile student programs. The compiler resides on the student's own computer or perhaps in a publicly available machine. Hence, some of the practice that would be desirable for a programming class must be done out of the MOO. However, the workbench represents an attempt to place part of this practice into the MOO. A workbench is a table driven parser, with enough of the tokens of a program fragment to allow the student to test whether they have the syntax of a contruct correct. The student builds a statement or program fragment from the pieces that are inserted into the workbench. When complete the student can ask the workbench to determine if the fragment is correct or not. In very simple instances the workbench may also interpret the code and run the program fragment. Like the code machine a successful parse of the code produces a point-scoring event on the student character.

Lesson Structure

ProgrammingLand is not a random collection of rooms containing instructional material any more than a textbook is a random collection of pages. There is an order imposed that organizes rooms into related clusters of rooms called sub-lessons. Sub-lessons have no required shape or size but often have some common characteristics. They are always a group of rooms on a single topic. There is often only one entrance in to the group and usually just one or two exits out. The first exhibit in the group is usually an entryway room with a short introductory paragraph and then a menu of available rooms. Often one of the rooms has only text that attempts to motivate the student or explain how the topic fits in the overall scheme of things. There is often a workroom in a sub-lesson as the final example. A sub-lesson may be nested within a larger sub-lesson.

The following objects were created to support the lesson: a sub-lesson, a sub-lesson-exit, a quiz room, a dispatcher and the roving goalie. These work together to post events on the student object and test the events. When students have enough point-scoring events, they can be given an "out of MOO" programming assignment to finalize their learning.

Sub-lessons

The head of the structure is the sub-lesson exhibit. It is a descendent of the lecture room so contains all the properties and methods of that object. It contains two additional properties as well, the all_rooms property and the requirements property. The all_rooms property is a list of all the exhibits in the sub-lesson. If a student is given credit for the lesson then the rooms on this list are removed from the student's history of rooms visited. This is done to shorten what can be a long list of rooms, under the assumption that mastery of the sub-lesson is more important than any subset of rooms visited. The requirements property states what is expected for a student to gain credit for the sub-lesson. It is a list of lists. If they satisfy any of the sublists they are given credit for the sub-lesson. However, to satisfy a list they must satisfy every requirement of the list. Each of the sublists may require any combination of simple room visits or specific events recorded. The order that these requirements are satisfied is irrelevant, only that the students did each of the items on one of the sublists. A requirements property does not have to contain multiple sublists, but that is often the case.

The sub_lesson_exit is a descendent of the normal exit object but behaves in a rather different way. When a student chooses an exit that will leave the sub_lesson, their progress towards satisfaction of the requirements is checked. If the student has previously met the requirements, the exit moves the student to their intended destination with no action out of the ordinary. If any of the sublists of the requirements of the sub-lesson have been fully met, then the exit tells the student that they have completed the sub_lesson. It also posts a completion of sub_lesson event to their event list. If they have not completed the sub_lesson they get a different set of messages. The first sublist of the requirements is checked and one or two unmet requirements are displayed. They are then asked if they want to continue to their destination and finish the sub_lesson later or if they want to prove their mastery with a quiz. If they opt for a quiz they are transported to a quiz room.

Quiz Rooms

The quiz room is a special room that is a descendent of the regular MOO room and not any of the aforementioned rooms. It always has a single exit, which is the destination that a student usually arrives at when leaving the sub_lesson. It has **no** entrances; the only way in is to take the quiz option when using a sub_lesson_exit. It has a single new method, which administers the quiz to the student. The quiz is randomly generated based on the requirements of the sub_lesson and the state of the students progress toward the satisfaction of the requirements. The quiz generator determines the rooms that the student has **not** visited by looking at the requirements of the sub_lesson and the history of the rooms from the student. Each lecture room has a property that contains quiz questions. These questions should be about the content of that room only. It then gathers the available quiz questions from the unvisited rooms and makes up a quiz of no more than five questions. If there are not enough questions in those rooms it will look at the sub_lesson for a store of more general quiz questions to get the total up to five.
A quiz consists of up to five questions. Each question is a four or five answer multiple choice question. The questions stored in the lecture rooms are coded with three distinct pieces: the problem statement, possible right answers and possible wrong answers. The quiz generator will randomly select one of the right answers and four of the wrong answers. Therefore it is desirable to form questions that have several right answers and many wrong answers to prevent students from communicating these questions to their peers. The randomization of the answers disallows certain types of multiple choice answers like *both b) and c)* and discourages answers like *all of these* and *none of these*. When the student answers, they are given immediate feedback, either that the answer was correct or the letter of the correct answer. If the student answers correctly a sufficient number of questions then the quiz posts the sub_lesson completion event on the student character.

Lesson Dispatcher

The sub_lesson_exit or the quiz room may give the student the event for completing the sub_lesson. This notice is put in the student's events property. It also notifies the dispatcher object of the student and the event. Certain sub_lessons are allowed to change the goal of a student. These sub_lessons are noted in the dispatcher. When the dispatcher receives the sub_lesson notification, it compares the sub_lesson with a list of sub_lessons and roving goalie objects. If this sub_lesson is on the list, then the matching roving goalie is activated. It will wait for three seconds and then move to the location of the student. It will assign them a goal and tell them some messages pertaining to that goal.

Goalies

A roving goalie is an object with several important properties for the interaction with the student. Generally, it is intended to give each student a separate, personalized assignment, usually a programming assignment. This is accomplished by three message properties. The first is the prefix message. This congratulates the student for completing the sub_lesson and usually starts to introduce the assignment. The second message is selected from a list of equivalent assignments. The roving goalie maintains an index which records the next assignment to be given. When an assignment is given, this index is circularly incremented. If there are more assignments than students each student will get a different assignment. If there are more students then several may receive the same assignment. The third message adds whatever concluding information may be appropriate. Every student receives the same first and third message, but the second message will vary between students. This message may be quite lengthy, not just a single sentence. If the student ever wants to reread the assignment, the goal and roving goalie are noted on their character. They have the showgoal command which shows them the three messages again. Moreover, the roving goalie records the student which received each assignment index. A student may only receive one such goal from a particular sublesson, since the sub_lesson_exit first checks that they do not have the sub_lesson completion event.

Toys in the Attic

In the spirit of the Exploratorium, the ProgrammingLand MOO is populated with a range of demonstrations, toys, robots, and interactive exhibits. These artifacts are intended to engage a visitor in the exploration of the content stored in the museum. It is hoped that these playful, interactive objects will serve to both engage and teach.

Demonstration Machines and Checker Machines

Demonstration machines were built for Lisp functions as an in-class project in the summer of 1998. A class of 50+ students were each assigned a unique Lisp function, and instructed to create a machine with a 'demo' function that would illustrate the operation of the function. For example, the Lisp 'cons function' room contains a description of the 'cons' function, written on the wall, a 'cons' machine that will give a demonstration of how the 'cons' function works, and a 'cons checker' machine where players can plug expressions in to see if they're well formed.When the student plugs a correct value into the machine a congratulation message is returned and an 'award' is added to the player's history. When the player makes a mistake, the feedback includes the correct answer.

The Recursive Leprechaun

Since recursion is one of the most difficult concepts for students to master, it is important to expose the students to recursion as often as possible. One approach is to implement a recursive leprechaun, which resides in the Realm of Recursion. The recursive leprechaun demonstrates a recursive counting function in a visually descriptive manner. For example, the Leprechaun gives demonstrations of recursive counting by producing new leprechauns from a sack, and handing them an N-1 value to count; when N reaches zero, the leprechauns shout their value, pass it to the next, and jump back in their neighbor's sack.

The Ring Toss Game

The Ring Toss game is intended to provide an amusing challenge in the area of associating programming languages with their historical antecedents. The goal of the ring toss game is to associate languages with people and other concepts. More than one ring can be tossed on a single peg.

The History Jukebox

The History Jukebox is a device for summarizing programming language history in an entertaining and on-demand fashion. If a player were to 'press 1959 on History Jukebox' they would be told about John McCarthy at MIT and the origins of Lisp.

Tutor Robots

Tutor Robots were implemented to make the function rooms in the LambdaMOO wing more active and engaging. They are created from a prototype Turing Robot developed by Ken Schweller, based on the Eliza model (Weizenbaum 1966) which was inspired by Turing (1950). The Robots are user programmable and capable of matching key words and sentence patterns, and can be implemented with random responses and question responses. However, Tutor Robots can display both remarkable responses, and remarkably obtuse responses.

Conclusion

ProgrammingLand was never designed to be completely self-contained. The student will always need access to a language system. Thus the goals assigned by the roving goalie are externally satisfied. Related MOOs such as the Geology Explorer (Slator et al. 1999) have a goal system that is completely internal. When a student is interacting with the Geology Explorer, they always have a goal, usually the identification of some mineral on the virtual planet. When they find that goal they are congratulated and given a new goal. The system itself may monitor the progress toward the goal. If they need a particular instrument to properly distinguish a mineral from others that may appear to be similar and they leave the starting point without it, a tutor may appear and give them some instruction. Similarly, if the goal mineral is in a room and they leave without identifying it, then a tutor may appear and give them some instruction about that as well. These advantages stem from the fact that the goal is issued by the MOO and progress towards the goal may be monitored by the MOO. Though there are many parallels between Geology Explorer and ProgrammingLand, there are some differences as well. Specifically Geology Explorer is a virtual laboratory, the student should gain experience and hone skills. ProgrammingLand is designed to replace either the textbook or the lecture or both. However, its laboratory features are substantially weaker, due to the topic. ProgrammingLand provides some facilities such as code machines and workbenches but the bulk of the experimentation must be outside of the MOO.

Student evaluations of a course using ProgrammingLand were generally quite high; in one survey, 92% of the students responding rated the quality of the course as either above or much above average. Similarly, 88% of the students believed their understanding of the course content was either good or very good.

The ProgrammingLand MOO is an interactive learning environment. It attempts to balance content material and immersive exploration. It is more interactive than a textbook or a lecture, it keeps better records than web instructional pages, it also productively uses the information that it records.

References

1. Hill, Curt & Brian M. Slator (1998) Virtual Lecture, Virtual Laboratory, or Virtual Lesson. In the *Proceedings of the Small College Computing Symposium (SCCS98)*. Fargo-Moorhead, April. pp. 159-173.
2. Holmevik, Jan Rune & Cynthia Haynes (1997). http://lingua.utdallas.edu/encore/.
3. Slator, Brian M. & Curt Hill (1999). Mixing Media For Distance Learning: Using IVN And Moo In Comp372. World Conference on Educational Media, Hypermedia and Telecommunications (ED-MEDIA 99), June 19-24, Seattle, WA.
4. Slator, B.M., P. Juell, P.E. McClean, B. Saini-Eidukat, D.P. Schwert, A. White, C. Hill (1999). Virtual Environments for Education at NDSU. World Conference on Educational Media, Hypermedia and Telecommunications (ED-MEDIA 99), June 19-24, Seattle, WA.
5. Turing, Alan (1950). Computing Machinery and Intelligence. Mind, 65(236), pp. 433-460. Reprinted in ``Computers and Thought'' (1963). Edited by Feigenbaum and Feldman. New York: McGraw-Hill.
6. Weizenbaum, Joseph (1966). ELIZA -- a Computer Program for the Study of Natural Language Communication between Man and Machine. Communications of the ACM, vol. 9, pp. 36-45

Acknowledgements

Thanks to Faye Erickson, who implemented the 'cons machine' and the 'cons checker'; Tom Lemke who implemented the 'recursive leprechaun'; Mahesh Sharma who implemented the 'ring toss game'; Bryan McGowan who designed the History Jukebox; and Justin Abel who implemented Curly the Tutor Robot.

Open Educational Hypermedia Systems: An n-dimensional framework for User Profile Interchange

Günter Hilmer
School of Computing, University of Glamorgan
Trefforest, Pontypridd, Wales, CF37 1DL, UK
ghilmer@glam.ac.uk

Geoff Elliott
School of Computing, University of Glamorgan
Trefforest, Pontypridd, Wales, CF37 1DL, UK
gjelliot@glam.ac.uk

Daniel Cunliffe
School of Computing, University of Glamorgan
Trefforest, Pontypridd, Wales, CF37 1DL, UK
djcunlif@glam.ac.uk

Doug Tudhope
School of Computing, University of Glamorgan
Trefforest, Pontypridd, Wales, CF37 1DL, UK
dstudhope@glam.ac.uk

Abstract: Increasingly Educational Hypermedia Systems (EHSs) are using the World Wide Web (WWW) as the medium of delivery. Many of these systems use methods and techniques from Adaptive Hypermedia Systems. This paper focuses on the interchange of information about the student's knowledge between EHSs over the WWW. A conceptual framework based on a 4-dimensional representation is introduced. A proposed implementation of this conceptual framework within the eXtensible Markup Language (XML) is described. The paper concludes with a brief summary of future work.

Keywords

Educational Hypermedia Systems, User Profile Interchange, WWW, XML, Adaptive Hypermedia

Introduction

The field of education has always been a research area of Adaptive Hypermedia Systems (AHS) [Brusilovsky, 1996]. Every Educational Hypermedia System (EHS) that not only displays prepared content to a student but also changes certain styles of display or paths through the system is an AHS. Increasingly hypermedia projects use the WWW as their delivery medium [Brusilovsky *et al.*, 1998; De Bra & Calvi, 1998; Specht & Oppermann, 1998; Nkambout & Gauthier, 1996]. Most of them lack the capability to share information about the users or students with other EHSs and are therefore isolated or closed. The result of this isolation is that every EHS has to organise information about the users by itself. To overcome this isolation we introduce an approach to "open" the EHSs. The approach will concentrate on information about the student but will also identify different areas where openness of the EHSs would be possible. A conceptual framework for an n-dimensional User Profile Interchange (UPI) is shown and future work in this area is outlined.

How could Educational Hypermedia Systems be open?

EHSs that use adaptive techniques are AHSs [Brusilovsky, 1996]. So, it can be assumed that EHSs implement the basic processes of an AHS, which are:

- Gather information about a student. This can be done fully automatically or collaboratively with the student. It is also possible in an educational context that the teacher provides the system with information about the student.
- Create a user profile of the student based on the information.
- Adapt the content, the content presentation, the teaching strategy or the navigational support to the students profile.

It would be beneficial if an EHS could be open in each of the aspects named above. This means that the information about the student as well as the teaching and learning strategies and the adaptation processes might be exchanged between the different systems. However, in this paper we will concentrate on the interchange of the information about the student's knowledge.

User Models in Educational Hypermedia Systems

Data about the student is important for an EHS because the adaptation process depends on this information. Most EHSs are require information such as:

- Learning preferences: What kind of teaching or learning strategies does the student prefer, e.g. case studies, problem solving, and so on?
- Presentation preferences: Has the student any preferences for specific presentation styles or particular media-types?
- Background and experience: What background and experience does the student have?
- Goals: Which goals or learning goals does the student have? What goals does the teacher have for the student?
- Knowledge: What knowledge does the student have?

Additional information about the student can be gathered during the usage of the system. The system could, for example, analyse the path taken by the student through the document or content space. It could analyse answers to tests or interaction during a problem-solving module. The system is then able to update the user profile during the presentation and adapt the presentation on the fly.
The information about a student is processed by an EHS to build a user profile for the student. If the same student were also working in another hypermedia system, then this system would also have to build a new user profile for the student. A very challenging part of the user profile is the representation of the knowledge of a student. Therefore we concentrate on this part of the user profile. Different approaches have been tried in the past by different systems:

- Stereotype [Boyle & Encarnacioni, 1994], e.g. students are classified into groups rather then being classified as individuals.
- Boolean [De Bra & Calvi, 1998], e.g. several variables are used to classify a student. Each variable represents a specific knowledge the user has or has not.
- Percentage values [da Silva *et al.*, 1998], e.g. variables represent the users knowledge about a certain domain. The variable has furthermore a graded value that holds the graded knowledge of the student about that domain.

The information about the user could also be represented within an n-dimensional framework that will be now introduced.

N-Dimensional knowledge representation

A feature of the above user modeling techniques is that they differ in the level of detail used to describe a student. The more accurately the individual student and his knowledge is to be modeled the more variables are needed. It is rather difficult to convert one of the user models into another whilst they are in their native state. For a working UPI model we have to build a framework that allows us to describe all user model structures, such as stereotype,

Boolean, and so on. For this task we introduce an n-dimensional user knowledge representation scheme. Each dimension represents the extension of a user model with the capability for a more fine-grained representation of the students' knowledge.
The following table explains the different dimensions:

Dimensions	Description	Corresponding user model concepts in AHS
Non-adaptive Model (0-dimensional)	No explicit user modeling technique is used. The systems user model is static and implicit. The user model can not be changed and the presentation is not adapted.	Every non-adaptive EHS
Single Variable (1-dimensional)	The student's knowledge is modeled only with one variable. The users are classified into groups rather then being classified individually.	Stereotype user model
Multiply Variable (2-dimensional)	The model of the knowledge is extended by one dimension. There are now multiple variables available to model the student's knowledge. The additional dimension indicates whether the knowledge modeled by one variable is present or not.	Boolean approach
Value dimension (3-dimensional)	Each of the variables used by the 2 dimensional approach can be extended with an individual or range of different values. These additional values allow an even more detailed description of the users knowledge.	Scalar or Percentage approach
Time dimension (4-dimensional)	There is not much research work available about 4-dimensional approaches. A promising idea is to introduce time as a fourth dimension [De Bra, 1999]. Every value of the variable could be marked with a time-stamp, after some time the knowledge of the student begins to degrade.	Knowledge degrades over time.
Possible future dimensions (n-dimensional)	Each additional dimension offers the system an even more detailed view of the student's knowledge. Future research in the area may discover more dimensions that need to be considered. The problem with too many dimensions is that the implementation overhead grows enormous with every new dimension.	Theoretical

Mapping approaches

The UPI between n-dimensional Open Educational Hypermedia Systems (OEHS) is difficult. After analysing the different dimensions it is important to realise that there are just 3 different approaches to map the information about the user from one OEHS to another. Depending on the dimension of user knowledge representation of the OEHS is it necessary to perform a *simple mapping*, *downsize* or *expand* on the information about the user. The different approaches will be now introduced in more detail.

Simple Mapping

The approach of simple mapping covers all the cases of UPI of OEHSs that have the same dimensional structure of their user model. No dimensional conversion has to be done. The information about the user can just be copied from one OEHS to the other. The problem of what to do if the different user systems do not have the same knowledge domain structure remains.

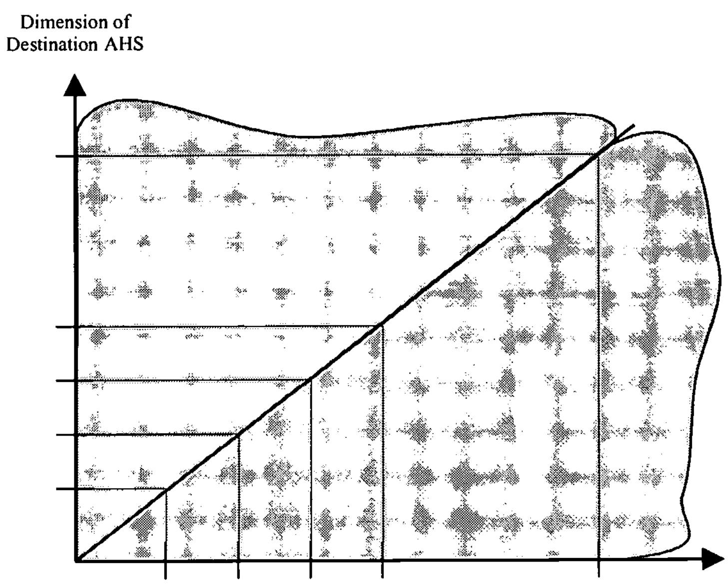
Downsizing

Downsizing the user information from one OEHS into another is necessary whenever the source OEHS has a higher dimensional user-model than the destination OEHS. During the transfer of the user profile information from the source OEHS with a higher user profile dimension to a destination OEHS with a lower user profile dimension it is quite obvious that there will be a loss of information about the user. The loss of information is larger the larger the dimensional gap between the two OEHSs is. A user profile that is transferred from a 4-dimensional OEHS into a 1-dimensional OEHS loses all the information of dimensions 2-4.
The downsizing process itself has either to be done manually or with a sophisticated automated process. This will not be easy and requires further development of the technologies and the framework.

Expansion

The user-model of the source OEHS has to be expanded if the user-model has a lower dimension than the destination OEHS. The expanding process is therefore the opposite approach to the downsizing approach. The difficulties within this approach lie in the need for creating additional information about a user. This is the biggest problem found in any of the three named approaches.

The following chart visualises our n-dimensional mapping approach of UPI in OHES:



The problem of different knowledge domains

We have to differentiate between two cases of user profile interchange. In the first case the two AHS have the same structure for representing the knowledge domain. Furthermore, not only the representation structure is the same, but also the perspective of the domains is the same. For example, the source and destination AHSs have the domain "multimedia" and the domains have the same meaning and scope in both AHSs.
In the second case the structure of the knowledge domains of the two AHSs are different. Either the different domains are named differently or the have the same names but not the same meaning for the two AHSs. For example, the domain knowledge concept *multimedia* symbolises a complete knowledge about multimedia in the one AHS but only coverage of video, audio and text elements in the other AHS. The mapping between non-identical knowledge domains in this second case is very difficult to implement and is left at the moment for further research.

The technique of the user profile interchange and the implementation will however stay the same in both cases. The only area where the two approaches differ is the grade of sophistication in the mapping of the user knowledge from one OEHS to the other.

Implementation

To describe the different dimensions of the students knowledge we use the eXtensible Markup Language (XML) [XML, 1998]. XML is a markup language that allows the creation of customised markup Languages and is used in several projects for describing educational metadata [ARIADNE, 1999; Ram *et al.*, 1999]. We propose the creation of a new XML Document Type Definition (DTD) specially designed for User Profile Interchange over the WWW. This DTD would offer the possibility of describing every category of the user model of an EHS. It would be designed so that it can be extended dynamically to describe new dimensions of the user model.

If two OEHSs want to exchange information about a specific student they would create XML files based on the UPI-DTD and exchange these XML files over the WWW.

As soon as the destination OEHS receives the UPI-DTD tagged information about the student it can start to import the user profile. The technical realisation of this import process could be done with any program language capable of reading XML files. The implementation has to provide the different mapping approaches to the OEHS introduced above. The authors are planing to use JAVA for this task, because it is particularly suited to working with the WWW and secondly, there are tools and classes being developed to provide XML capability.

Advantages

The biggest benefit of this approach is that the n-dimensional UPI builds a meta-framework for student knowledge representation. The XML implementation will permit an interface for every EHS that wants to exchange user specific information over the WWW. Other advantages are:

- Information about a student and his knowledge will no longer be isolated into separate systems but can be exchanged between them.
- It provides an easy and dynamic extendable framework that is able to describe the entire present user modeling techniques in AHSs and EHSs.
- XML allows the easy and standardised implementation of the n-dimensional UPI model for the WWW.

Problems

Despite the advantages of this new framework covers there are still some problems which have to be solved. The biggest one is probably the one about the different knowledge domains of the OEHSs. This situation is difficult to solve without additional information about the different systems. The problem is not so big if one of the two systems, either the sending or the receiving one knows the user model structure of the other EHS. In this case the system that knows the others user model structure can export or import the user information in the proper way. Some other problems that need more research are:

- At the moment there is a lack of a common terminology for describing student knowledge variables.
- How can variables of certain dimensions be converted to variables of other dimensions?
- How are individual-based user modeling techniques transferred into group-based modeling techniques and vice versa?

Conclusion and Future Work

In this paper we have introduced a new conceptual framework for User Profile Interchange in Open Educational Hypermedia systems. This new framework is based on an n-dimensional projection of user models. The framework will be implemented in XML and evaluated in our future work. Subsequent work will concentrate on the interchange of teaching and learning strategies, content organisation and adaptation processes in Open Educational Hypermedia Systems.

References

[Ariadne, 1999]
http://ariadne.unil.ch/ Alliance of Remote Instructional Authoring and Distribution Networks for Europe

[Boyle & Encarnacioni, 1994]
Boyle, C. & Encarnacion, A.O., MetaDoc: an adaptive hypertext reading system
User Modeling and User Adapted Interaction, v4(1), pp.1-19

[Brusilovsky, 1996]
Peter Brusilovsky, Methods and techniques of adaptive hypermedia
User Modeling and User Adapted Interaction, v6(2-3), pp. 87-129

[Brusilovsky *et al.*, 1998]
P. Brusilovsky, J. Eklund, E. Schwarz, Web-based education for all: A tool for developing adaptive courseware. Computer Networks and ISDN Systems (Proceedings of Seventh International World Wide Web Conference), Vol. 30(1-7), pp. 291-300

[da Silva *et al.*, 1998]
Denise Pilar da Silva, Rafael van Durm, Erik Duval, Henk Olivie, Concepts and Documents for adaptive educational hypermedia: a model and a prototype
2nd Workshop on Adaptive Hypertext and Hypermedia, pp. 33-40
http://wwwis.win.tue.nl/ah98/Pilar/Pilar.html

[De Bra & Calvi, 1998]
Paul De Bra & Licia Calvi, AHA! An open Adaptive Hypermedia Architecture
The New Review of Hypermedia and Multimedia, vol. 4, pp. 115-141

[De Bra, 1999]
Paul De Bra, Design Issues in Adaptive Web-Site Development
Proceedings of the 2nd Workshop on Adaptive Systems and User Modeling on the WWW

[Nkambout & Gauthier, 1996]
Nkambout, R. & Gauthier, G., Use of WWW resources by an intelligent tutoring system
Ed-Media'96 – world conference on educational multimedia and hypermedia, Charlottesville: AACE, pp. 527-532

[Ram *et al.*, 1999]
Ashwin Ram, Richard Catrambone, Mark Guzdial, Colleen Kehoe, Scott McCrickard, John Stasko, PML: Representing Procedural Domains for Multimedia Presentations
Technical Report GIT-GVU-98-20, to appear in IEEE Multimedia

[Specht & Oppermann, 1998]
Marcus Specht & Reinhard Oppermann, ACE – adaptive courseware environment
The New Review of Hypermedia and Multimedia, vol. 4, pp. 141-163

[XML, 1998]
http://www.w3c.org/XML Extensible Markup Language (XML™)
Current W3C Recommendations XML 1.0

Acknowledgements

Work supporting this research was conducted in the HEFCW funded Internet Technologies Research Lab in the School of Computing, University of Glamorgan.

Considering Pedagogy in the Design, Development and Evaluation of Educational Software

J. Enrique Hinostroza
Instituto de Informática Educativa, Universidad de La Frontera
Montevideo 0830
Temuco, Chile
ehinost@iie.ufro.cl

Harvey Mellar
Science and Technology, Institute of Education, University of London
20 Bedford Way,
London, WC1HOAL, England
hgm@ioe.ac.uk

Abstract: This paper explores the consequences for the design, development and evaluation of educational software of a model of understanding information technology based upon teachers' concepts and beliefs about this technology. The model was the result of a case study and considers two dimensions. The first dimension is the role of the computer, conceptualizing it as a teaching resource that helps teachers to develop their teaching strategy, replacing them in the role of managing students' rehearsal of materials and serving as a classroom management tool. The second dimension is the pedagogy that teachers embedded into the characteristics of the software, such as classroom atmosphere in the human-computer interface scenarios and elements, the teaching routines in the design of the navigation structure of the software, and the learning strategy in the human-computer interaction. The main consequence of this model is in illustrating a specific integration of pedagogy-related concepts to the design, development and evaluation of educational software, thereby demonstrating the need and usefulness of such integration.

Introduction

This paper explores the consequences of a model of understanding information technology in the processes of designing, developing and evaluating educational software. The model is the result of a research study aimed at understanding teachers' concepts and beliefs about educational software (Hinostroza, 1999). The research was designed as an instrumental case study (Stake, 1994) to provide insight into teachers' concepts and beliefs about computers. The process of definition of the study followed (Yin, 1994)'s recommendations. The 'case' was a process of educational software development, in which two primary teachers, a software engineer, a psychologist and a graphic designer were committed to the development of a piece of educational software over a period of seven months. Each session of the development process was observed and video recorded. The data was analyzed from both, qualitative and quantitative stand points, using systemic networks (Bliss & Ogborn, 1979) to organize and give a structure to the categories of analysis and the software QSR NUD*IST to support the coding process.

The unit of analysis was defined as a sequence of utterances made by members of the team in which they refer to one particular aspect of the software. Where they referred to two (or more) aspects simultaneously (in parallel), these have been considered as two (or more) separate units. This unit was named 'Discussion about Software Design' and was described through the systemic network.

The two main attributes that characterized the unit of analysis are: the 'Topic' discussed and the 'Participants' in the discussion. The 'Topic' of discussion was divided into three main subjects related to the software design. The first one was related to the dimensions of software engineering ('Subject Areas', 'Content Organization', 'Navigation', 'Interaction' or 'Interface Element'); the second one was about the characteristics of the user ('Teacher', 'Pupil' or 'Group'); and the third one dealt with 'Pedagogic Issues' that were related to software and/or computers ('Aim', 'Teaching Strategy' or 'Actions').

The data classified was analyzed using three methods: (i) participation analysis, aimed at establishing individual participation profiles during the development process; (ii) sequence analysis, aimed at establishing the inter-relations among the different components of the software based on the analysis of the patterns of sequences of units in the data for the group and for each team member, and (iii) contents analysis, aimed at looking for the meanings expressed by the teachers about the different dimensions of the piece of educational software. These analyses were used in a complementary way, enabling the researcher to focus on relevant issues and to enable some triangulation of the implications drawn.

The main implications of this study were represented through a model of understanding information technology that is presented in the next section.

The Model of Educational Software

This model, firstly, shows, what the participating teachers conceived of as the role of the computer, and, secondly, presents the characteristics of the educational software that these teachers designed and shows the dimensions of their teaching strategies that were embedded in these characteristics.

In discussing the role of the computer in the classroom, the teachers indicated how important for them the role of the computer as rehearsal tool , this was the role that they naturally picked up and expanded on. They designed this role by integrating it into a larger teaching strategy that separated teaching into two stages: learning new concepts and rehearsing these concepts. This model of use of the computer is represented in Fig 1.

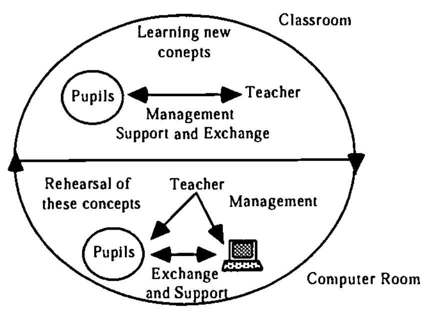


Figure 1. Model of the role of the computer

In this model the computer is acting as a resource for the teacher that helps him/her carry out some of their current tasks more effectively. Some ground rules in this model are that (Hinostroza & Mellar, 2000):

- the teacher teaches new concepts in the classroom and not in the computer room;
- the teacher does not interact with the computers;
- the teacher when working in the computer room guides the pupil's construction of knowledge through managing the classroom and solving computer problems, but (s)he does not engage with the contents to be learned;
- the teacher manages the pupil's access to the computers, and by incorporating them within the punishment-reward system of the classroom (s)he is able to use them to manage the class.

Regarding the design of the piece of software, it was found that they transferred several teaching principles, or classroom routines, to characteristics of the educational software. These principles can be classified as the three different types of classroom routines described by (Leinhardt, Weidman, & Hammond, 1986):

- **Management**, this includes housekeeping, discipline maintenance and people moving tasks.
- **Support**, that is, specific behaviors and actions necessary for a learning-teaching exchange to take place, for example 'how to pass in papers'.
- **Exchange**, that is, the interactive behaviors that permit the teaching-learning exchanges to occur. They govern the language contacts between teachers and students - for example, routines for choral responses.

The correspondence of these routines and the software characteristics is presented in Tab. 1 (Hinostroza & Mellar, 1999).

Teaching Routines Domain	Software Design Domain
Management: In this case classroom atmosphere and tone.	The human-computer interface elements (scenarios, backgrounds, characters and particular functionality of these elements) and the overall organization of the subjects.
Support: In this case, lesson flow, contents provision, and control of the user's progress.	The navigation structure of the software and the response to certain situations (for example, feedback on errors).
Exchange: In this case, learning strategies or theories.	Particular human-computer interaction and user's actions.

Table 1. Correspondence between teaching routines and software design domains.

The model was grounded in two sources of evidence, first, the data collected in the research and second the evidence reported in research studies about teachers' everyday practices in the classroom, (i.e. their strategies, routines, roles and beliefs). This latter source of evidence expands the theoretical framework of the study, covering not only the area of information technology in education, but also the area of pedagogy. In this sense, this model of educational software constitutes an interesting starting point for further research in this area. We now turn to the discussion of the consequences of this model for the design, development and evaluation of educational software.

Implications for Educational Software Design

Educational software is still an arena for debate and controversy, and as yet there are no clear design prescriptions that could ensure its actual use nor its effectiveness (see for example discussions in: Cuban, 1997; Johnson, Cox, & Watson, 1994; Lowther & Sullivan, 1994). We (also) suggest that much of the reason for this continuing controversy is that little attention has so far been paid to a consideration of teachers' actual classroom practices.

Based on the model presented in the previous section it is possible to argue that in order to design software one important issue to address is the role of the software in the teaching strategy that the teacher will implement. In this case the software was defined in such a way as to have a role in the rehearsal stage of the teaching strategy, but it is also possible to imagine that it could have a role in the stage where the teacher explains new concepts (for example a piece of simulation software would probably fit into this stage).

The implication of this definition is that the software is designed to play this and no other, role while teaching. This helps to focus the design of the software to meet a particular set of learning requirements only, without pretending to support the complete teaching and learning process.

Given the role of the computer in a given teaching strategy, the other consequences are related to the design of the characteristics of the software (Human-Computer Interface, Navigation Structure and Human-Computer Interaction) and will be presented in the following sections.

Human-Computer Interface Elements

It was argued that this characteristic of the software was related to the design of management routines, particularly to the creation of a 'classroom atmosphere and tone'. Regarding the latter, (Woods & Jeffrey, 1996) describe how primary teachers create 'atmosphere' and use different 'tones' in interaction with the children to achieve different effects, they describe it as having the following characteristics:

- **Anticipation and expectation**: teachers are skilled in the construction of situations and in their sense of timing.
- **Relevance**: teachers are able to ensure that pupils feel a strong sense of involvement by making the pupils identify and get involved in the atmosphere.
- **Achievement and success**: there is a sense of high teacher expectations and confidence in children's abilities to meet them.
- **Satisfaction**: Pupils feel satisfaction and the sense of 'a job well done' because of the achievement.

These characteristics are part of the techniques that teachers use during their lessons. (Woods & Jeffrey, 1996) also describe the different tones that teachers use during the lesson as "Andante (to be performed in moderately slow time)", "Legato (smoothly and connectedly, no gaps or breaks)" and "Spiritoso (with spirit)".

These techniques can be considered in the design of the human computer interface (HCI) elements of the software, for example:

- Creating the background of the HCI as a story, so that students can get involved in it and believe it.
- Designing the storyboard so that it can be reviewed in one lesson and that, independently of the particular path followed by the users, they find a coherent end to the story.
- Designing the graphic representation of the characters and scenarios of the HCI so that they are known to the users.
- The organization of the 'contents' of the software should take care that users can review the complete story in one lesson.

The Navigation Structure

It was argued that the design of the navigation structure was related to the support routines, in this case this implies that the software should implement the 'flow' of the lesson. With respect to this, (Hammersley, 1990) says that teachers present the lesson "pitched at a certain level of 'difficulty' according to the co-ordinate position of the class in relation to age and ability" (p. 47). He argues that teachers gradually provide more and more clues to 'what the answer is' in order to pace the lesson in such a way as to get the answer to emerge towards the end of the lesson. Further on, he gives some reasons why they do this: "this pre-setting is designed not only to ensure that pupils are taught something 'new', that they 'keep moving', but also that they have the resources to understand what the teacher is to teach" (p. 47).

This strategy can be transferred to the design of the navigation structure of the software using a schemata such as the one presented in Fig. 2.

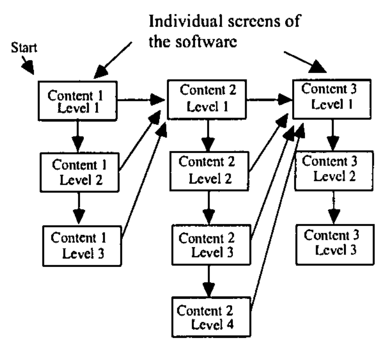


Figure 2. Navigation structure of the software.

In such a structure users can navigate through different sequences of 'contents' accordingly to their 'level' of achievement and will have the opportunity to learn something new and to keep moving as Hammersley describes students as doing in a teacher taught lesson.

Human-Computer Interaction

It was argued that the design of the human-computer interaction was related to the exchange routines, in this case that is to the teachers' learning theories (conceptions) that govern the teacher-student dialogue. The literature describes the teacher-student interaction as based mostly on dialogues that have the structure of question, answer, and feedback. About the former, (Gall & Artero-Boname, 1995) classifies teachers' questions during a lesson as: lower or higher cognitive questions; recitation and discussion questions; or as test-relevant questions.

The feedback provided to students has also been studied. (Mayer, 1995) describes the educational uses of feedback as corresponding to academic learning tasks, behavior management tasks and skill learning tasks. In the first, feedback provides information concerning the correctness of students' performance, in the second, it provides information concerning the appropriateness of students' behavior and in the third it provides information concerning the accuracy of students' behavior.

These two areas provide a rich framework for designing the human-computer 'dialogues' that take into consideration the type of questions that the software should consider and the different types of feedback that need to be considered.

Implications for Educational Software Development

Looking at the literature that describes educational software development (for example: Eraut, 1996; Galvis, 1994; Squires, 1996), there are few references to issues such as 'Classroom Atmosphere', 'Lesson Flow', or 'Classroom Management'. Although some of these reviews mention 'pedagogy' as a dimension that needs to be considered (for example: Squires, 1996), they do not expand on these issues. Whilst it is true that teachers have sometimes been incorporated into the software development process, they have generally been asked to contribute to the learning and curriculum design issues, and the issues of actual classroom practice have been neglected.

This lack of material discussing these issues indicates the low importance that seems to have been given to knowing and considering the actual use of the software in order to design it. Through a study of the literature relating to pedagogy it was possible to identify at least three theoretical areas that could influence the development process of educational software (i.e reported techniques for classroom atmosphere, lesson flow and learning).

These findings have clear implications for the software development process, in so far as they show the need to incorporate these dimensions during the development of a piece of educational software. Some concrete consequences are for example:

- The need to define a teaching strategy first and then analyze in which stage the software should play a role.
- The need to define what teaching-learning problem(s) will be addressed through the software. For example, improvement of the efficiency and/or effectiveness of the teaching-learning process.
- It places the teacher as a relevant user of a piece of educational software and therefore the software engineer needs to take into consideration a new area of expertise (i.e. pedagogy) to inform the decisions during the development process.
- The test procedures during the development process should contemplate observations of teachers using the software in a normal lesson.

Implications for Educational Software Evaluation

As mentioned previously, the design of educational software to date has been primarily focused on learning and has paid little attention the teaching dimension, and as a result, teachers have difficulty incorporating it into their practice. Software evaluation has paid little attention to this area, and has only recently begun to give serious consideration to the teaching dimension (for example see: Wishart & Blease, 1999).

So, it could be argued that the evaluation and selection of a piece of educational software could be improved if these issues were considered and 'evaluated', defining additional standards to judge and characterize a piece of software. For example, to evaluate the interface elements of a piece of software by considering the design of a 'Classroom Atmosphere', the navigation structure should be evaluated taking into consideration Hammersley (1990)'s descriptions of the strategies that teachers use in the classroom and the human-computer interaction should be evaluated considering the principles of what the literature defines as good practice in questioning and providing feedback. Some specific implications for this area are, for example:

- Prior to the evaluation of a piece of software, the teaching strategy should be defined, this in order to specify the context (teaching aims, environment and techniques) in which it would be used.
- The evaluation criteria should consider the teaching routines used by teachers of the subject area and school level in which the software is to be used.
- The evaluation should know and consider the users' previous knowledge (abilities, skills), given the stage of the teaching-learning process in which it will be used.
- The evaluation should consider measurements to qualify and/or quantify the improvements in the teaching-learning process. For example in terms of the efficiency of the process, this is, instead of investing five lessons to teach something, with the software it can be done in three lessons with the same (or better) results.

Conclusions

These implications for educational software design, development and evaluation indicate new issues that should be considered. They show that there is a need for further research that could help to define the specific teaching-learning strategies, principles and routines that should be known and used to define and evaluate the particular characteristics of a piece of educational software. If considered, they can change the very conceptualization of such products and eventually transform them into teaching aids or 'professional tools' for the teachers.

Finally, it must be considered that whilst our intention here was to present one model of educational software and thereby to illustrate how the prescriptions of this model could be use to improve the processes of designing, developing and evaluating educational software, it must be kept in mind that this model is the result of a small case study and all that it enables us to do is to propose this model and its consequences tentatively, recognizing that it requires much wider verification.

References

Bliss, J., & Ogborn, J. (1979). The analysis of qualitative data. European Journal of Science Education, 1(4), 427-440.

Cuban, L. (1997). Foreword. In H. J. Sandholtz, C. Ringstaff, & D. C. Dwyer (Eds.), Teaching with technology: Creating student centered classrooms . New York: Teachers College Press.

Edwards, D., & Mercer, N. (1987). Common knowledge: Development of understanding in the classroom. London: Routledge.

Eraut, M. (1996). Concepts of educational technology. In A. C. Tujinman (Ed.), International encyclopedia of adult education and training . Oxford: Pergamon - Elsevier Science.

Gall, M. D., & Artero-Boname, M. T. (1995). Questioning. In L. W. Anderson (Ed.), International encyclopedia of teaching and teacher education . Oxford: Pergamon.

Galvis, A. H. (1994). Ingeniería de Software Educativo. Santafé de Bogotá, Colombia: Ediciones Uniandes.

Hammersley, M. (1990). Classroom ethnography: empirical and methodological essays. Philadelphia: Open University Press - Milton Keynes.

Hinostroza, J. E. (1999). Teachers' concepts and beliefs about educational software: A case study of teachers within a software development process. Unpublished PhD, University of London, London.

Hinostroza, J. E., & Mellar, H. (1999, 29-31 March). Pedagogy embedded in educational software design: Report of a case study. Paper presented at the CAL99: Virtuality in Education, London.

Hinostroza, J. E., & Mellar, H. (2000). Teachers' beliefs about computers: Report of a case study. Journal of Educational Computing Research, 22(4).

Johnson, D. C., Cox, M. J., & Watson, D. M. (1994). Evaluating the impact of IT on pupils' achievements. Journal of Computer Assisted Learning(10), 138-156.

Leinhardt, G., Weidman, C., & Hammond, K. M. (1986). Introduction and integration of classroom routines by expert teachers. Curriculum Inquiry, 17(2), 135-176.

Lowther, D., & Sullivan, H. J. (1994). Teacher and technologist believes about educational technology. Educational Technology Research and Development, 42(4), 73-87.

Mayer, R. E. (1995). Feedback. In L. W. Anderson (Ed.), International encyclopedia of teaching and teacher education (pp. 249-251). Oxford: Pergamon.

Squires, D. (1996). Production of educational software. In T. Plomp & D. E. Ely (Eds.), International encyclopedia of educational technology (pp. 217-221). Oxford: Elsevier Science - Pelgrum.

Stake, R. (1994). Case studies. In N. Denzin & Y. Lincoln (Eds.), Handbook of qualitative research (pp. 236-247). London: Sage.

Wishart, J., & Blease, D. (1999). Theories underlying perceived changes in teaching and learning after installing a computer network in a secondary school. British Journal of Educational Technology, 30(1), 25-41.

Woods, P., & Jeffrey, B. (1996). Teachable moments: the art of teaching in primary classroom. Buckingham: Open University Press.

Yin, R. (1994). Case study research design and methods. (2nd ed.). London: Sage.

Acknowledgments

This work has been carried out thanks to the support of the British Council, through the H. E. L. Project 'Acottel', the Alfa project "The Educational Potential of Advanced Technologies with Mathematics, Engineering and Science" and of the Chilean Ministry of Education through the MECE programme's Enlaces Project.

Using Web-based Templates to Support Reflection on Learning in University Classes

Garry Hoban
Faculty of Education
University of Wollongong
Wollongong, NSW, Australia
garry_hoban@uow.edu.au

Abstract: This paper explains how a WWW site was designed to assist preservice teacher education students in using a reflective framework to study how they learned in university classes. There were three phases in the reflective framework: (i) analysis; (ii) synthesis; and (iii) theorizing. In this last phase the students developed a metaphor to represent an optimum classroom learning environment. The web site was designed using a FileMaker Pro database with a template for each category of learning—personal, teaching, peer and situational—to assist students in managing, sharing and theorizing about their reflections. Students claimed that the web site supported their reflections and the metaphor helped them to conceptualize the dynamics of classroom relationships.

Introduction

The notion of being reflective means rethinking experiences, particularly ones which are problematic, to make clearer sense of them and to gain insights for subsequent experiences (Dewey, 1933; Schön, 1983; 1987). It is now common practice in preservice teachers education programs to encourage students to use reflective journals to rethink and analyze their experiences in university subjects (Loughran, 1995; McRobbie, 1994; Wilson, Hine, Dobbins, Bransgrove, & Elterman, 1995). This includes reflecting upon education readings, class discussions, personal thoughts or school experiences. However, the focus of the reflection is often about *what* students understand, what they don't understand and to specify areas which require further readings or explanations. Rarely are preservice teachers asked to reflect upon *how* they learn, how they are being taught, or how they interact with other students.

During their training, preservice teachers are exposed to a wide range of teaching strategies and content as well as interacting with a variety of students. This exposure to a variety of learning situations provides a wonderful opportunity for preservice students to study how they learn. When trainee teachers gain these insights, they can deduce implications for their own pedagogy based on personal experiences. Although this idea was raised over 30 years ago, it is a rare practice in teacher education programs:

> The student in the process of becoming a teacher is not made acutely aware of how he is learning, that is, to utilize himself as a source of understanding of the nature of the learning process. . . . one of the major reasons so many teachers are dissatisfied with themselves in their work is that their training did not illuminate the nature of *their* learning process and how this relates to and affects the learning process of their pupils. (Sarason, Davidson, & Burton, 1962, p. 118)

When preservice students are asked to reflect upon complex interactions such as how they are learning, technologies such as the World Wide Web can be a useful tool to support students in documenting, analysing and sharing insights (Bennett, 1998). The purpose of this paper is to explain a reflective framework which encourages preservice teachers to study how they learn in university classes and how a World Wide Web site was designed with templates to help students manage and theorize about their reflections.

Using WWW Templates to Support a Reflective Framework for Studying Learning in University Classes

Over the last four years, a reflective framework has been developed to guide preservice teachers in studying how they learn in university classes (Hoban, 1995, 1997, 1998). This framework encourages each preservice teacher to be "a researcher in the practice context" (Schön, 1983, p. 68) with the context being their experiences as learners in their university classes. There are three phases in the framework which encourage students to analyze their experiences, synthesize key factors which influence learning and to develop a metaphor to represent an optimal learning environment. The first phase occurs for the duration of the subject and the second and third phases are completed by students towards the end of the subject, although they can be completed concurrently by students.

In 1999, a WWW site was designed with a FileMaker Pro database as a tool to help preservice students use the reflective framework. The site was designed with the intention of minimising the cognitive load on students when reflecting by using a screen design which "promotes understanding by allowing the reader to focus on new information rather than devoting time and energy to variations for format" (El-Tigi & Maribe Branch, 1997, p. 25). In addition, the web site assisted students in organizing and theorizing about their reflections to deduce a metaphor to represent an optimal learning environment. In spring semester 1999, 25 trainee teachers used the WWW site in a preservice science methods subject which lasted for 13 week in an elementary teacher training program. The students had a three hour class each week—two hours were spent with the students doing hands-on science experiments and a third hour was spent reflecting upon how they learned in the class using the web site. The three phases of the reflective framework are now described as well as features of the web site.

Phase 1 Analysis. After each university class students logged onto the WWW site and had to reflect upon their class experiences to identify the personal, social (teaching and peer) and situational factors which influenced his/her learning. There was a template for each category which is consistent with a constructivist perspective that views learning as an individual process of knowledge construction that is supported by social interactions with the outside world (Duffy & Cunningham, 1993). The templates were labelled according to the following four categories:

1. personal factors attributed to each student, such as prior knowledge, feelings, self esteem, motivation and personal learning strategies;
2. teaching factors attributed to the instructor/tutor, such as class organisation, teaching strategies, class organisation goals, and rapport;
3. peer factors attributed to other students such as how they encourage each other, share ideas and cooperate in tasks; and
4. situational factors attributed to the task, setting and environment.

After each class, the students identified factors which enhanced or inhibited their learning and documented these processes or strategies in the templates on the WWW site. The following is an example of a student's weekly reflections as written in the four templates of the web site in week 2 of the subject. It should be noted that students noted a positive factor with a "+" and a negative factors with a "-" and highlighted key words using upper case:

Personal Factors

- I am not confident with teaching science in front of an audience therefore I feel this elective will be very rewarding as I will gain KNOWLEDGE, CONFIDENCE and UNDERSTANDING of how to teach science to a young audience.

+ I work better in an environment where I am comfortable and feel free to exchange ideas and questions without the worry/fear that others will criticize me. This style of teaching suits the way I learn.

+ As this was the first real science lesson I had no idea of what to expect from this elective so I was INTERESTED and WILLING to get involved with the debates and answer any questions thrown at me.

Teaching Factors

+ Today's teaching strategies were very suited to my learning and understanding of science. I enjoy a RELAXED environment where I feel free to contribute to the class discussions.

+ It was amazing how pre-knowledge that I have gained over time was used in this lesson. I didn't realize simple experiments can make things clear.

- Initially, I didn't feel it was necessary to write a reflection of the lesson on the internet. I prefer to share and discuss how I feel in some cases I feel it easier to talk about problems or ideas rather than writing it down.

- I'd prefer writing on the white board to be set out more clearly and more information for each point when an idea is raised.

+ It was interesting that there is no right way to go about teaching a particular subject, everyone goes about learning differently. I enjoyed the many different styles that were discussed (the frameworks).

+ the instructor seemed to deliver the information clearly and effectively providing relevant FEEDBACK in order for us (the students) to improve.

Peer Factors

- Initially, everyone in the class was a little daunted at what to expected from this science lesson.

+ From this lesson I feel confident with raising issues and asking questions. Everyone in the class was willing to accept everyone's ideas openly and ask for any queries.

+ The class members continually gave positive ENCOURAGEMENT to those students who didn't understand the work covered. Everyone tried to help everyone understand what the lesson was about (TEAMWORK).

+ I enjoyed working in small groups to achieve each activity everyone had their own idea on what they thought was right.
+ Already I have met new friends from this lesson and together we have worked together to achieve the work set out.
Situational Factors
+ This class is not large therefore where the instructor was teaching or standing was always close by. There were no heads in the way, there was enough material to go round, the labs which are well lit and everyone had a great attitude to work (I suppose this was because this was the first week).
+ It was great having food and coffee provided for us which also seemed to break up the lesson.
+ As the materials were well set out it was easy to get straight into the hands-on-activities and get started.
+ Everyone in the class seemed to get on well with everyone (CO-OPERATION) therefore it was easy to reap the rewards of each activity.

Phase 2 Synthesis. Towards the end of the subject, students collated factors documented in their weekly reflections according to the same four categories identified in phase 1. After the students completed their collations, they used an iterative process of "constant comparative analysis" (Glasser & Strauss, 1967, p.vii) to compare, combine and synthesize factors resulting in the identification of several key factors for each of the four categories. The WWW site helped students to synthesize their reflections because it was designed to collate similar categories for all the weeks so that students could scan them to identify the most influential factors. For example, the data base within the web site linked the templates from week to week enabling each student to see the personal factors across all the weeks on one screen. This aggregation of the reflections assisted the students to identify the key factors within each category and these were summarized in a table called a "Learning Profile". Collectively, the key factors highlighted in their Learning Profile represent a student's identification of factors which would establish an optimal learning environment for them in a university class. It should be noted that an optimal learning environment would only be possible if all of the enhancing factors (or nearly all) were present. The following documentation represents a student's Learning Profile which is the synthesis of key factors for each category for the duration of the subject:

Personal
- knowledge, confidence and understanding
- interested and willing to get involved
- preparation is necessary in order to benefit from the lesson
- motivation
- sense of achievement
- prior knowledge: you need to do the readings
- "what you put in is what your get out!'

Teaching
- creating a relaxed environment
- positive feedback/reinforcement for us (the students) to improve
- information given to the students is clear and concise
- providing relevant examples to explain concepts
- classroom management
- teacher involvement

Peer
- positive encouragement
- working as a team (teamwork).
- group dynamics
- group motivation when needed. eg. 'We can do anything, come on girls!!!'

Situational
- all class members working together (co-operation)
- the relaxed atmosphere created by the teacher and students
- materials safe and accessible (all materials are available when needed)
- the preparation of each activity e.g. layout and materials needed
- timing of the lesson e.g. activities

Phase 3 Theorising. Each preservice student considered the key enhancing factors identified in phase 2 and theorized about the relationships between them to devise a metaphor (Lakoff & Johnson, 1980) that represents an optimal learning environment for a university class. Although the students did not use the web site for designing their metaphor, it was labeled with key factors identified in their Learning Profile from phase 2. Nonetheless, the process of theorising was assisted by having the reflective data presented systematically and collectively in the templates. This thinking is consistent with (Strauss & Corbin, 1994) interpretation of a theory as "*plausible* relationships proposed among *concepts* and *sets of concepts*" (p. 278, italics in original). Alternatively, students may conceptualise the metaphor earlier from their reflections in the subject and then use the factors from their profile to label the diagram.

The student whose reflections have been shown in phases 1 and 2 theorized to develop a metaphor of "learning to snow ski" to represent her optimal learning environment. This metaphor was sketched and labeled with personal factors such as "prior knowledge, confidence, preparation and motivation", teaching factors such as "guidance, feedback, clear and concise instruction" and peer factors such as "encouragement, teamwork and group motivation". She explained how her metaphor of a learning to ski represented an optimal learning environment and drew implications for her classroom teaching:

> There are many steps involved before turning into a proficient skier similar to the fact that it takes time and practice before you are a capable student in any area of learning. It is important that the student sets a goal on what they want to achieve, however, there are decisions to be made on the plan of attack. The ski shop is an integral part in the learning process as preparation, organization and understanding are necessary to commence learning. Comparing this to a classroom situation is being prepared with homework, equipment and prior knowledge so that you are not disadvantaged to the rest of the class. The most important factor is the instructor/teacher who provides correct information, positive reinforcement/feedback, guidance and instruction. In most classroom settings the teacher is the main focus for students in preparing, organizing and implementing various lessons.

Generating a metaphor is like producing a mental model of teaching and learning and other students in the class generated a range of metaphors such as playing an instrument in an orchestra, learning to be an acrobat in a circus, playing in a one-day cricket match, going on a mountain hike, being in a rocket blasting off into space, playing in a fun park and playing a game of baseball. In addition, students are expected to use these insights into an optimal learning environment to draw implications for their future role as teachers.

Discussion and Conclusion

In any one year, teacher education students attend over 300 hours of formal class time at university and are exposed to a wide range of experiences across different subjects. Yet little opportunity is provided for students to reflect upon these authentic experiences to analyze how they learn in different types of learning environments. In particular, trainee teachers often do not get the opportunity to study their own experiences as students in class to gain a first hand understanding of the relationship between teaching and learning. This is a valuable insight for trainee teachers as designing an optimal learning environment, which is the main outcome of the reflective framework, takes into account the type of teaching *and* the type of learning *and* the type of social interaction with peers. Developing such an awareness of the dynamics in any educational setting can support students in participating in reflective conversations about teaching and learning which is a useful skill for their future role as teachers.

Furthermore, it is important that trainee teachers are not simply passive recipients of formal theory at university, but engage in theorising about their own experiences. This means systematically using a framework to reflect on experiences by documenting, analysing and seeking patterns within the data for generating personal theories. This means that preservice students can deduce implications for their own pedagogy based on the analysis of their own experiences of learning. Although students previously used the reflective framework with pen and paper (Hoban, 1997, 1998), this is the first time that students have documented their reflections on a World Wide Web site. Previously, students had to write their reflections each week in a journal and then scan manually across many pages to synthesise the key factors for each category. Also the students had to seek patterns within the data and deduce their metaphor to represent an optimal learning environment. Doing this manually was time consuming and conceptually difficult for some students.

Using the WWW site has enabled the students to manage and theorize about their reflections more effectively which has reduced their cognitive load in using the framework. In an end of subject evaluation, some of the students made comments about using the web for their reflections:

> The idea of using the web was good, it was convenient for everyone and everything was in front of you in the one place which made it easier to collate etc. I would prefer to use the web but have the option of doing it in my own time.
>
> I preferred to use the web because at the end it was easier to bring everything together. I also found the reflections were more to the point and there wasn't as much rambling on. The only negative was the inconvenience of getting onto the net whenever we needed to reflect and also when the web page was down.
>
> It was better using the web. It was a great way to group the information into the different factors and it was easier to see a clear pattern of learning.

Two issues, however, became evident when preservice teachers used the web site for the reflective framework. First, initial use of the framework was conceptually difficult for preservice students as they had not reflected upon different learning influences before and were unsure about what to look for and how to do it. For this reason, several reflective journals produced by students in previous subjects were shown at the beginning of the subject as examples of how to analyze their learning experiences. Furthermore, this needed to be revisited several times in the first few weeks with discussions about what the students were documenting. Also, towards the end of the course several students commented that this was the first course which gave them a specific framework to guide them in reflecting on their class experiences. Previously they had undertaken reflective journals in other subjects, but were not provided with a framework and students stated that in many cases they just wrote about "what the lecturer wanted to hear". It appears from the students' data that the web site made the reflective framework easier to use because it focused students in their reflections and helped them to manage the data for phases 2 and 3 of the framework.

A second issue is that I am the only person who saw all of the students' reflections on teaching and learning for the subject as I marked their journals. Certainly, the WWW site made it easier to mark the students' journals as all the data were more accessible on the web site rather than screening large hand written journals. Also, it was a valuable insight for me to understand how different students responded in different ways to the same learning experience. In some weeks, the same science activities were praised by some students and criticized by others. This highlights the problematic nature of teaching and it would be valuable for the preservice students to become more aware that people experience learning in different ways. Although students could access a summary of each student's weekly reflections on the web, they could not access the Learning Profiles or metaphors produced by other students. Perhaps the web site needs to be modified to enable more sharing of products of students' reflections, however, there are ethical issues that need to be considered as the students are documenting personal experiences. Nonetheless, it is a valuable lesson for any teacher to realize that students do not perceive the same class experience in the same way.

Note

The web site discussed in this paper is available at http://www.edonline.uow.edu.au/edus224

References

Bennett, L. (1998). *Using the Internet to Reflect on Teaching.* Paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications, Seattle, Washington.

Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educative process.* (2nd Edition ed.). Boston, MA: Heath and Co.

Duffy, T. M., & Cunningham, D. J. (1993). Constructivism: Implications for the Design sand Delivery of Instruction. In D. H. Jonassen (Ed.), *Handbook of Research for Educational Communications and Technology* (pp. 170-198). New York: MacMillan.

El-Tigi, M., & Maribe Branch, R. (1997). Designing for interaction, learner control, and feedback during web-based learning, *Educational Technology,* 37(3), 23-29.

Hoban, G. F. (1998). Reciprocating self-study: A reflective framework for conceptualising teaching-learning relationships. *Resources in Education.* (ERIC Document Reproduction Service No. ED 423 216), 1-32.

Hoban, G. F. (1997). Learning to learn in the context of a science methods course. In J. J. Loughran & T. Russell (Eds.), *Teaching about teaching: Purpose, passion and pedagogy in teacher education* (pp. 133-149). London: The Falmer Press.

Hoban, G. F. (1995). *Listening to learners: Generating practical knowledge about learning.* Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by.* Chicago, IL: University of Chicago Press.

Loughran, J. (1995). Practicing what I preach: Modelling reflective practice to student teachers. *Research in Science Education, 25*(4), 431-451.

McRobbie, C. J. (1994). Promoting reflection in tertiary teaching through collaboration. *South Pacific Journal of Teacher Education, 22*(1), 27-38.

Sarason, S., Davidson, K., & Burton, B. (1962). The preparation of teachers: An unstudied problem. New York: John Wiley and Sons.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. New York: Basic Books.

Schön, D. A. (1987). *Educating the reflective practioner: Toward a new design for teaching and learning*. San Francisco: Jossey-Bass.

Strauss, A., & Corbin, J. (1994). Grounded theory methodology: An overview. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of Qualitative Research* (pp. 273-285). London: SAGE Publications.

Wilson, S., Hine, A., Dobbins, R., Bransgrove, E., & Elterman, J. (1995). The use of reflective journals in undergraduate teacher-education courses: A multi-campus perspective. *South Pacific Journal of Teacher Education, 23*(2), 165-176.

Interactive Computer Assisted Formulation of Retrieval Requests for a Medical Information System using an Intelligent Tutoring System

Dr.Andreas HOLZINGER, PhD, MSc, MPh, BEng, DipEd
Andreas KAINZ, BEng
Prof.Dr.Guenther GELL, PhD
Institute of Medical Informatics, Statistics and Documentation (IMI)
Graz University

Max BRUNOLD, BEng
Prof.DDr.Hermann MAURER, PhD
Institute of Information Processing and Computer Supported New Media (IICM)
Graz University of Technology

andreas.holzinger@kfunigraz.ac.at
http://www-ang.kfunigraz.ac.at/~holzinge/its

Abstract: A medical information system at Graz University contains three millions of diagnostic reports, which form the basis of patient care and of scientific work. Complex retrieval systems are prepared in a time consuming dialogue between clinical researchers and IS-experts. In this paper we describe the development and questions of evaluation of an intranet Web-based query/answer system with reference to aspects of human-computer interaction. The system formulates a well structured and, ideally, machine interpretable retrieval request in interaction with the user (i. e. medical professionals, bio-statistical researchers, ...) and stores it in an existing request-management-application. The user learns, incidentally, how to use the hospital information system for his needs. For optimal interpretation of the gathered information exact formulation of the questions is essential. An intelligent guidance during the dialogue is obligatory since we cannot assume any technical skill on the part of the medical users. In the near future this service will be extended to the countrywide hospital information system. By using this system, the quality of the retrieval and therefore the quality of scientific research and medical studies is raised. Less iterations mean a lower system-workload. Last but not least, we expect to lower the response time without increasing the need of human resources.

"When we write programs that "learn", it turns out that we do and they don't."
(Alan J. Perlis, Yale University)

1. Introduction

The information systems at the departments of radiology and pathology at the 2.300 bed University Hospital in Graz support activities in patient care and serve as a basis for scientific research, not only for radiology and pathology but also for all other clinical departments which refer to these systems in connection with their own patient data. Since the data are partly in standardized form (codes for examination types, organizational entities) and partly in natural language, scientific retrievals require complex strategies to yield optimal results. As will be shown below, the scope of the retrieval request is defined in an interactive discussion between a clinical researcher and an IS-expert. This procedure will be replaced as far as possible by the proposed system. The system will primarily be used by medical doctors or assistants. To improve the quality of data preparation it is necessary to provide precisely formulated questions. Since the typical user does not have detailed technical knowledge, intelligent guidance is required during the dialogue.

The user starts the dialogue with the System by stating his question in medical terminology for administrative and future purpose only. During the subsequent dialog, unconsciously he will adopt the dialogue's behavior in formulating further questions. Succeeding dialogues must always be based on information already ascertained, thus avoiding 'silly questions'. Following the indicated evaluation of criteria and features, only useful selections of data-reports should be offered. In this project the main emphasis is on 'the dialogue'. The dialogue will help the user understand and benefit from the functional possibilities of the information system. Furthermore it will help them to accept limitations and guide them to provide structured information. The high level of the system's operating

comfort aims at persuading the user not to make complicated and time consuming telephone discussions or use written inquiries to collect required information. This system provides a remarkable potential of savings in administrative expenditures by means of good integration into existing administration facilities and adding to the quality of data evaluation.
The system itself has to adapt to the user's formulation of a question not only per session but also in the long term, thus adapting to the importance and priority of knowledge objects in general.

2. Background

The Information-System used for research and patient care was originally developed by the Institute of Medical Informatics, Statistics and Documentation (IMI) at Graz University for use in Radiology, Pathology, Neurosurgery and Pediatrics, and has been steadily refined ever since the early seventies. The IS Data Base contains approximately three million (!) medical documents, which have been gathered since 1971. Patient information, technical parameters and performance data are saved in a thoroughly structured form, anamnese, examination descriptions and diagnoses are available in free-text. Besides hundreds of simple routine retrievals for patient care, there are, on average, about one or two highly complex retrieval requests per day for scientific purposes, which requires the knowledge of an IS expert. Quite often the huge possibilities and potentialities of filtering, structuring and representing are not familiar or even known to the medical researcher. High competence by the IS expert in medical and technological fields is needed to assess the real scope of the information required by the clinical researcher for his work. The formulation of the retrieval needs are elaborated in a personal discussion between the clinician and the IS expert, a time consuming process, requiring patience and perseverance. Due to the personnel shortage and the increasing demands based on increasing standards in quality management, output documentation, health reports, etc. we consider an automation of this process is necessary to enable continued functioning in the future. The following excerpt of a conversation between an IS-expert and a client shows that several areas of knowledge are necessary to lead an intelligent dialogue:

Client: I would like to have all reports of the angiography with interventional cases from 1998 up to the present.
IS-Expert: You mean all types of examinations concerning the angiography ?
Client: Yes, because the examinations are all entered with different coding abbreviations.
IS-Expert: That is clear to me. How can I identify interventions ? What does the examination report say?
Client: ... well, the criteria of the contexts are ... (speaks slowly and pause for a moment) ... A.carotis, A.vertebralis, A.basilaris, embolisation, neuroembolisation, stent, baloon dilatation, PTA, ...
IS-Expert: ... hmm, that appears to be a lot to me ... if I ... for instance only look for A.carotis or A.vertebralis ... then I will find a vast amount of data-sets ... should these criteria really all combined by 'OR' ?
Client: ... no, no ... I only mean neuroembolisation OR embolisation etc. with A.carotis OR A.vertebralis, ...
IS-Expert: ... ah, I see, ... well that is O.K., ... I am looking for interventions in the examination reports such as embolistion, neuroembolisation, stent, balloon dilatation and PTA and within the diagnosis for A.carotis OR A. vertebralis, OR A. basilaris
Client: yes exactly ...
IS-Expert: ... would you like to read all the documents of the interventions ... or are you primarily interested in the patience convalescence ...
Client: No, we are looking for eventual complications which might have occured later ...
IS-Expert: Ah, yes ...

It would be extremely difficult and exhaustive to put the whole special medical knowledge into the system. For instance the fact, that a balloon dilatation is already an intervention, on the other hand A. basilaris is an organ, where the intervention actually has been made. Also the knowledge about the structure of the IS (types of examinations are divided into coding abbreviations, these depict the radiological technology, but not an interventional operation) and meta-knowledge would be extremely difficult to put into the system. With the strategy mentioned above, one can find the initial intervention, but to find more about complications requires other strategies.

These problems are solved by using a combinatorial approach. Every fact, which can be appear as a filter, a classification item or as representation feature in the resulting request, is represented as an object. One method, implemented in this objects enables the dialogue with the user (e. g. a question about an examination type within a meaningful subset represented as HTML Structure). The reactions which alter the factual knowledge basis of a particular session and that modifies the persistent user depended state of learning are important methods which are also implemented in these objects. By extending a good Meta-Data-Strategy with actions that represent semantic rules in medical context, we implement a small, dedicated part of global behavior. These actions are 'triggering questions' and 'generating answer-like facts'.

3. The system assembled as an Intelligent Tutoring System

3.1. What is an ITS ?

Intelligent Tutoring Systems (ITS) are remarkable with regard to their methods and the fundamental theories used. Their origin comes from the field of Computer Assisted Learning. Generally the "Intelligence" in ITS is traced back to Carbonell in 1970. Carbonells prototyp SCHOLAR, which was actually an interactive program for computer-aided instruction based on semantic networks as the representation of knowledge, was primarily designed for learning geography. He implemented a socratic dialogue in an artificial tutor.
ITS generally provides a high level of guidance and control interactive processes in great detail. Possible navigation decisions by the users are controlled by the system. There is no clear border between adaptive systems and those generally called ITS (cf. Sleeman & Brown (1982)).
Recently, ideas from both intelligent tutoring systems and from hypermedia have been brought together. This has lead to interactive and adaptive hypermedia, which we use in our system. This synthesis responds to the specific strengths and weaknesses of both approaches. A domain model representing all facts of the field to be learnt usually forms the background for a model of the learner's knowledge and knowledge acquisition.

3.2 The problematic of intelligence

Constant misuse and misinterpretation of the term "Intelligence" and in particular "Artificial Intelligence" has made it increasingly undesirable to label systems with this designation.
It is generally accepted to refer to an "Intelligent Tutoring Systcm" if the system is able to

a) build a more or less sophisticated model of cognitive processes,
b) adapt these processes consecutively and
c) is based on these fundamentals to control an question-answer-interaction.

The basics of Intelligent Tutoring Systems are most suitable for our special purpose.

3.3 Interface and Interaction

Initially, an ITS should be able to analyze the current process of knowledge acquisition. Based on this information the ITS should be able to build instructions for the user. An ITS is generally considered to be "intelligent" if it is able to react to the process of communication in a flexible and adaptive manner. Kearsley (1987) distinguishes basically between five different types of interfaces for IT-Systems: 1) socratic dialogue, 2) coaching, 3) debugging, 4) microworlds, 5) explainable expert-systems. In our system we use the principles of the "socratic dialogue":
The system questions the user and, on the basis of the questions and answers, guides the user through a controlled interaction. A specific answer of the user is a starting point for the next question. The interaction happens close to a natural-language dialogue (cf. Kearsley (1993)).

4. The System, its features and its implementation

4.1. Prerequisites

Concerning the implementation of this system, there were several preconditions to be taken into consideration.
Firstly, the system is supposed to work in cooperation with the Meta-Data strategy of existing department information systems that currently work on proprietary databases. As mentioned the information systems are about to be replaced with a countrywide information system within the next year. That means that our solution needs to provide an interface that can be easily extended or replaced.

Secondly, we had to keep in mind that we needed to find a way of implementing the system so that the result would provide as open an architecture as possible with regard to interfaces and interoperability with other systems and platforms.
Thirdly, the system should also be capable of easy expansion, e.g. additional functionality in future at very low expense.
Fourthly, in the event of migration to other hardware and/or software platforms in future, it should be easily possible to port the system without endangering the stability and/or functionality. Only minor changes or adaptations should be necessary by that time. This means that portability also had to be taken as a prerequisite.

4.2. Implementation Framework: The Java 2 Enterprise Edition

We ran across Java and the Java 2 Enterprise Edition (J2EE) pretty quickly. The J2EE provides all the functionality and tools that fulfill the preconditions of the project listed above and impresses the developer with its "write once - run anywhere" functionality. In addition, the Java Enterprise Components give us the advantage of minimum possible implementation time and low costs combined with a maximum outcome. Networking, multithreading, security and even database connectivity are available via standard APIs and do not have to be written again from scratch. Since the release of Java in 1996, a very large community of Java developers (Java Developer Connection, about 1 Mio. members) has evolved, who provide a wide variety of Servlets and Beans (reusable components) almost for free which can easily be integrated in any project without having to "reinvent the wheel".
When considering an open system that is expected to provide as much interoperability and expandability as possible, the choice for a Multi-Tier architecture approach is obvious. Using a Multi-Tier architecture also ensures that the whole system is built to work in a distributed scalable environment, which was another prerequisite of the project.

4.3. Multi-Tier Architecture

Taking into consideration a Multi-Tiered architecture relating to the general condition explained before, we expect the following framework to meet our needs.

Presentation Layer

The user communicates with the system through an HTML - Browser that is driven by a Thin - Client Servlet. The dialogue phases should be fast and simple. In addition to the claim that the dialogue should usually be similar to a natural language dialogue, (Spada and Opwis (1985)), the possibilities of graphical user interfaces should improve the performance of the human computer interaction.

Business Layer

Here we implement all application specific components and the session management using state-full Session Beans. It is necessary to convert the stateless http-communication into a persistent, re-activateable dialogue by means of the user context. So, if the user looses the dialogue with the system for what ever reason, next time he authenticates himself to the system, he has the opportunity to continue, without loss of previous dialogue.

Technical Layer

The association of the fact-, semantic- and knowledge objects builds the didactic components in this layer. The dependency of classes from the database layer and the over all didactic strategy builds the classes.

Database Layer

Here we find the object representation of the Meta-Data in the Data-Dictionaries and their semantic meanings, as well as the user specific model, his habits, behavior, last session status and previous accesses. Also the knowledge model is represented as a class of this layer.

With respect to the manageability of all growing information components, all permanent data will be stored on database servers. Flexibility is acquired by means of using only JDBC-interfaces to the servers.

5. Research

A hospital information system provider looks ahead, hoping to gain experience in covering the complexity of huge information archives under retrieval aspects. For the cognitive scientist, the greatest advantage of that approach will consist of the feedback, that will be provided by the quality improvement for retrieval requests. During our talk at ED-MEDIA 2000 we will present some answers to questions asked in the following paragraphs.

5.1. Aspects of Informatics

5.1.1 Meta Data Dictionary (for details see http://www-ang.kfunigraz.ac.at/~holzinge/its/mdd)

The main goals during design of the Meta Data Dictionary were simplicity and extendibility, but focusing on an intelligent way of storing knowledge (actual legacy database and future SAP R/3). How can the IS-Meta-Knowledge be stored and accessed in a intelligent way to get an optimum out? What has to be prepared to be able to change the database engine itself whenever the MDD has to be moved to another platform (what about XML)?

5.1.2 Distributed System Design (for details see http://www-ang.kfunigraz.ac.at/~holzinge/its/dsd)

Thinking about a distributed application framework, it is obvious that one has to be prepared for different platforms and will result in a multi-tier architecture. The main questions in this context are: How can the system be kept portable for future platforms (JAVA Enterprise Edition)? What will happen when one component in the network cannot be reached and will not deliver an answer? What can be done to ensure good performance of the system so that the user will be satisfied?

5.1.3 Intelligent Engine (for details see http://www-ang.kfunigraz.ac.at/~holzinge/its/ite)

How should the engine decide in case of equal weighted questions (aspects of fuzzy logic)? How can the user profile be integrated as a decision criteria (adaptive behavior)?

5.2. Aspects of Human-Computer-Interaction

The knowledge representation, as a framework of objects that cover facts, semantic information and parts of common knowledge is especially important, as are the methods used to keep the users' interest, motivation and attention on the actions to keep the dialogue process alive. As an experimental design we have chosen a pre-test/post-test control-group design, assisted by qualitative analysis via interviews. The experimental sample to be examined includes 24 people: 12 experts (including MD's) and 12 novices (students of medicine). The research questions are divided into Dialogue, Usability and Learning.

5.2.1 Questions concerning the evaluation of the System (Dialogue)

How do users (experts versus novices) handle the machine-dialogue, in contrast to the human-dialogue provided by an IS-expert ? How extensively do the users proceed within the dialogue ? At which time do they quit the dialogue ? Why do the users break off the dialogue ? How often do we get useless or irrelevant information ?

5.2.2 Questions concerning the evaluation of the Graphical User Interface (Usability)

How does the GUI influence the user behavior ? What is the difference in handling between experts and novices ? What screen contents and hints are useful for novices and experts ?

5.2.3 Questions concerning the evaluation of the Intelligent Behaviour (Learning)

How big is the learning achievement by using this system ? How does incidental learning (cf. Holzinger & Maurer 1999) increase the efforts of the users ? How do motivation, attention and arousal directly influence the necessary actions to keep the dialogue process alive ?

6. Practical Aspects

Eventually, when the IS is extended to the countrywide hospital information system, it will no longer be possible to include the whole system information in one human to human consultation call. The findings and experiences of this project will lead to a suitable knowledge representation, which provides an interactive dialogue suitable for a more complex system. Finally the quality of requests for scientific medical research can be increased by reducing the response-time and lowering the system work load through minimizing iteration cycles.

7. References

Anderson, J. R. (1991). The place of cognitive architectures in a rational analysis. In: K. VanLehn (Ed.), *Architectures for intelligence*, Hillsdale (NJ): Erlbaum, 1 - 24.

Carlile, S.; Barnet, S.; Sefton, A.; Uther, J. (1998). Medical problem based learning supported by intranet technology: a natural student centred approach. In: *International Journal of Medical Informatics*, 50, 225 - 233.

Chan, T. W. (1994). Curriculum tree: a knowledge-based architecture for intelligent tutoring systems. In: *Artificial Intelligence in Education*, 140 - 147.

Chignell, M. H.; Hancock, P. A. (1988). Intelligent Interface Design"; In: Helander, M., *Handbook of Human-Computer Interaction*. Amsterdam, New York; Oxford; Tokyo: North Holland, 969 - 995.

Chisnall, A. C.; John, R. I.; Bennett, S. C. (1995). Knowledge Elicitation Techniques for Grounded Theory. In: *Research and Development in Expert Systems XII*, Proceedings of Expert Systems '95, SGES Publications: Oxford.

Chowdhury, G. G (1999). *Introduction to modern information retrieval*. London: Library Association Publications.

Collins, A.; Brown, J. S. (1988). The computer as a tool for learning through reflection. In: Mandl, H.; Lesgold, A. (Eds.), *Learning issues for intelligent tutoring systems*, New York: Springer, 1 - 18.

Gell, G.; Oser, W; Schwarz, G. (1976). Experiences with the AURA Free Text System. In: *Radiology*, 119, 105 - 109.

Gosling, J.; Arnold K. (1998). *The Java Programming Language (Java Series)*. Reading (MA): Addison Wesley.

Hirschheim, R.; Klein, H. (1989). Four paradigms of information system development. In: *Communications of the ACM*, 32, 1199 - 1216.

Holzinger, A.; Maurer H. (1999). Incidental learning, motivation and the Tamagotchi Effect: VR-Friends, chances for new ways of learning with computers. In: *Computer Assisted Learning (CAL) 99*, London: Elsevier, 70.

Hunter, J. (1998). *Java Servlet Programming*. Cambridge (MA): O' Reilly.

Kearsley, G. P., Ed. (1987). *Artificial Intelligence and Instruction*. Reading (MA): Addison-Wesley.

Kearsley, G. P.(1993). Intelligent Agents and Instructional Systems: Implications of a New Paradigm. In: *Journal of Artificial Intelligence in Education*, 4, 4, 1993, 295 - 304.

Mandl, H.; Lesgold, A., Eds. (1988). *Learning issues for intelligent tutoring systems*. Berlin; Heidelberg: Springer.

Mark, M. A.; Greer, J. E. (1993). Evaluation Methodologies for Intelligent Tutoring Systems. In: *Journal of Artificial Intelligence in Education*, Vol. 4, 129 - 153.

Newell, A; Simon, H. A. (1972). *Human Problem Solving*. Englewood Cliffs (NJ): Prentice-Hall.

Nkambou, R; Gauthier, G. (1996). Use of WWW Resources by an Intelligent Tutoring System. In: *Proceedings of ED-MEDIA 96*, Boston (MA), June 17 - 22, 121 - 126.

Ntuen, C. A.; Hanspal, K. (1999). Intelligent Objects in Human-Computer Interaction. In: *8th HCI International Conference on Human-Computer Interaction*, August 22 - 26; Vol. I; Ergonomics and User-Interfaces, Munich, Germany, 1262 - 1267.

Preece, J.; Keller, L. (1990). *Human-Computer Interaction: Selected Readings*. Englewood Cliffs (NJ): Prentice Hall.

Puppe, F.; Puppe, B.; Reinhardt B.; Schewe S.; Buscher, H.P. (1998). Evaluation medizinischer Diagnostik-Expertensysteme zur Wissensvermittlung. In: Informatik, Biometrie und Epidemiologie in Medizin und Biologie, 29 (1), 48 - 59.

Salter, W. J. (1988). Human Factors in Knowledge Acquisition. In: HELANDER, M., *Handbook of Human-Computer Interaction*, Amsterdam; New York; Oxford; Tokyo: North Holland, 957 - 968.

Schewe, S.; Quak, T.; Reinhardt, T;. Puppe, F (1996). Evaluation of a knowledge based tutorial program in rheumatology. *3rd Conference on Intelligent Tutoring Systems (ITS 96)*, Montreal, Springer, 531 - 539.

Seitz, A.; Martens, A; Bernauer, J.; Scheuerer, C.; Thomsen, J. (1999). An Architecture for Intelligent Support of Authoring and Tutoring in Multimedia Learning Environments. In: *Proceedings of ED-MEDIA 99*, Seattle (WA), 852 - 857.

Self, J., Ed. (1988). *Artificial Intelligence and Human Learning: Intelligent CAI*. London: Chapman and Hall.

Sleeman, D.; Brown, J. S. (1982). *Intelligent Tutoring Systems*. London: Academic Press.

Sleeman, D.; Ward, R. D. (1988). Intelligent Tutoring Systems in Training and Education: Prospects & Problems. In: *Research & Development in Expert Systems*, V, (Kelly, B.; Rector, A. (Eds.)) C.U.P.: Cambridge, 331 - 343.

Sutcliffe, A. G. (1999). Developing HCI Design Principles for Information Retrieval Applications. *8th HCI Conference on Human-Computer Interaction*, Vol. II; Communication, Cooperation and Application Design; Munich, Germany 90 - 96.

Reinhardt, T; Schewe, S. (1995). A Shell for Intelligent Tutoring Systems. *Artificial Intelligence in Education*, WA(DC), 83 - 90.

Volpe, R. M.; Aquino, M. T. B.; Norato, D.Y.J. (1998). Multimedia system based on programmed instruction in medical genetics: construction and evaluation. In: *International Journal of Medical Informatics* 50 (1998), p.257 - 259.

Multimedia Training Materials for the Community University of the Valleys

Tim Hutchings
University of Glamorgan
Centre for Lifelong Learning
Pontypridd, CF37 1DL, Wales, UK
tdhutchi@glam.ac.uk

Mike Watkins
University of Glamorgan
School of Computing
Pontypridd, CF37 1DL, Wales, UK
mwatkins@glam.ac.uk

Geneen Stubbs
University of Glamorgan
School of Computing
Pontypridd, CF37 1DL, Wales, UK
gstubbs@glam.ac.uk

Abstract: During the period from September 1st 1998 to December 31st 1999 the first and second authors jointly managed a project funded under European Social Funding objective 2,5b and the Regional Technology Initiative entitled *"Multimedia Training Materials for the Community University of the Valleys"*. The aim of the project was to develop learning materials, in a variety of subject areas, using a variety of media, for use in the communities of the South Wales Valleys. A variety of materials were produced and piloted by Community Tutors. The most notable successes being (1) an interactive multimedia package to teach Multimedia Principles delivered on CD-Rom and (2) a paper-based Career Planning package. A more general achievement is a wider awareness of the need for training in the use of Information and Communication Technology (ICT) in the South Wales Valleys.

Introduction

The *"Multimedia Training Materials for the Community University of the Valleys"* project involved the creation, delivery and evaluation of multimedia education and training materials in the areas of Multimedia, the European Computer Driving License and Employability Skills. The project is funded under European Social Funding (ESF) objective 2,5b and the Regional Technology Initiative from 1st September 1998 to 31st December 1999. The paper begins with an outline description of the CUV and a variety of its initiatives and a description of the context in which this particular project took place. It then describes the nature and structure of the materials development project and concludes with a discussion of the key lessons learned and of the ways in which the initiative could be sustained.

The Community University of the Valleys

Context

Wales is a country, part of the United Kingdom, lying West of England. The communities of the South Wales Valleys lie north of the more affluent cities in South Wales, i.e. Newport, Cardiff, and Swansea. The area is relatively deprived compared with other areas in the UK, having suffered economically from the loss of much heavy industry, particularly coal mining. The Community University of the Valleys (CUV) is a unique partnership between the University of Glamorgan, the Swansea University and the Open University in Wales representing part of the regeneration strategy for valley communities in Industrial South Wales. It aims to provide for lifelong learning and widening participation in Higher Education (HE) through an active partnership of public, community, voluntary and private sectors. At Glamorgan the CUV involves a series of projects and courses, ranging from state funded delivery through to European and projects funded by Private industry. Approximately 2000 learners within the community are involved each year in various educational programmes delivered in the community by CUV tutors. The CUV project has been recognised internationally, by the European Union, and nationally in the Dearing report (NCIHE, 1997).

The CUV operates in a variety of environments but the bastions of the community provision are (i) the workplace, (ii) School and (iii) local Community Centres. Some examples of CUV provision are as follows:

Continuing and Adult Education (CAE)

Since 1994/95, many community centres have been used for the delivery of modular and non-accredited courses. The campus has also been used. The CUV team in partnership with FE providers is now addressing the need to define and market progression pathways into HE. Curriculum areas cover languages, arts, business, study skills, technology, social science and astronomy.

Glamorgan Summer School

The annual residential summer schools, (held at the Glamorgan Campus) attract between 400-600 learners. This is a stimulating and high profile activity offering valued educational opportunities to low income learners (through subsidy from the Rhondda Cynon Taff unitary authority) as well as more affluent students. The Summer School has gained a national reputation for its jazz courses.

Compacts

Compacts (developmental partnerships) are operating with schools in a number of Local Education Authorities and involve:

- student tutoring,
- records of achievement initiatives,
- aiming for a college education days,
- 'A' level master classes and
- GCSE revision sessions.

In 1998 the Compact initiative was selected by the Committee of Vice Chancellors & Principals (CVCP) as a national case study for good practice in widening access to higher education.

Internet Simulation

A project funded through the European Union *'Socrates'* programme, established an internet-based journalism activity for adult learners within the Rhondda Cynon Taff area. The learners developed IT expertise as well as awareness of media issues and news values based on a newspaper editing project. This also involved students in Finland, Scotland and France. The project led to a more extensive electronic newspaper simulation involving local schools, thanks to sponsorship via the British Telecomm University Development Award for 1998.

Partnership Framework

A University strategy on employability has been agreed by Academic Board, leading to the establishment of a Work-Based Learning Office that develops links with work based learners. The employability initiative recognises the importance of accrediting prior experience and distance learning, as well as projects within the workplace, and offers educational opportunities to employees who would not otherwise be able to attend traditionally delivered programmes on campus or in the community.

It is against this background, of an urgent need for the development of ICT (Information and Communications Technology) Skills, that this project was conceived and was successful in obtaining funding from the European Union.

Multimedia Training Materials for the CUV

Project Rationale

Nationally and internationally patterns of employment are changing, characterized by
(a) a shift away from labour intensive heavy industry to 'information age' organisations,
(b) a shift away from the concept of a job for life towards more short contract and part time work, and
(c) increasing numbers of female employees.

These changes are clearly applicable to the South Wales Valleys labour market. In this context the UK Government and the Welsh Assembly have recognised an urgent need to develop Information and Communications Technology (ICT) skills amongst the existing and potential work force.

Three recent publications evidence the concerns of Government.

1. The ***Wales Information Society*** report produced by the Welsh Development Agency from which the following quotation is taken.
   "If Wales is to sustain a competitive position within the increasingly information-based European and global economy, it must move towards a knowledge-based economy. The new ICTs provide the tools to enable this to happen." (Welsh Development Agency, 1998)

2. The ***Lifelong Learning is for Everyone (LIFE)*** green paper presented to Parliament in 1998. The paper provides evidence that supports the following claims for Wales:
   - *there is a serious learning deficit;*
   - *educational achievements are lower;*
   - *there is a greater shortfall in basic numeracy and literacy skills;*
   - *barriers to learning stifle access and participation;*
   - *education and training are not always appropriate to the needs of the individual or the economy;*
   - *existing patterns of provision are not achieving the best results;*
   - *the nature of the qualifications framework is inflexible; and*
   - *there are persistent deficiencies of skill and capability in all walks of life and throughout Wales.*

   (Secretary of State for Wales, 1998)

3. The ***Future Skills Wales*** report, commissioned by the largest partnership of organisations assembled in Wales including the Careers Service, CBI Wales, FEFCW and HEFCW, Wales TUC, WDA and the Welsh Office. The report indicates that in the future the following skills will be most important.
   - *Basic IT*
   - *Understanding Customers needs*
   - *Ability to Learn*
   - *Communication*

   (MORI Research and Business Strategies Wales Ltd, 1998)

With these requirements in mind, it is unfortunate that some studies have shown that many adults, particularly those from socio-economic groups D and E, are not attracted to using modern day ICT. It may also be the case that many people:

(a) do not perceive or understand the need to develop skills in these areas, and
(b) do not have the financial resources to become ICT literate.

There is thus a pressing need to extend and refocus CUV activities into these areas. The Multimedia Training Materials project is intended to begin to break down these barriers by:

- Delivering citizen-level ICT skills through the vehicle of the nationally recognised European Computer Driving License – a British Computer Society supported initiative.
- Developing a web-based collaborative learning environment providing access to a variety of new and legacy learning resources.

The European Union has recognised the needs of the South Wales Valleys by classifying the region as objective 1, but it is clear that initiatives such as the CUV need to do much more than simply developing materials and offering courses. They also need to work in partnership with schools, employers and Government agencies on changing attitudes and raising awareness of the need for lifelong learning and more specifically the need for the development of ICT skills.

Project Description

Aims and Objectives

The aim of the project itself is to deliver a variety of educational materials to community learners. The objectives are threefold:

1. To deliver specific materials to the community in the following areas:
   - Multimedia
   - European Computer Driving License
   - Employability Skills
2. To provide technology training to lecturers and community tutors
3. To develop and maintain a technical and managerial infrastructure which will enable further materials to be incorporated.

Project Structure

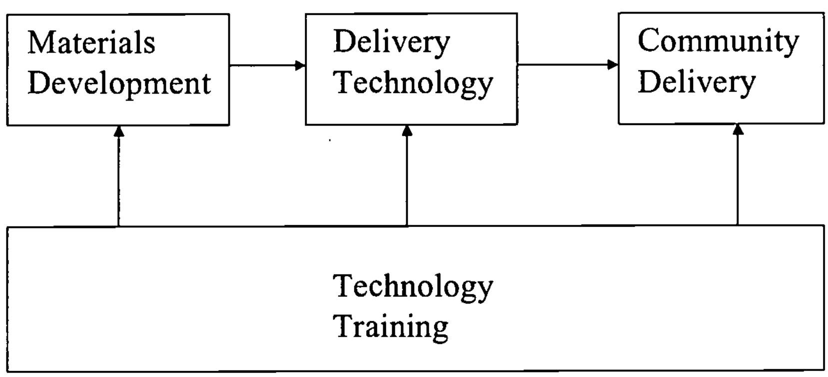


Figure 1: Project Structure

A Project Structure was required to facilitate the co-ordination of the various sub-activities within the project. The project steering group developed the structure described in figure 1 that distinguishes four related types of activity.

Materials Development

Some team members were mainly concerned with identifying and developing education and training materials. In the area of Multimedia a specialist team is developing a multimedia Computer-Based Learning package to teach multimedia principles and techniques. Staff at Glamorgan are collaborating with Swansea to produce web-based portfolios of materials for each of the 7 modules of the ECDL. A further team are working on portfolios in 6 Employability Skills areas including, Communications, Numeracy, Using IT, Problem Solving, Working with Others and Improving Learning and Performance.

Delivery Technology
Other team members are largely concerned with developing the web-based collaborative learning environment. This environment is accessible by registered learners and through an easy to use interface the learner builds up a Personal Academic Menu (PAM) containing all the links required for their individual programmes. A different interface to the environment is provided that allows development staff to create a standard look and feel for their materials. The efficiency, effectiveness and appropriateness of this environment is a key issue for the sustainability of the project.

Community Delivery
This is the activity the project stands or falls by. It is absolutely essential that any problems experienced, by the tutors or learners, with the materials (e.g. with inaccuracies or irrelevance) or with the delivery technology, are reported back to the project steering group for action. The key initiatives in this area are concerned with establishing reporting and feedback mechanisms to ensure that the provision works in practice.

Technology Training
The remaining team members are concerned with providing any technology training required by the members of the other teams. In Swansea the emphasis so far as CUV is concerned is on the Humanities rather than IT and thus many of the community tutors themselves have limited ICT experience. Therefore the approach will be to train lecturers and tutors in the development of flexible learning materials and the use of a variety of technologies such as video and computer conferencing. The emphasis is on providing lecturers and tutors with the technological skills to create materials for use in the community.

Lessons Learned

1. Close collaboration within and across departments and particularly between campus-based development staff and community-based tutors is critical to the success of such initiatives.
2. Developing high quality educational materials, as is already well reported (e.g. Marshall *et al* 1997), and based on the authors experience, is difficult and time consuming. However it became apparent that the community tutors would prefer early access to small chunks of materials for evaluation purposes, through the course of the project rather than waiting to receive finished materials.
3. Careful and close project management is required. On reflection I feel that it would have been better to begin with a much smaller portfolio of existing materials and go through the complete process in a first milestone and subsequently once the key lessons had been learned to expand the portfolio during a second milestone.

Sustaining the Initiative

Four key issues regarding sustainability have emerged.
1. Progression Pathways into Higher Education: Small cohorts of learners on non-accredited community programmes do not generate profit, clearly making them difficult to sustain. However profit can be generated if community learners eventually become full or part-time students on accredited modules and awards. So in the future we intend to focus on creating pathways into Higher Education from three sources (i) from industry via a work-based learning initiative, (ii) from schools via the University's compact scheme and (iii) from the community.
2. Focussing on Specific Economic Regeneration Needs: The key seems to be the resolution of particular local problems and the subsequent dissemination of good practice.
3. Maintaining the Efficiency, Effectiveness and Appropriateness of a Collaborative Learning Environment: In view of the perceived lack of ICT skills in South Wales it is essential to ensure that the learning environment is adding value to the learning experience rather than getting in the way.
4. Teaching Community Tutors to Develop their own Materials: It is recognised that the materials produced by campus-based academics only provide a baseline and that community tutors will augment this with materials and activities of their own in response to the idiosyncratic needs of their learners. Providing tutors with the

technical and educational skills to do this effectively (training the trainers) is another important way of developing sustainable provision.

Concluding Remarks

In the past, indigenous industry faced a responsibility to valleys communities, with organisations such as the Miners Federation acting essentially as a community college. (The Miners Federation enabled many people to successfully make the transition from mining into higher education.) Today's more mercenary hi tech industries do not face such responsibilities. These changes in the nature of the labour market combined with temporary project after temporary have not encouraged sustained education and training initiatives for valleys communities. We hope that objective 1 funding, together with emerging initiatives such as the University for Industry will enable such initiatives to flourish.

References

Marshall IM, Samson WB, Dugard PI and Sutherland JN, 1997: *Multimedia Courseware Engineering – Lessons Learned from the Failure of Technology-Based Learning*, in Aspects of Educational and Training Technology XXIX Implementing Flexible Learning, edited by Bell C, Bowden M & Trott A

MORI Research and Business Strategies Wales Ltd, 1998: *Future Skills Wales* report, commissioned by the largest partnership of organisations assembled in Wales including the Careers Service, CBI Wales, FEFCW and HEFCW, Wales TUC, WDA and the Welsh Office.

NCIHE, 1997: *TheDearing Report* (The report of the National Committee of Enquiry into Higher Education)

Welsh Development Agency, 1998: *Wales Information Society* report produced by the Welsh Development Agency.

Secretary of State for Wales, 1998: *Lifelong Learning is for Everyone* (LIFE) green paper presented to Parliament in 1998.

Inducting On-campus Students into Online Discussion

Alistair Inglis
Learning Technology Services
RMIT University
Melbourne, Victoria, Australia
alistair.inglis@rmit.edu.au

Jeremy Keens
Faculty of Biomedical, Health Sciences and Nursing
RMIT University
Melbourne, Victoria, Australia
jer.keens@rmit.edu.au

Abstract: The shift that is currently taking place within universities from teaching face-to-face to teaching online is presenting teachers in universities with the need to induct large numbers of students into learning in this new mode. It is pertinent to ask how learners themselves are experiencing this change. In a subject in human biology, an activity based on the topic on the use of statistics in the mass media was employed as a way of inducting students into online discussion. Students' responses were monitored by focus groups before and after the exercise, by an evaluation survey and by inspection of the transcripts of the discussion. The issues that students reported included the frustration experienced in gaining sufficient access to computers, the perceived value of the task, and their comfort level in using computers in learning.

Introduction

The shift that is currently taking place within universities towards online learning is confronting teachers in universities with the need to induct large numbers of students into this mode of learning over a relatively short timeframe (Inglis et al. 1999). As students can presumably be expected to build upon the skills obtained from their first experience of online conferencing as they move on to later subjects, this need is likely to be relatively short-lived. However, as most students will have had no previous experience of anything approaching this mode of learning, their initial experience is therefore likely to colour their subsequent outlooks. It therefore behoves universities to try to come to understand the learning experience as students perceive it. In that way they can tailor introduction and delivery to meet varied students' needs. The major hurdle is to get students off to a confident start in the first place.

In other studies it has been reported the students have found the process of learning online to be less satisfying than learning face-to-face even though this it was more effective at enabling students to attain expected learning outcomes (Benbunan-Fich and Hiltz 1999; Hiltz 1998). A number of factors may account for the stress students experience in their first encounter with online discussion in a university setting: they may have had no experience of the software used; they may not feel comfortable with using computers; they may be unfamiliar with the etiquette and conventions of computer conferencing; and they may not even see the value of interacting online when they can so easily meet face-to-face in an actual classroom or in a campus cafeteria.

Harasim et al. (1995) pointed out that inducting students into the use of computer conferencing involves two separate functions: familiarising students with the operation of the particular conferencing system that is being used, and enabling students to learn how to interact in a conferencing environment. Learning the technical skills needed to use the conferencing system obviously comes first. Harasim et al. (1995) suggested that, whenever feasible, as this gives students the opportunity to build confidence in a supportive environment rather than being thrown on their own resources. These authors suggested that a three hour session or two shorter sessions is normally sufficient for this purpose.

Inducting students into conferencing itself is quite a different task. Harasim et al. (1995) recommended that this be accomplished by use of an initial private email exchange followed by an all-group "great debate". They pointed out that centering the debate around a controversial issue which is certain to arouse passions ensures that participants join in the discussion.

RMIT University, like many Australian universities, is expanding its use of online learning with on-campus students as well as using online learning to increase the number of students studying off-campus. The teaching staff view these trends with mixed feelings. On the one hand, there is a perception — perhaps a fear — that the administration's drive for greater use of new technology is mainly motivated by a desire to reduce contact hours and thereby cut costs. On the other hand, they recognise that online delivery offers the possibility of improving student learning as students are afforded greater opportunities for working collaboratively while proceeding more at their own pace. However, if expectations of the value of using online learning in on-campus courses are to be achieved, then it is essential that these segments be incorporated into courses in ways that meet students needs.

The Induction Activity

In 1999 a range of online components were incorporated into the subjects in Human Biology within a Bachelor of Applied Science degree. These included lecture notes, demonstrations, web-based assignments and a discussion forum.

A task in second semester required students to summarise an instance of the use of statistics by the media (examples they chose ranged from local papers through to Rikki Lake), and comment on its accuracy and value. They were then required to respond to a minimum of two other students' postings. Students were asked to post and comment within their practical groups which comprised approximately 20 people each. The conferencing system used was HyperNews and the groups were established within the HyperNews structure. However, due to the nature of the program, once the number of postings became significant students had difficulty identifying the first-order structure, and later posts were added in an ad hoc fashion.

This task was the 'practical' component of a unit which is based on Stephen Jay Gould's 'Mismeasure of Man', and concludes an introduction to physical anthropology. Gould highlights some egregious examples from the history of the science where statistics have been used and abused in the scientific and, to a lesser extent, popular media. One of Gould's points is that while data may have been generated 'objectively' by reputable academic researchers, when the data are released into the public sphere, the reporting of the significance of the data is often not as objective.

The activity was scheduled for weeks 9 to 11 of a 13 week semester. It was set down as an assessed task, but was allocated a weighting of only 4% of the final mark. In the end it was decided that all students who completed the task satisfactorily should be awarded full marks. In this respect it could be classed as a 'hurdle requirement'. However, students could still pass the subject without completing the activity. Of the class of 83 students, 75 completed the activity.

Students were introduced to the web-delivered material over an extended period. Their first practical for the year was held in the Faculty computer laboratory. During this session they were introduced to the range of resources that were to be provided online. However, the conferencing system was not then functioning. A demonstration of the conferencing system was presented in a lecture in week 7 of the 13 week semester. Students were encouraged to use the discussion forum from that time onwards. Prior to the commencement of the discussion activity, the structure and operation of the discussion forum was again introduced in a lecture/demonstration.

Evaluation Methods

The principle method used to evaluate the success of the induction activity was the conduct of focus groups at the commencement of the activity and once the activity had been completed. We were particularly interested in observing any changes in students' 'before' and 'after' responses to the activity.

Students were asked to volunteer for participation in the focus groups and were offered light refreshments as an incentive to participate. Two focus groups were conducted. The first focus group was held in Week 10, and the second in Week 13 of the semester. The first focus group comprised 6 students. The second focus group comprised four students from the first focus group plus three students who had not participated in the original group. The focus groups met for approximately three quarters of an hour. The discussion was guided by a series of pre-prepared questions (see Table 1). The discussion was recorded and transcribed for analysis.

<table>
<tr><th colspan="2">Questions put to both focus groups</th></tr>
<tr><td colspan="2">1. What problems have you been experiencing in gaining access to the online material?</td></tr>
<tr><td colspan="2">2. How well do find that the online medium suits what you are needing to do in this subject?</td></tr>
<tr><td colspan="2">3. What do you think about the type of task you are involved in?</td></tr>
<tr><td colspan="2">4. What has interacting online been like for you?</td></tr>
<tr><th>Additional questions put to the first focus group</th><th>Additional questions put to the second focus group</th></tr>
<tr><td>5a. How do you feel about being criticised online and do you feel that you have sufficient opportunity to contribute?</td><td>5b. Now that you've completed the activity, what did you think you got out of it?</td></tr>
<tr><td>6a. What changes would you like to see in the way the subject is offered?</td><td>6b. If you were doing the subject again what would you like to be different about the way it uses online learning?</td></tr>
<tr><td>7a. How do you feel about flexible delivery in</td><td>7b. How would you feel about more extensive</td></tr>
</table>

general	use being made of discussion groups
	8b. Given the importance of computers where do you think we should be striking the balance between accommodating preferences and challenging you to escape from your comfort zone

Table 1. Focus group questions

The transcript of the online discussion was also reviewed.

An evaluation questionnaire was distributed to students at the completion of the semester which sought feedback on all aspects of the subject. Discussion of the full results of this evaluation is not covered in this report. However, where the results of the evaluation threw further light on the way in which students responded to the induction activity specific reference will be made to these results below.

Findings

The members of the focus group expressed a diverse range of
The various modes of analysis presented a broad view of the students' perception of online learning and response to the task. Some students were familiar with computers and at ease using them

> 'I like the concept of online ... I mean for people who use it you are not going to get anything better'.

Another student was resigned to the inevitable

> 'Like I do everything to avoid it but its going to hit me in the face shortly so ...'

> 'There's nowhere where I feel comfortable using the Internet'.

They were also perceptively critical of online material

> 'It just seemed that it was that the person who had actually dished it out didn't give a lot of thought into what had to be there' or

> 'If I wanted to study remotely I would have chosen that way'.

However, three principle issues emerged from the discussion and evaluation:

- access to computers
- the perceived significance and relevance of the task
- attitudes to online learning

Access to computers

The Bundoora campus of RMIT University is located on the northern outskirts of Melbourne. Because of this, many students travel considerable distances to and from the campus each day. Many use public transport or rely on friends. Activity on the campus therefore peaks in the middle of the day but falls away sharply in the late afternoon. As a consequence, the facilities on the campus including the general access computers are in heavy demand between the hours of eleven and three.

One might expect that having the opportunity to engage in discussion online would be as an advantage by students because it allows them to undertake part of their study at home. However this was found to be only partly the case.

A survey of the class group indicated that while 80% had a computer at home, only 50% had a modem and an account with an Internet Service Provider. Therefore half of the students still needed to rely on university computer facilities to complete the task. Even students who did have a computer at home still said that they wanted to make use of computers on campus so that they could make best use of their time. Difficulty in gaining access to a computer was therefore the source of a considerable frustration for some students.

Although the Faculty of Biomedical, Health Sciences and Nursing has specialised computer laboratories on campus, the students in the focus groups expressed a preference for using the general access laboratories provided in the campus Library notwithstanding the fact that these were the busiest. The end-of-semester evaluation confirmed that most students access the conferencing system from home or from the Library. The main reasons given by members of the focus groups for preferring to use the laboratories in the Library were that these laboratories had the most up-to-date equipment and that they also had an efficient queuing system in place. However, students also commented that having to wait in the queues for a computer to become available consumed scarce time that they would otherwise have been able to spend on the activity itself.

Provision of general access to computers is a vexed issue. The cost of alleviating the shortage of computers would probably not have been much more than the equivalent of one academic staff salary for one year. Yet the cost of the provision of computers is subjected to much greater scrutiny that the cost of appointing new staff. Some staff consider that students ought to be required to provide their own computers; others believe that most students will soon have computers at home anyway. Yet all the evidence points to the likelihood that the demand will continue for the foreseeable future and that it is capable of being met a reasonable cost. The evidence provided by student's feedback in this study is that lack of sufficient access to computers has the potential to become a fatal flaw in the strategy to build greater use of online learning into the delivery of on-campus courses.

Perceived Significance and Relevance of Task

While the activity had been designed to engender discussion amongst students the extent of discussion was relatively limited. Students generally logged in, posted their piece and two comments and logged out in one or two sessions. However, the reasons for their failure to go beyond the minimum level of participation turned out to be largely pragmatic rather than reflecting the value of the task.

Students explained their reasoning in terms of the perceived importance of the task. There were two aspects to this. First, the credit being given for the activity was quite modest and secondly as anatomy/physiology majors in science they did not see the exercise as particularly relevant. Therefore, given the difficulty in gaining access to computers they said that they elected to do the minimum that would satisfy the assessment requirements.

The members of the second focus group were asked what their attitude would have been to the hurdle being set higher — for example, having to provide four responses. All members of the panel said that they would have had no objection to a more substantial activity provided that it was more relevant to their course and that they had adequate access to computers. However, they emphasised that if they were required to put in more time then they would hope that the activity would receive higher weighting. Students appear to connect weighting more to the amount of work involved rather than to the relative value of the subject to their learning.

Attitudes to online learning

Despite the apprehensions that some students in the first focus group had expressed about the discussion activity prior to its commencement, all participants in the second focus group agreed that the task had been interesting and a worthwhile introduction to discussion forums. Typical comments included:

> It was pretty interesting a lot of it ... it was pretty cool
>
> It sort of motivated [me]. It was interesting.

The students also enjoyed the experience of online discussion when it did occur. In the end-of-semester evaluation, comments like the following were typical:

> It was an interesting and different idea for an assignment
>
> allowed us to communicate with the whole group
>
> different perspectives
>
> I liked the interaction and comments between students and ideas

Some students complained that there had not been enough discussion and others complained about the formality of the system.

In the focus group there was concern about one interchange, however the overall tenor of the discussions was positive, and as one student said 'I couldn't really be bothered abusing anyone'.

Issues Arising from the Activity

The issue of relevance merits closer examination. The task around which the induction activity was centred was designed to develop the students' critical response to the use of data and its interpretation and presentation, as well as to foster a stronger community through discussion-based interaction. While the staff may have been clear about the particular and general value in the activity, the responses of students suggested that they had a much narrower understanding of the purpose of the activity. Nevertheless, the majority of the participants in the second focus group said that they did enjoy the exercise and that they gained benefit from it in terms of their familiarity with computers, their interaction with other students and understanding of the reporting of statistical data in the media.

The question of relevance brings up, however, a more fundamental question, which is why include online components in an on-campus program? While the distribution of lecture notes, the presentation of demonstrations and the provision of quizzes can be justified on the grounds that all of these contribute to increased flexibility, the justification for the use of discussion groups is less obvious. As one student pointed out

> 'I live with three other biology students anyway. So if I had a question I would just ask them'.

The educational rationale for extending the use of discussion groups to on-campus students' needs to be better articulated. It would seem that there are two main rationales for promoting the greater use of online discussions amongst students studying on-campus. The first is that gaining the capability of being able to converse in a group online is an element of computer literacy in the life of today's professional. The second, and more important, is that participating in academic discussion is critical for a student's intellectual development and that online discussion has the potential to involve more students more often in this type of intellectual exchange.

Given the positive response of students to the induction activity described here, it is perhaps unfortunate that the activity was scheduled late in semester 2. As an induction task, it could perhaps have engendered much greater involvement and have led to had it been scheduled earlier in the year.

Conclusion

The results of this study show that students by-and-large adopt a pragmatic approach to becoming involved with new teaching approaches associated with online delivery. They recognise the growing importance of computers and the benefit they derive from becoming conversant with them. They will willingly participate in activities requiring the use of computers even though they might not feel entirely comfortable with computers. However, the extent of their involvement is very much governed by their cost-benefit assessment of the value of a particular activity. The contribution to grades weighing strongly as either a cost or benefit depending on the mark-value and the difficulties of gaining access to a computer. The contribution that computer-based activities make to a student's overall workload weighs strongly as a cost.

The responses obtained from students in this study suggests that universities ought to pay close attention to contextual factors in inducting students into online learning, if they want to ensure that students' initial experience is positive. If students are to gain the benefits from these activities, then they need to be given an effective induction to online discussion, be set tasks that they see as relevant and be given adequate on-campus access to computers.

Therefore, with Harasim et al. (1995), we would suggest that the introduction to conferencing should be through a broad debate as much through a great one. If students are aware that the relevance is as much in the process as the specific material they will respond positively, and if it is constructed as a hurdle task, they will participate.

References

Benbunan-Fich, R. and Hiltz, S. R. (1999) Educational applications of CMCS: Solving case studies through asynchronous learning, *Journal of Computer Mediated Communication*, 4(3).

Gould S. J. (1981) *The Mismeasure of Man*, New York: W.W Norton and Co.

Harasim, L. Hiltz, S.R., Teles, L. and Turoff, M. (1995*) Learning Networks: A Field Guide to Teaching and Learning online*, Cambridge, MA: MIT Press, Cambridge.

Hiltz, S.R. (1998) Collaborative learning in asynchronous learning networks: Building learning communities. Invited address at "WEB98" Orlando Florida.

Inglis,A., Ling, P., and Joosten, V. (1999) *Delivering Digitally: Managing the Transition to the Knowledge Media*, London: Kogan Page.

Excellent Teaching and Early Adopters of Instructional Technology

Dr. Michele Jacobsen
Faculty of Education
University of Calgary, Calgary, Alberta, Canada
http://www.ucalgary.ca/~dmjacobs
dmjacobs@ucalgary.ca

Abstract: What can we learn from individuals who are both early adopters of instructional technology and excellent teachers? Roger's (1995) adopter categories are useful for simplifying the complexity of adoption patterns in a social system by describing a central exemplar or summarization of the early adopter and other categories. Diffusion theory and research yields global judgments and perspectives, but storytelling enables us to take the personal point of view, to understand the particular aspects of expertise and experience embodied by the unique and variable individual. This paper describes an investigation into the relationship between excellent teaching and early adoption of technology by highlighting the stories and narratives of individual adopters using Roger's (1995) innovation-decision process as a conceptual framework.

1.0 Global Characteristics versus Individual Stories

A potential limitation of considering the integration of technology using the adopter categories derived by Rogers' (1995) diffusion theory lies in their very nature as summaries of global characteristics (i.e., innovator, early adopter, early majority, late majority, and laggards). While the adopter categories are useful for simplifying the complexity of adoption patterns in a social system by describing a central exemplar or summarization of the early adopter and other categories, these "defining characteristics" also understate the uniqueness of the individual member. It is worth remembering that early adopters are unique and variable individuals who may resemble each other much less than they resemble the general subgroup characteristics. For example, one can readily appreciate that early adopters possess various and different: levels of ability and skill, beliefs and visions about the value of technology, specific personality traits, levels of risk-taking behavior, motivations to learn about technology (e.g., internal, external, environmental, opportunity), development patterns (e.g., self-taught, peer teaching, formal courses), and have implemented computers in different environments, under different conditions and with different expectations.

Sternberg (1997) profiles the views of expert professors who teach introductory psychology and have written textbooks for the course. His rationale for profiling expert teachers is that the best help comes from seasoned instructors who not only have taught for many years, but from those who have thought deeply about the course, and have come up with new and exciting ideas about how to teach it. His approach to documenting teaching excellence using narrative captured both the similarity and variability between experts, and is useful to professors across disciplines who want to improve their teaching.

Narrative stories and profiles of experts are well suited to capturing exactly those elements or details that formal models, such as theories of diffusion and adopter categories, may leave out. Personal stories, such as the profiles of expert teachers (Sternberg, 1997), capture the subjective emotions, thoughts, and beliefs of the category members. Logic generalizes, stories particularize (Norman, 1993). Diffusion theory allows one to form a global judgment and perspective, while storytelling allows one to take the personal point of view, to understand the particular aspects of expertise and experience embodied by the individual. Stories are not better than logic; logic isn't better than stories (Norman, 1993). It is appropriate to use both in the attempt to characterize early adopters of technology on campus.

2.0 Methodology

This investigation profiled individuals who are both early adopters of instructional technology and excellent teachers. This study begins to address the need for "best help from seasoned instructors" by providing role models for faculty who want to adopt technology in their teaching. This case-by-case analysis models Sternberg's (1997) framework by documenting instances where the adoption of technology and excellent teaching exist in the same individual. The rationale for collecting this information is based upon the value of providing descriptive accounts of this expertise for the benefit of faculty members who wish to develop both their technology integration and teaching skills. Post-secondary instructors from across disciplines can benefit from the collective wisdom of those who have thought deeply about and taught extensively with technology for a number of years. The individual experiences represent great diversity. Faculty members profiled here represent the social and physical sciences, as well as administration and management, and they range from being enthusiastic beginners to seasoned experts at integrating technology in their teaching and research. The individuals share a passion for excellent teaching and continue to pursue new ways to integrate technology to fundamentally improve teaching and learning.

2.1 Information Collection

Semi-structured interviews were conducted with faculty members to gather more in-depth and specific information about the integration of technology for teaching and learning. The primary objective was to record, analyze and interpret the individual faculty member's experiences, opinions, and perspectives with regard to integrating technology for teaching and learning. While the interview procedure used a semi-structured format guided by specific topics, it was also open-ended in nature to be responsive to emergent topics and themes. Discussion questions were drawn from ten sub-scales of a faculty survey (Jacobsen, 1998) as well as using the following topics as guides: (a) Perceptions of value of computing skills for self and students, (b) computer use patterns and skill, (c) training and staff development (if any) & modeling from mentors, (d) motivation for using technology (instructional, personal, institutional mandate), (e) experiences with technology (early positive or negative), (f) degree to which they require technology use by students, and (g) changes in use, practices, and beliefs about computers over time.

2.2 Interpretive Analysis

Interview transcripts were analyzed using a constant comparison method, and sorted into major themes using a combination of categories derived from prior research on teaching excellence (Andrews, Garrison, and Magnusson, 1996) and from Rogers' (1995) innovation-decision process. Five categories provide a conceptual framework for the consideration of individual stories about adopting technology for teaching and learning: 1) *Knowledge*: values, beliefs and characteristics, as well as felt needs/problems and degree of innovativeness, 2) *Persuasion*: expected outcomes and benefits, as well as perceived characteristics of the innovations such as relative advantage and compatibility with existing teaching methods, 3) *Decision*: processes used to attain desired outcomes, and factors influencing the decision to adopt or reject the innovation, 4) *Implementation*: specific instructional strategies that support the processes, and 5) *Confirmation*: motivators and impediments to integrating computer technology, as well as descriptions of continued adoption or discontinuance.

3.0 Case Studies

The following section represents a selective summary of interview results illustrated with condensed excerpts from source transcripts. Cases are presented in no particular order, and pseudonyms are used to provide anonymity for participants.

3.1 Knowledge

The following faculty member has been awarded teaching awards at the University of Calgary, and has integrated various technologies in classroom teaching in the past few years. This individual increases their awareness-knowledge about ways to integrate technology in the classroom using a variety of means. Completing the on-line survey as part of the present investigation (Jacobsen, 1998) was treated as a learning opportunity: *"I found it interesting to go through the questionnaire, because it occurred to me that there was a whole lot there that I had heard of, ...I am doing stuff like that, and I am doing that, and so on..., and there was a bunch of stuff that I hadn't really thought about using for the classroom."* S/he also described a few instructional strategies being discussed by her/his department to enhance the experience of students in large enrollment (250+) sections, including CD-ROM-based study guides produced by textbook publishers and developing web-based, self-paced instructional modules.

3.2 Persuasion

This individual brings more than two decades of experience in information technology to a consideration of the characteristics of early adopters. As such, this individual's retrospective analysis of some of the issues surrounding the integration of technology is rich and in-depth. This individual was particularly interested in the innovators, the pioneers on the edge of their field who actually develop new technological tools to address certain problems:

"When I look at people, I consider the innovators. They've never sat around waiting for somebody to parachute in with a solution to their problems, they go out and look for it. So, I guess the first instance is the character of the innovator, the self-starter, a desire to get on with something, not just.... There are a lot of academics who, I won't say go through the motions, but there are a lot of academics who pursue the normal cycle in the normal way. They meet their classes, they write research papers, they supervise graduate students, and whether they contribute anything to the body of knowledge is questionable. But I think that most of the professoriate, certainly a significant portion of the professoriate are ... effective, competent, participants in process. The people that we are talking about are process-changers."

This view is reminiscent of Bereiter and Scardamalia's (1993) work on competent teachers and expert teachers, and the difference between them in investing cognitive resources in progressive problem solving. Early adopters appear to be constantly pushing the edge of the problem, and as soon as it gets close to being solved, they prefer to reformulate the whole thing and start again with a new problem.

3.3 Decision

This faculty member has more than two decades of experience teaching with and about computers, has been recognized as an excellent teacher with several awards, and concentrates on technology as a major area of research. Excerpts from the interview transcript highlight some of the motivators and impediments to integrating technology for both early adopters and mainstream faculty. An individual's decision to adopt or reject technology for teaching and learning may be influenced by external factors in their research domain that take priority over an internal desire to focus on innovative teaching methods.

"Globally, the extrinsic reward systems have to be there. People at the assistant professor or associate professor level who want to get promoted or get tenure, will find very quickly that unless they are in a Faculty of Education or being sponsored by a Dean or Department Head who has a very strong commitment to quality teaching, they will not get any extrinsic rewards, such as merit pay, tenure, or promotion if they do research of this type ... in chemistry or physics or biology, the pay off is going to be in doing more basic research in their domain, such as NSERC funded research, or MRC funded research ... They make get intrinsic rewards from seeing better quality teaching in themselves, but to get that better quality teaching they have to invest a lot of time and effort, and sometimes their own money because there are no research dollars to do the things they want to do, and the payoff is quite minimal."

The following professor has integrated technology into teaching and learning for over five years, has been awarded teaching excellence awards on campus, and currently uses the World Wide Web as a supplement to on-campus teaching. In addition to addressing workload concerns about the time needed to learn about and integrate technology, the potential threats to employment security, and the possible influence of the annual review process, this individual, who has over twenty years of experience as a member of an academic staff, discussed the possibility that some faculty are concerned about putting their lack of skill with technology on display.

"Another part of it I think is just plain competencies, old fashioned technology skill. Knowledge and skill, and sometimes an unwillingness to look stupid, I mean that is one of the things that you have to recognize when learning a new technology is you have got to become a fool for awhile. Some of my colleagues have difficulty doing that, I don't, I never have, but that is another part of the resistance."

3.4 Implementation

The following faculty member volunteered to participate in an interview after completing the on-line survey (Jacobsen, 1998). This individual is an early adopter of technology for teaching and learning, and has past experience in the information technology industry. The discussion of this case will include attitudes and beliefs expressed by this faculty member about technology integration plans on campus and elsewhere. Even if a technology integration plan has relative advantages for the faculty, if administration attempts to force a seemingly political agenda, the plan is likely to fail. Faculty will become cynical, feel unjustifiably pressured, and not listened to. Focus will shift from the teaching and learning issues, to discussions about the perceived agenda. Faculty may seek to undermine the innovation by actively or passively rejecting the proposal. Another constituency that will be affected by top-down decision making is the student body.

"Some students, particularly those who understand the issues, are vehemently opposed [to a lap-top acquisition requirement]. Their incensed that tuition has doubled in the last five years, and they are looking at another doubling to pay for these computers. Student leaders are very aggressive in opposition to us ... we need to deal with those concerns ... we need to deal with the fact that students have an installed base of hardware that they have bought, invested substantial amounts of time and money in, and now we are going to now say its obsolete."

3.5 Confirmation

The following faculty member has been integrating technology into classroom teaching for more than two decades and conducts both basic and applied research with computer and networking technology. In order to justify the investment of time and effort, faculty members need to be convinced that their technology integration efforts are having the desired or intended effects on student learning. This individual described some of the reinforcing messages that s/he has received from the community about the integration of technology into her/his courses.

"I have had e-mail from people in lots of places saying how they like this course. I have students who have put stuff up on the web for assignments, and then I get e-mail from industry people, people in government, hospitals, all over, who say, 'Oh, what you have been doing is exactly what I need to do for my research project'. I have to write back and say 'this was an undergraduate assignment', or 'I got that out of this textbook', or whatever. They write from all over and say, 'you are obviously a great expert on this and this and this', and it's nothing, it is just stuff I have put up along the way. So, I say to them, 'well, these are the people who have developed this, why don't you talk to them', and the students are really thrilled you know, because I mail it along to the students concerned, and I say talk to these people. ...it makes it all very authentic, because they are not just sharing it with their instructor, they are literally sharing it with other interested people in the world. And our students now do that automatically, they search for other people, and they look for list servers and newsgroups in areas that they have got an interest in, and if they have got a question, technical questions, they ask 'has anybody had this problem, or does anybody have any research material on something or other', and they get all of this stuff coming back and they make contacts."

In addition to observations and evaluations of the quality of student work throughout the course, this instructor draws upon feedback from sources beyond the institution about the relative advantage and effectiveness of using technology as an on-line publishing environment.

4.0 Discussion

The cases presented here provide some insight into the development of expertise, variable experiences, dispositions, decision making, and motivation for technology integration efforts of early adopting faculty members who are also excellent teachers. These are meant to be useful accounts of the individual experience with technology integration, as well as provide insight into the beliefs and values of individual faculty members, their expectations for outcomes and benefits from using technology for teaching and learning, and a variety of instructional strategies they use to support educational processes. There is some consistency in what the individual faculty members regard as important and valuable instructional goals, and also diversity in the characteristics of instructors and their specific instructional methods for integrating technology into teaching and learning. Readers can compare and contrast characteristics and teaching methods of a faculty member who is relatively new to technology integration and a faculty member who has used technology in teaching and learning for over twenty years. The cases present different perspectives on the administrative and cross-campus issues involved in widespread adoption of technology. A goal that was accomplished with this research was the generation of descriptive accounts that provide a means for drawing parallels and contrasts between the early adopter profiles and a faculty member's own educational practice. The cases presented here were reconstructed from interviews and depended upon the individual's retrospective analysis of their technology integration efforts and teaching philosophies. Future research that attempts to profile early adopting faculty who are excellent teachers could also employ a longitudinal observation methodology to be more informative. Although it was not a goal of the present investigation, future research of this kind may also choose to profile excellent teachers who do not integrate technology into their teaching and learning to facilitate a comparison with the early adopter cases presented here.

5.0 Conclusions

The results from interviews with early adopters suggest that there is a relationship between early adoption, motivation, and excellent teaching. The motivation to integrate technology in their teaching tends to be located in the early adopter's beliefs about excellent teaching. The faculty members described ways in which technology enables them to be a better teacher, provided enriched learning opportunities and access to information, and improved communication with students. Early adopters seem to exhibit characteristics of "expert-like learning", such as progressive problem solving, belonging to second-order environments, and flow (Bereiter & Scardamalia, 1993). They often describe or refer to their extensive experience and knowledge about the technology as a given, "*it is not rocket science*," which suggests they take for granted their greater literacy and fluency with computers, but might also be a sign of indifference or lack of awareness about how others struggle with the technology. However, it must also be said that most of the early adopters interviewed, who have first hand experience with the unreliability of computers and anticipate problems, demonstrate empathy for colleagues who encounter bottlenecks or problems with the technology.

Early adopters appear to regard technology knowledge and skills as one type of expertise, and pedagogical skills as another type of expertise. Some early adopters cringe at the awkward and ineffective uses of technology by their peers, and are convinced that technology cannot improve poor teaching. Early adopters interviewed in this study seem to be constantly changing teaching and learning processes, reformulating and pushing the edges of the problem, creating and designing alternate solutions, and seem to be more content with risk-taking than the status quo. Not only do early adopters appear to have the self-confidence in using technology for teaching and learning, early adopters have intrinsic motivation and a belief structure that integrating technology into their teaching is the right thing to do. An individual early adopter explained that they apply technology in their teaching because it is the solution to her/his problems, not a solution looking for a problem.

Early adopters are concerned about student evaluations of their teaching, and student access and equity issues, but many continue to integrate technology because of their enduring beliefs about the relative advantage, and the potential benefits and value of computers for students. Early adopters described some of the same impediments that other faculty highlighted, such as equipment & software failures, poorly designed classrooms, and slow and clumsy Internet connections. However, a subtle difference was that these difficulties seem to be expected, the early adopters locate the problem in the technology rather than themselves, and do not appear to be deterred by these impediments.

Because of their different levels of computer use and years of experience, each early adopter appeared to have a unique innovation-decision cycle (Rogers, 1995). For example, most of the early adopters used the WWW for demonstrations in their classroom, some of them published information to the web, and only a few required their students post work on the web. Only one described the development and delivery of a web-based course. One early adopter was convinced of the benefits of web-delivered instruction, while another only considers the web as an enhancement to face-to-face instruction. These differences are consistent with Rogers' (1995) suggestion that the same innovation may be desirable to one early adopter in one situation, but undesirable for an early adopter in another situation. Some of the early adopters described events that have lead to their current adoption patterns, and others described factors that may lead to future adoption, discontinuance, or rejection.

Current fiscal realities are impacting the early adopters as well as the mainstream. Some early adopters purchase software using personal resources, since funding is not available on campus, because they believe the application is important for instructional goals and students' learning processes. The adoption of presentation software is undesirable to some early adopters, not because of lack of skill, but because there appears to be little relative advantage; the impediments include poor lighting and unreliable equipment, and interactivity is perceived to be low.

Early adopters described their frustration with the annual review process and funding agencies that seem to undervalue their teaching and technology integration efforts. Further, for many early adopters, who are working at the edge of their fields and developing new teaching and learning environments, it is disheartening to be evaluated by department heads and peers who may not share the same belief structure and often fail to understand the significance of and motivation for their work. Early adopters also describe frustration with the "insufficient evidence" argument put forth by peers who do not share their beliefs about the benefits of this type of research and teaching. Two early adopters described the difficulty of doing experimental research on the benefits of technology integration with students because of equity (and ironic) concerns about the control group who does not get the technology intervention.

There were clear signals that some early adopters feel left out of the current planning and decision-making processes in their faculties or departments. Two individuals described situations in which their opinions and expertise were not been called upon by committees when major technology planning was being done and decisions were being made about the acquisition of technology for teaching and learning. One individual described a situation in which their faculty was hiring a new faculty member in the area of information and communications technology, and they were not even consulted or asked to sit on the hiring committee.

Early adopters offered some solutions for bridging the gap between themselves and mainstream faculty. One early adopter suggested providing training and support to increase the comfort level and how-to knowledge of other faculty so they can approach any piece of software and figure it out (i.e., perhaps to become more like an early adopter?). One individual called for increased standardization of hardware, software, and networking in order to make it very convenient for faculty and students to use the technology, and increase the amount of "just in time" training and support by building more critical mass technology skill and knowledge on campus. Another proposed solution from an early adopter was to give experienced faculty members course reductions so that they can invest time creating and developing technology-enhanced curricula that can be standardized throughout a department or faculty. In some cases, early adopters had strong opinions about why mainstream faculty do not adopt technology that may be inaccurate and not supported by research, such as other faculty are too old and fearful about their jobs to adopt. However, the one characteristic that all early adopters appeared to have in common was a willingness to share their knowledge and expertise in some way to encourage further adoption of technology by peers.

The interviews proved to be a valuable way to gather in-depth information from and about early adopters. Rogers (1995) calls for more diffusion research into the "why" or motivations for adopting an innovation, and interviews with early adopters extend our understanding of and provide insight into the early adopters motivation to integrate technology. A comparison of the interviews reveals that early adopters have both common and unique: (1) values, beliefs and characteristics, (2) expectations about outcomes and benefits from integrating computer technology, (3) integration processes to attain outcomes, (4) specific instructional strategies that support educational processes, and (5) motivators and impediments to integrating computer technology.

Acknowledgements

Financial assistance for this work has been made available by the Social Sciences and Humanities Research Council, and The University of Calgary Graduate Scholarships Committee. Thanks are also due to the faculty members for their participation in interviews and the examples used to illustrate this article.

References

Andrews, J., Garrison, D. R., & Magnusson, K. (1996). The teaching and learning transaction in higher education: A study of excellent professors and their students. *Teaching in Higher Education, 1* (1), 81-103.

Bereiter, C., & Scardamalia, M. (1993). *Surpassing Ourselves: An Inquiry Into The Nature And Implications Of Expertise.* Chicago, IL: Open Court Publishing.

Jacobsen, D. M. (1998). *Adoption Patterns and Characteristics of Faculty Who Integrate Computer Technology for Teaching and Learning in Higher Education.* Doctoral Dissertation, Educational Psychology, University of Calgary. [On-line]. Available: http://www.acs.ucalgary.ca/~dmjacobs/phd/diss/

Kearsley, G. (1996). Teaching excellence: The foundation for technology effectiveness. Educational Technology Review, 6, 24-27.

Norman, D. A. (1993). *Things That Make Us Smart: Defending Human Attributes In The Age Of The Machine.* New York: Addison-Wesley.

Rogers, E. M. (1995). *Diffusion of Innovations.* (4th ed.). New York: Free Press.

Sternberg, R. J. (1997). *Teaching Introductory Psychology: Survival Tips From The Experts.* Washington, DC: American Psychological Association.

Designing a WWW-based Course Support Site for Learners with Different Cultural Backgrounds: Implications for Practice

Karen Jager
Distance Education and Technology
University of British Columbia
Vancouver, Canada
karen.jager@ubc.ca

Bettty Collis
Faculty of Educational Science and Technology
University of Twente
Enschede, The Netherlands
Collis@edte.utwente.nl

Abstract: The acceptance, use of and impact of learning resources are influenced by culture. This article presents ten design guidelines for culture-related flexibility in WWW-based course support sites and shows how they can work in practice. Two case studies, one from the University of Twente and one from the University of British Columbia, both involving WWW-based course-support sites designed for a culturally diverse group of learners, are described and related to the proposed guidelines.

Introduction: Culture and WWW-based Course-Support Sites

The WWW has the potential to make the world more global, which creates the possibility to deliver courses to students all over the world. But can you use the same course for all these students? Will they all react the same to your course? The answer to this question is most likely to be no. Earlier research has shown that the acceptance, use of, and impact of learning interventions are influenced by culture (Jin & Cortazzi, 1998; Watson, Ho & Roman, 1994). As WWW-based course-support sites are an example of such a learning intervention, their acceptance, use, and impact will be influenced by culture-related aspects (Collis, 1999). These cultural aspects can affect the reactions of the institution, the instructor, and the learners to the WWW sites. This implies that it is important for educational designers to consider the question how such sites can be designed to adapt to different expectations and learner preferences, especially those related to culture.

What are these culture-related aspects? Culture can be defined in many ways, but a pervasive view seems to be that culture involves the "beliefs, value systems, norms, mores, myths and structural elements of a given organisation, tribe or society" (Watson, Ho & Roman, 1994, p.45) that manifest itself in the shared and identifiable ways in which a group interprets and reacts to its environment. The influence of culture on the reactions to a WWW-based course-support site occurs at a number of levels: the level of society, the personal level, the organizational level, and the level of the discipline being taught. Several authors have presented analyses of the influence of different cultural levels on the acceptance, use, and impact of different types of learning support (see Collis, Vingerhoets & Moonen, 1997; Henderson, 1996; Reeves & Reeves, 1997).

However, based on the character of these efforts, Wild (1999) reaches the conclusion that research in the domain of the two-way interaction between culture and learning in distributed networks such as the Web is at an early stage of development. There seems to be a need for guidelines for the design of culturally appropriate WWW-based course-support sites (Wild & Henderson, 1997). Collis (1999) responds to this need by providing ten design guidelines for culture-related flexibility in WWW-based course support sites.

This article presents ten design guidelines for culture-related flexibility in WWW-based course support sites and shows how they can work in practice. Two case studies, one from the University and Twente and one from the University of British Columbia, both involving WWW-based course-support sites designed for a culturally diverse group of learners, are described and related to the proposed guidelines.

Guidelines for the Increase of Culture-Related Flexibility in the Design of WWW-Based Course-Support Sites

The following guidelines are a combined result of the analysis of research literature and several years of experience at the Faculty of Educational Science and Technology at the University of Twente with the use of WWW-based course support sites with a culturally diverse group of students (Collis, 1999). The ideas presented here are not only related to adapting to cultural differences, but also to adapting to learner differences in general, in other words to good instruction in general. However, in this article the comments are directly focused to cultural differences, rather than stated at a more general level, in order to assist those who are particularly working with culturally diverse student groups.

1. Plan for flexibility and adaptation right from the start (Griffiths, Heppell, Millwood, & Mladenova, 1994)
2. Design for a variety of interchangeable roles for both instructors and students and offer support for an eclectic variety of types of learning experiences (Henderson, 1996).
3. Use different media for the students in the most appropriate way. For example, use books and print materials as primary study materials, instead of expecting the students to get this information on-line if access time to a computer and/or a network are likely to be limited (Collis & DeBoer, 1998; Griffiths et al., 1994)
4. Use the site to supplement study materials and to integratc and manage student study activities, not to replace the teacher (Collis & Remmers, 1997; Collis, Vingerhoets & Moonen, 1997).
5. Emphasize student and instructor input and make use of a wide variety of learning resources (Collis, Vingerhoets, & Moonen, 1997).
6. Design for minimal technical levels: minimal levels of technical support, and of computer-related skills and competencies, both for students and instructors.
7. Limit the amount of communication, such as text and pictures, that is pre-set in the system, so that adaptations to different cultures are simplified (Griffiths et al., 1994).
8. Provide tools so that the instructor and the students can tailor communication and interactivity expectations and approaches (Collis & Remmers, 1997).
9. Design for flexibility in the organization of courses. For example, differences in length or in examination/ assessment requirements (Collis, Vingerhoets & Moonen, 1997).
10. Be realistic about what instructors can and will do, in terms of time and skills (Collis, 1998).

How can these guidelines be applied in practice? The next two sections describe two examples of the design of WWW-based course-support sites planned to be appropriate for learners representing a number of different cultural backgrounds.

The TeleTOP Method: An Example from the University of Twente

The TeleTOP Method has been developed at the Faculty of Educational Science and Technology at the University of Twente in the Netherlands during 1997-1998 and is being used to redesign all of the courses in the Faculty for more flexibility. The first- and second-year courses are in full operation and the remainder of the courses, including courses for the Masters programme for international students, are in the process of re-design (Collis, 1998; see also http://teletop.edte.utwente.nl). Each first- and second-year course serves two cohorts: the regular students and what is called the "Friday" Cohort, mature students who work during the day and only come to the campus one every two weeks, on a Friday, when they attend face-to-face or practical activities with the other students in the course. The rest of the time these students participate in the course via the WWW sites. These WWW sites, however, are just as extensively used by the regular students as well; both cohorts just participate in different ways and within the cohorts students can also choose different forms of participation.

This flexibility is related to the different cultures of the students, in terms of their life experiences, educational backgrounds, ages, backgrounds, and work histories. There is also need to provide for flexibility related to instructors and subject-area characteristics. To provide for flexible responses to these different aspects, students have the choice of different instructional methods and learning resources as well as the more-familiar flexibilities of time and place. An increasing number of the courses now are offered to combinations of students in the regular and distance groups as well as non-Dutch students in the Masters program of the Faculty and foreign-exchange students visiting the university. Eight aspects of the TeleTOP Method can be identified that provide this flexibility:

1. The instructor is extended, not replaced, to make the current practice more flexible. It is assumed that not all instructors will follow the same approach to teaching.
2. The TeleTOP technical system is based on ease of use for instructor and students.
3. The WWW-based TeleTOP Decision-Support Tools (Collis & DeBoer, 1998) assist the instructor to choose WWW-site features tailored in form and combination to his or her own setting.
4. The matrix-like course roster and the course "communication centre" are standard features of the WWW sites, but can be tailored and adapted to the instructor's wishes (Collis & DeBoer, 1998).
5. Communication and presentations that happen in face-to-face settings can be made available as asynchronous streaming video, in whatever segments the instructor or students wish, via the WWW site for use at different times and/ or locations.
6. Courses are designed for "multiple use", a course is designed to teach once, adapt within for individual differences. In particular, to alter aspects related to assignments and study materials based on characteristics of groups of the students, but having all integrated within the same site.
7. Instructors are provided with an easy-to-apply analysis approach for the re-design process, based on concrete aspects of a course. They are encouraged only choose to use the WWW site when it offers added value compared to other media.
8. The *TeleTOP Rapid Prototyping Method* (Collis & DeBoer, 1998) involves instructors in the design and building of their own course-support sites at the same time as they develop their own skills and competencies in handling the sites.

As pointed out earlier, the TeleTOP method is being used to adapt a large number of courses, varying in instructional approaches, from project-oriented to skills training in programming, from courses focused on statistical methodologies and their applications to courses involving substantial amount of theoretical, conceptual materials. Besides this, the course-support sites include a wide diversity of WWW-based features, from very few to very many, and show a great diversity in how the instructors are using them and organizing their courses.

The Post-Graduate Certificate in Technology-Based Distributed Learning: An Example from the University of British Columbia

The post-graduate certificate in Technology-Based Distributed Learning is the result of a partnership created between the Virtual University of the Monterrey Institute of Technology (ITESM) in Mexico and the University of British Columbia (UBC) in Canada. The certificate consists of five graduate courses and was launched internationally in the fall of 1997. The five courses, on designing, developing and delivering technology-based distributed learning, are offered to several different target groups simultaneously. The first group consists of Masters students in the Educational Technology program at ITESM, originating from several Spanish-speaking countries including Mexico, Venezuela, and Chile. UBC offers the courses to UBC graduate students in the Masters in Education program as electives. In addition, international and Canadian students can take the courses as single non-credit courses or as part of the post-graduate certificate. Finally, audit status is also available. This all makes up for a diverse group of students. The first course for example had students from 27 different countries (Bates & Escamilla de los Santos, 1997; Janes, 1999; see http://itesm.cstudies.ubc.ca).

Some characteristics of this program that relate to cultural flexibility are:

1. The courses are designed for "multiple use": designed to teach once, adapt within for individual difference. In particular, the same site is used for both the ITESM side and UBC side, but for example each institution has its own discussion groups.
2. The technology used in the course is a combination of print (textbooks and selected readings), a WWW site (consisting of a study guide, original teaching materials, online discussion groups, online resources (online articles, journals, access to the extension library), a bookmark database (created mainly by students), student and instructor biographies, and assignment questions) and email. In one of the courses a purpose-designed CD-ROM is used.
3. The technical environment consists of a separate, advanced Web Server and a user-friendly WWW-based user interface developed using WebCT software.
4. The core component for each of the courses is the online discussions about key issues created in the WWW Site forums. Students are encouraged to participate actively in the discussions and course assignments are tied directly to the online discussion activity.
5. The course WWW sites share common features as mentioned in the first four points, but are tailored and adapted for each individual course. For example, the design of the discussion forums varies from course to course.
6. Students are assessed both for individual work and for (on-line) group work. International collaboration is encouraged, for example by forming small groups consisting of Canadian, Mexican, and international students.
7. Tutors play an important role. Students are divided in different tutor groups of about 15-20 students. In addition to that, each course has some internationally renowned guest tutors, often the authors of the texts or readings used. Video-conferencing sessions are organized between ITESM students and UBC tutors.
8. Communication between the participant takes place in several ways, via online discussion forums, email, and chat sessions for online group work.

The fifth and final course is being offered for the first time this fall. All the other courses have been offered at least once, and some two or three times. The first course has been evaluated as part of a two-year study entitled "Developing and applying a cost-benefit model for assessing telelearning" and showed positive results regarding meeting the needs of the different target groups (Bartolic-Zlomislic & Bates, 1999).

Relating the two case studies and the design guidelines

How culturally appropriate are these two case studies? How well do they relate to the ten proposed guidelines for the design of culture-related flexibility in WWW-based course-support sites? Table 1 shows the result of the mapping of the guidelines with the characteristics of the described cases. The numbers in the columns related to the cases correspond to the numbers in the lists of case characteristics above.

Table 1 provides different examples of how to put the ten design guidelines into practice. Besides that it indicates a good fit between the two case studies and the proposed guidelines. There are differences, however. The TeleTOP approach involves many more courses, of different types, than the set of courses in the ITESM. However, the ITESM course involves more cultural differences in terms of land of residence and language than is the case in many of the TeleTOP courses. The TeleTOP approach puts the major responsibility for cultural adaptation in the hands of the individual instructor, whereas the ITESM courses are coordinated among themselves, with a small number of course instructors and coordinators sharing the responsibility. The TeleTOP courses offer a wider variety of flexibility options, compared to the ITESM courses, which assume all students will participate in forum discussions. Despite these differences in context, both cases show how flexibility options can increase responsiveness to cultural differences among students and instructors when sharing a WWW-based course-support environment.

Culture-related Design Guidelines (Collis, 1999)	*TeleTOP Method*	*Certificate in Technology-Based Distributed Learning*
1 Plan system for flexibility	1 Plan for differences in teaching approaches and make current practice more flexible 2 Easy-to-use TeleTOP system 3/4 Plan for instructors to make their own choices regarding features of WWW sites 6 One course, multiple-uses concept	1 One course, multiple-uses concept 2 User-friendly interface 5 Adaptations for different courses
2 Support a variety of roles for instructors and students and easy change in these roles	1 Plan for different teaching approaches 4 Plan for instructors to make their own choices regarding features of WWW sites	6 Different forms of assessment
3 Use different media according to appropriateness	7 Only choose to use WWW site when it offers added value compared to other media	2 Different technologies used
4 Use the site to support and supplement the course, not to replace the teacher	1 Extend the teacher, not replace 4 Adapt the course site to the instructor's wishes 5 Asynchronous access to synchronous activities when and where wanted	7 Important role for tutors 1 Spanish speaking tutor groups for ITESM
5 Emphasize student and instructor input and use a wide variety of learning resources	2 Easy-to-use TeleTOP system 4 Possibility to supplement sites by anything available via the WWW and any kind of file made by instructor or student	2 Different technologies used and access to WWW resources via WWW site 3 User-friendly interface 4 Importance of online discussions
6 Make technical aspects of using the system as easy as possible	2 Easy-to-use TeleTOP system 8 Rapid prototyping technique involves instructors in the design and building of their own course-support sites	3 User-friendly interface
7 Have a minimal amount of fixed communication, so that adaptation is anticipated	6 One course, multiple-uses concept	1 One course, multiple-uses concept
8 Let the instructor and students tailor the communication and interaction approach	3 Decision-support tools to assist instructors in designing the course site as they want it	8 Different communication tools available
9 Design for flexibility in organization of courses	6 One course, multiple-uses concept	1 One course, multiple-uses concept
10 Be realistic about what instructors can and will do	2 TeleTOP technical system 8 Rapid prototyping technique	3 User-friendly interface 7 Small tutor groups

Table 1: Relating the *TeleTOP method* and *the Post-Graduate Certificate in Technology-Based Distributed Learning* to the design guidelines for culture-related flexibility in WWW-based course support sites

Conclusions

Cultural sensitivity is important in any teaching and learning situation involving participants from different backgrounds and with different life experiences. Designers and instructors should be aware of cultural differences, in what people do, how they react, to what extent they accept different reactions from different people. For example, in some cultures it is normal to criticize others and their work, in other cultures it is not. In some cultures it is normal to work in heterogeneous groups, in others not. The expectations of what comprises a good student, a good instructor, and a good learning situation vary as well. WWW-supported courses have the potential and often the intention of reaching greater number of culturally diverse students. The key to success in crossing these cultural boundaries lies in the appropriate design of the online environments (Henderson, 1996). "It is apparent however that instructional design for Web-based learning systems cannot and does not exist outside of a consideration of cultural influences- both the cultural influences operating on the authors and instructional designers of Web-based learning materials, and similarly, those influences that impact on the interpretation of such materials by learners" (Wild, 1999, p. 197). We believe that increased flexibility is a necessary base for better cultural sensitivity in the courses. However, it is not sufficient. The skill and sensitivity of the course instructor or moderator remains a central variable.

References

Bates, A.W., & Escamilla de los Santos, J.G. (1997). Crossing boundaries: Making global distance education a reality. *Journal of Distance Education, 12*(1/2), 49-66.

Bartolic-Zlomislic, S., & Bates, A.W. (1999). *Assessing the costs and benefits of telelearning: A case study from the University of British Columbia*. Vancouver, Canada: Distance Education and Technology, the University of British Columbia.

Collis, B. (1998). New didactics for university instruction: Why and how. *Computers and Education, 31*(4), 373-395.

Collis, B. (1999). Designing for differences: Cultural issues in the design of course-support sites. *British Journal of Educational Technology, 30*(3), 201-215.

Collis, B., & DeBoer, W.F. (1998). Rapid prototyping as a faculty-wide activity: An innovative approach to the redesign of courses and instructional methods at the University of Twente. *Educational Media International, 35* (2), 117-121.

Collis, B., & Remmers, E. (1997) The WWW in education: Issues related to cross-cultural communication and education. In B. Khan (ed.) *Web-based Instruction* (pp. 85-92). Englewood Cliffs, NJ: Educational Technology Publications.

Collis, B., Vingerhoets, J., & Moonen, J. (1997). Flexibility as a key construct in European training. *British Journal of Educational Technology, 28*(3), 199-218.

Griffiths, D., Heppell, S., Millwood, R., & Mladenova, G. (1994). Translating software: What it means and what it costs for small cultures and large cultures. *Computers and Education, 22*(1/2), 9-17.

Henderson, L. (1996). Instructional design of interactive multimedia: A cultural critique. *Education Technology Research and Development, 44*(4), 85-104.

Janes, D.P. (1999). Techniques and strategies for international group work: An online experience. In A. Ellis, R. Hall & J. Li (Ed.), *N.A. WEB'99 Web-based learning: What works and why! Proceedings of N.A. WEB'99. Fifth International North America World Wide Web Conference* (pp. 99-107). Fredericton, New Brunswick: University of New Brunswick.

Jin, L., & Cortazzi, M. (1998). Dimensions of dialogue: Large classes in China. *International Journal of educational research, 29,* 739-761.

Reeves, T., & Reeves, P. (1997). Effective dimensions of interactive learning on the World Wide Web. In B. Khan (ed.), *Web-based Instruction* (pp. 59-66).Englewood Cliffs, NJ: Educational Technology Publications.

Watson, R. T., Ho, T.K., & Raman, K. S. (1994). Culture: A fourth dimension of group support systems. *Communications of the ACM, 37* (10), 45-55.

Wild, M. (1999). Editorial: Accommodating issues of culture and diversity in the application of new technologies. *British Journal of Educational Technology, 30*(3), 195-199.

Wild, M., & Henderson, L. (1997). Contextualising learning in the World Wide Web: Accounting for the impact of culture. *Education and Information Technologies, 2,* 179-192.

LEARNER'S COGNITIVE CONSTRUCTION IN A WEB-COURSEWARE

Hueyching Janice Jih
Associate Professor, Department of Educational Technology,
Tamkang University, Taipei. Taiwan
jih@mail.tku.edu.tw athens@ms1.url.com.tw

Abstract

Web-based courseware is an alternative approach to provide ideal learning opportunities that empower the symbol systems and mental processing capabilities of learners. The quality of interface to courseware is a matter of vital importance to its learning effectiveness. The overall purpose of this study is to contribute to the understanding of how primary students learn in web-based courseware with respect to learners' interaction and their mental models (personal construct of interfaces) of the courseware.

This study utilized document analysis, observation, and interview methods for gaining insight into the learners' background information, their mental models of the construct of learning activities in the courseware, their actual interactive behaviors during use of web-based courseware, and the results of that use. Qualitative analysis based on learners' behaviors and their explanations of the specific learning activity frame were used to explore the nature of their interactive behaviors, their instances of mental models in web-based learning environment. A summary of the study, discussion of the conclusions, implications of the study, and recommendations for further research form the focus of this report.
Keywords: Human-computer Interaction, Mental models

Background and Purpose

Interactive Learning on the Web

Advocates of active learning, collaborative learning and authentic projects make compelling arguments, but integrating these ideas with educational technology is a challenge. Internet technologies of e-mail, listservs and the web are remarkable vehicles for thrilling educational journeys.

Human beings are information processing systems and have a huge learning potential in a dynamic and irreversible changing world. Novak (1964) suggested that exploratory oriented learning is "the set of behaviors involved in the struggle of human beings for reasonable explanations of phenomena about which they are curious." Though the learning process involves hands-on activities and learning skills, "the focus is on the active search for knowledge or understanding to satisfy a curiosity" (Haury, 1993).

To arrive at an effective learning process and result has always been an ideal for educational technology professionals with the goal of conveying knowledge efficiently and accurately. Leaning is the outcome of ongoing changes in our mental frameworks while we actively make meaning out of our experiences (Osborne & Freyberg, 1985). Current theories on learning focus on the "active agent" role of learners who do not passively receive message delivered via instructional channels but who do actively explore phenomena and construct knowledge by themselves. Web-based learning environment is an option of such goal.

Learning context of web-based courseware can evoke learner's creation of analogies from previous experiences. Learners are likely to make meaning out of their interactive experiences, to interpret the verbal as well as visual information, to construct their mental frameworks, and to understand the natural facts as they work directly with virtual phenomena in the learning context.

HCI & Mental Models

Interactive learning is an emphatic concept and strategy for web-based learning; a learning party plays an active role in such process of learning. External events, learning activities on the web, might initialize or allure internal events in the learners.

Learners' perception and understandings of interfaces in terms of mental models is an important issue in investigations of web-based courseware performance (Shackel, 1997). Learners interact with the learning activities of any instructional media/technology to construct a mental model (symbolic representation) of the specific domain and to make inferences based upon representation processing. Kozma (1991) proclaimed that "Learning with media can be thought of as a complementary process within which representations are constructed and procedures performed, sometimes by the learner and sometimes by the medium. While some learners with appropriate prior knowledge can construct and use representations on their own with information obtained from any medium, other students can not benefit from media that are capable of providing representations and performing or modeling operations on them."

The human-computer interfaces to an courseware is the only channel, a window, an agent through which a learner has access to the learning opportunities provided by the courseware in terms of information content, medium elements, interactive learning activities, and functionality. An interface might facilitate, hinder, or totally block the desired interaction between a learner and the learning context. Therefore, the quality of interface to courseware is a matter of vital importance to its learning effectiveness.

The better we understand the ways learners interact with interactive courseware, the more we can develop effective and efficient courseware (Jih & Reeves, 1992). Research on mental models can identify salient characteristics of cognitive processes and help in the development of research-based guidelines for the design of effective courseware, thus linking the technology and instruction fields together.

Research Design

The aim of this study is to explore the attributes of learners' interpretations of visual representations and their cognitive construction in a web-based learning context with respect to cognitive, affective, as well as operational aspects of mental models in order to gain a deeper insight into the interaction processes within a web-based guided-discovery courseware.

The suitable four candidates for this study were selected from two elementary schools in Taipei metropolitan by Snowball technique. The term 'suitalbe' pertains to 5th-graders and 6th-graders whose schedule meets with those of this study with the consent of the subjects and their parents.

The web-based courseware, named The Heart of Earth, used in this study utilizes guided-discovery environment where learner can constructs personal meaning via attempting to interpret and explain time and space concepts of Earth Science from personal exploration, experiences, and understanding. Representation medium in interfaces of the "The Heart of Earth" are designed for the following purposes (Jih & Wang, 1998): An Attention Guide, A Context Builder, An Interaction Motivator, A Record Keeper, A Visual Reasoning Anchor, The Invisible Behaviors Manifestation, and A Message/ Feedback Provider.

Accepting the suggestions by Sasse (1991), the researcher used different approaches to measure learners' mental models: observing learners interacting with the courseware, asking learners to explain the courseware to a new learner (the teach-back technique), asking learners to predict feedback of the courseware, asking learners to describe interacting with the courseware, and observing learners interacting with the courseware with a co-learner.

Information collected from subjects includes their level of prior domain knowledge, observation and video-taping on their interaction processes, in-depth interviews, teach-back results, and their audit trials. Figure 1 presents the research settings of this study.

Findings and Conclusions

Multidimensional data analysis revealed the dynamics of mental-model development as subjects learn Earth science via the courseware. This study shows that a few tasks require learners shared decision-making and mutual dependence. High motivation among learners, which is a key to participate interactive tasks actively, can be achieved by presenting a current status of each one's progress. When learners are highly motivated, competitiveness develops spontaneously among different persons in the same class.

The characteristics of learners' mental models toward interfaces included exploration, topology, pattern, preference to audio/visual elements, and pictographic representation. In each learning activity within the courseware, specific patterns emerged. The mental model of the learners can be structured in representing objects to operate on, operations (actions and their syntax), content structure, functions or features, and the courseware states.

Learning is a function of the learner's individual differences, the interaction behaviors, the interfaces of courseware, the content to be learned, the technology issues, as well as the facilities, equipment, organizations, social context within a learning environment/organization/community (cf. Figure 2).

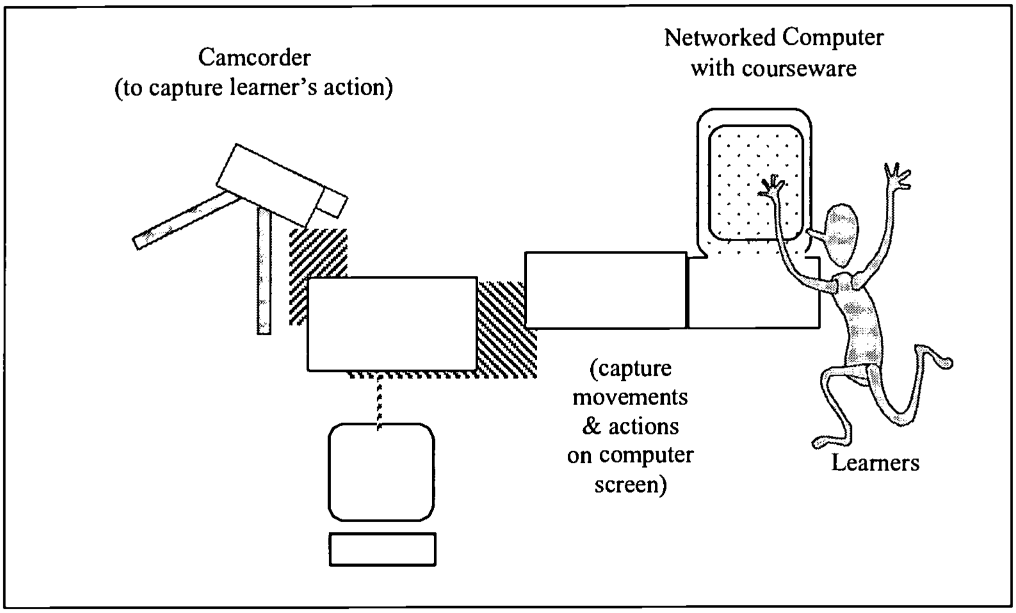


Figure 1. Research Settings

Learners have a variety of responses to computer interfaces, e.g., reflective, thoughtful, and changing. Learning is influenced by three dimensions of learners' mental models: (Abou Khaled et. Al., 1998; Ackerman, Sternberg, & Glaser, 1989; Ayersman & Reed, 1998; Iiyoshi & Hannafin, 1998; Nahl, 1998; Stark, Renkl, Gruber, & Mandl, 1998; cf., Figure 2.)

- ✧ *Cognitive factors* such as aptitude, ability, skill, prior knowledge, concepts, perspectives, educational level, experiences, and learning styles;
- ✧ *Affective factors* such as, values, self-efficacy, motivation, attitude, preferences, expectations, and anxiety; and
- ✧ *Psychomotor factors* such as eye-hand coordination and visual acuity.

Active participation is limited to those who are literate, those who have access to the technology, and those who are able to use the technology to filter information of value, bringing order out of chaos. This ability involves meta-cognitive skills that are not automatic.

Implications and Suggestions

In order to increase the learner's satisfaction and performance and to create high-quality interactive courseware, designers must take human factors, learner-courseware interaction into account with specific reference to perceptual, physiological, and psychological aspects (Corry, 1998; Suess, 1997).

It is argued that virtual learning in cyberspace possess new features of learning environments. Benefits of emerging virtual learning environments include new metaphors for navigation, better opportunities for knowledge construction, and better opportunities for knowledge transfer. However, future research is called for to more fully understand the potential impact of these features (Oliver, 1997).

Research issues on human-computer interaction could be broader. More studies on various factors, as shown on Figure 2, in order to further understand learners' mental models in an web-based learning environment are encouraged.

Figure 2. Factors Influencing Learning

Environment
Facilities, Equipment, Organizations, Social context, ...

Technology
Features, Equity, Accessibility, Ergonomics, ...

Content
Subject matters, Objectives, Hierarchical structure, Content infrastructure, Criteria, Teaching methods, Learning approaches, Functions, Consistency, Error handling, Pace control, Treatment, ...

Interface
Presentation of messages in text, graphics, animations, photos, videos, audio, Dialog/Queries, Induction devices, Evaluation, Feedback, Metaphor, Context, Screen Layout, Icons, Color, Spacing, Size, Font, Map, Help/Manuals, Bookmark, Notebook, Snapshot, Multi-windows

Interaction
Sensation, Perception, Information Processing, Response, Evaluate feedback...

Individual
Interpretations, experiences, expectations, satisfaction, habits, personality, abilities, goals, motivations, reading/visual/technical literacy,

Acknowledgement

The interactive WWW courseware "The Heart of Earth" was designed and developed in 1997-1998 in Taiwan. The research project described in this article was performed pursuant to grant from the National Science Council and the Computing Center, the Ministry of Education, Taiwan, R.O.C. The opinions expressed herein do not necessarily reflect the position or policy of the NSC, MOE, nor the Tamkang University, and no official endorsement by any group should be inferred. The author wishes to deliver special thanks to teachers of Hsin-Der and Tang-Kon Elementary Schools for their collaboration in consulting subject matters and arranging data collection environments.

References

Abou Khaled, O., Pettenati, M. C., Vanoirbeek, C., & Coray, G. (1998). MEDIT: A Distance Education Prototype for Teaching and Learning. Paper presented at the 3rd WebNet 98 World Conference of the WWW, Internet, and Intranet, Orlando, FL, November 7-12, 1998.

Ayersman, D. J., & Reed, W. M. (1998). Relationships among Hypermedia-Based Mental models and Hypermedia Knowledge. Journal of Research on Computing in Education, 30(3), pp.222-238.

Corry, M. D. (1998). Mental models and Hypermedia User Interface Design. Educational Technology Review, 9, pp.20-24.

Iiyoshi, T., & Hannafin, M. J. (1998). Cognitive Tools for Open-Ended Learning Environments: Theoretical and Implementation Perspectives. Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA, April 13-17, 1998.

Jih, H. J, & Whang, S. K. (1998). Emporing interactive learning with contextual interfaces in the Heart of Earth web course. Paper presented at the WebNet98 (World Conference of the WWW, Internet, & Intranet), by Association for the Advancement of Computing in Education (AACE), Orlando, Florida, USA, November, 7-11, 1998.

Jih, H. J., & Reeves, T. C. (1992). Mental Models: A Research Focus for Interactive Learning Systems. Educational Technology, Research and Development; 40(3), 39-53.

Kozma, R. B. (1991). Learning with media. *Review of Educational Research, 61*(2), 179-212.

Nahl, D. (1998). Learning the Internet and the Structure of Information Behavior. *Journal of the American Society for Information Science,* 49(11), pp.1017-1023.

Novak, A. (1964). Scientific inquiry. Bioscience, 14: 25-28.

Sasse, M. (1991). How to t(r)ap users' mental models. In M. J. Tauber & D. Ackermann (Eds.), Mental models and human-computer interaction 2. Human Factors in Information Technology No. 7. Amsterdam, North-Holland: Elsevier Science Publishers B.V.

Oliver, K. M. (1997). A Critical Analysis of Hypermedia and Virtual Learning Environments. ERIC ED412925.

Osborne, M., & Freyberg, P. (1985). Learning in science: Implications of children's knowledge. Auckland, New Zealand: Heinemann.

Shackel, B. (1997). Human-Computer Interaction--Whence and Whither? Journal of the American Society for Information Science, 48(11), pp.970-986.

Stark, R., Renkl, A., Gruber, H., & Mandl, H. (1998). Indeed, Sometimes Knowledge Does Not Help: A Replication Study. Instructional Science, 26(5), pp.391-407.

Suess, A. P. (1997). Designing the User Interface. Journal of Interactive Instruction Development, 10(2), pp.28-33.

An Interactive History as Reflection Support in Hyperspace

Akihiro Kashihara, Shinobu Hasegawa, and Jun'ichi Toyoda
The Institute of Scientific and Industrial Research
Osaka University, JAPAN
kasihara@ai.sanken.osaka-u.ac.jp

Abstract: The main problem addressed in this paper is how to help learners reflect on knowledge that they have constructed during exploration in hyperspace. In this paper, we describe an interactive history that encourages learners to annotate and reconstruct their exploration history to reflect on what and why they have explored so far. The interactive history also generates a knowledge map proper to the annotated/reconstructed exploration history. It can be viewed as a potential support for constructive learning in hyperspace.

Introduction

Hypermedia/hypertext based learning resources generally provide learners with a hyperspace within which they can explore the domain concepts/knowledge in a self-directed way (Conklin 1988, Kashihara et al. 1997). The exploration often involves making cognitive efforts at constructing the knowledge from the contents that have been explored (Thuering, Hannemann, & Haake 1995). These cognitive efforts would enhance learning (Carroll et al. 1985). However, learners often fail in knowledge construction since what and why they have explored so far become hazy as the exploration progresses. To what extent the learning has been carried out also becomes unclear. This is a frequently experienced problem of learning in hyperspace (Nielsen 1990).

A possible resolution of this problem is to encourage learners to reflect on what they have constructed during exploration in hyperspace (Tauscher & Greenberg 1997, Thuering, Hannemann, & Haake 1995). The reflection also involves rethinking the exploration process that they have carried out since it has a great influence on their knowledge construction. In particular, exploration purposes, which mean the reasons why the learners have searched for the next node in hyperspace, play a crucial role in knowledge construction (Kashihara, Uji'i, & Toyoda 1999, Murray et al. 1999). For instance, a learner may search for the meaning of an unknown term to supplement what is learned at the current node or look for elaboration of the description given at the current node. Each exploration purpose would provide its own way to shape the knowledge structure. The reflection support accordingly needs to adapt to the exploration activities and the knowledge structure being constructed by the learners.

In this paper, we discuss a proper reflection support with a careful consideration of exploration process in hyperspace. This paper also describes an interactive history for learning with hypermedia/hypertext based learning resources on the Web. The interactive history system provides learners with their exploration history annotated with exploration purposes that have arisen during exploration. It also transforms the annotated exploration history into a visual representation called knowledge map. It spatially shows semantic relationships among WWW pages the learners have visited (Kashihara, Uji'i, & Toyoda 1999). Using the interactive history system, the learners can view and reconstruct the exploration history to rethink their exploration process that they have carried out so far. They can also view the knowledge map to reflect on what they have constructed in hyperspace. Before discussing the interactive history, let us first consider exploration process in hyperspace and how we can represent it.

Exploration in Hyperspace

In hyperspace, learners generally start exploring from one node to others by following links among the nodes with a learning purpose. The movement between the nodes is often driven by a local purpose called exploration purpose to search for the node that fulfills it. Such exploration purpose is also regarded as a sub purpose of the learning purpose. We refer to the process of fulfilling an exploration purpose as primary exploration process, which is represented as a link from the starting node where the exploration purpose arises to the terminal node where it is fulfilled.

Exploration Purposes	Visual Representation
Supplement	Inclusion
Elaborate	Set or Part-of tree
Compare	Bidirection arrow
Justify	Vertical arrow
Rethink	Node superposition
Apply	Arrow

Starting node Terminal node

Table 1: Exploration Purposes and Visual Representation.

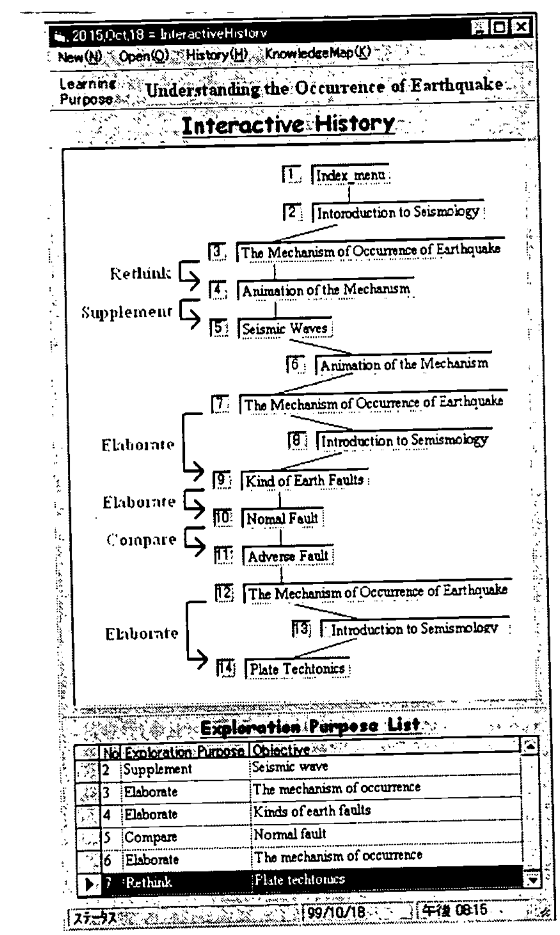


Figure 1: An Exploration History.

An exploration purpose may have several terminal nodes with one starting node. Exploration purpose, represented as verb, signifies how to develop or improve the domain concepts and knowledge learned at the starting node. We currently classify exploration purposes as shown in Table 1, which are not investigated exhaustively.

An exploration purpose arising from visiting a node is not always fulfilled in the immediately following node. In such case, learners need to retain the purpose until they find the appropriate terminal node/s. While searching for the fulfillment of the retained purpose, it is possible for other exploration purposes to arise. The need to retain several exploration purposes concurrently makes the knowledge construction more difficult to achieve.

The exploration process can be modeled as a number of primary exploration processes. Let us give an example where a learner uses a hyperdocument on a WWW server with the learning purpose of understanding the occurrence of earthquake. In this example, he/she explores a number of nodes (WWW documents) with various exploration purposes. Figure 1 gives the exploration history, which shows the sequence of the nodes visited and primary exploration processes. For example, he/she visited the node "Animation of the Mechanism" in order to rethink the description in the node "The Mechanism of Occurrence of Earthquake". He/she then visited the node "Seismic Wave" since he/she did not know the meaning of the term used in the previous node.

Exploring hyperspace in a self-directed way, learners construct a knowledge structure that is often different from the structure of hyperspace (Thuering, Hannemann, & Haake 1995). The knowledge structure is shaped according to primary exploration processes, especially the exploration purposes. Each exploration purpose provides its own way to shape the knowledge structure (Kashihara, Uji'i, & Toyoda 1999).

Interactive History

Problems Addressed

Let us now discuss what kind of reflection support is indicated by the above consideration. There are the following important problems to be addressed towards a proper reflection support. The first issue is how to help learners retain the primary exploration processes that they have carried out. The retention may cause cognitive overload on exploration. It is also hard for computer to infer their exploration purposes, which arise in the learners' mind. These suggest that learners should be encouraged to note down the primary exploration processes.

The second problem is how to assist learners in reconstructing their exploration process. In reflecting on their exploration process, they would not only look at it but also modify/delete the primary exploration processes and add new primary exploration processes. It is accordingly necessary to provide learners with a space where they can reconstruct their exploration process after exploring hyperspace.

The third problem is how to help learners reflect on knowledge constructed during exploration. One way to resolve this is to visually represent semantic relationships among nodes included in primary exploration processes. Such representation does not obviously show the contents included in the explored nodes. However, this would be a useful map for the learners to reflect on what they have learned. We accordingly call it knowledge map.

In order to resolve the above problems, we have developed an interactive history that helps learners reflect on their exploration process and knowledge structure by means of an exploration history annotated with primary exploration processes.

Annotated Exploration History

In order to help learners note down and retain primary exploration processes during exploration, the interactive history system provides them with a user interface as shown in Figure 2. They explore hyperdocuments on a WWW server with one learning purpose in the left window. When they want to set up an exploration purpose in visiting a node, they are required to click one corresponding to the purpose in the "Exploration Purpose Input" section of the right window. The clicked purpose is added to the "Exploration Purpose List" section. The node visited currently is also recorded as the starting node of the exploration purpose.

The learners can also add the object of verb describing an exploration purpose. It means what to develop/improve in the current node whereas the exploration purpose specifies how to develop/improve. When the learners do not add this object, the system adds the title of the current node, which is the title tag in the HTML file. When the learners find a terminal node of the exploration purpose, they are required to mouse-select the exploration purpose in the "Exploration Purpose List" section, and to push the "Fulfilled" button. The node visited currently is then recorded as the terminal node of the exploration purpose.

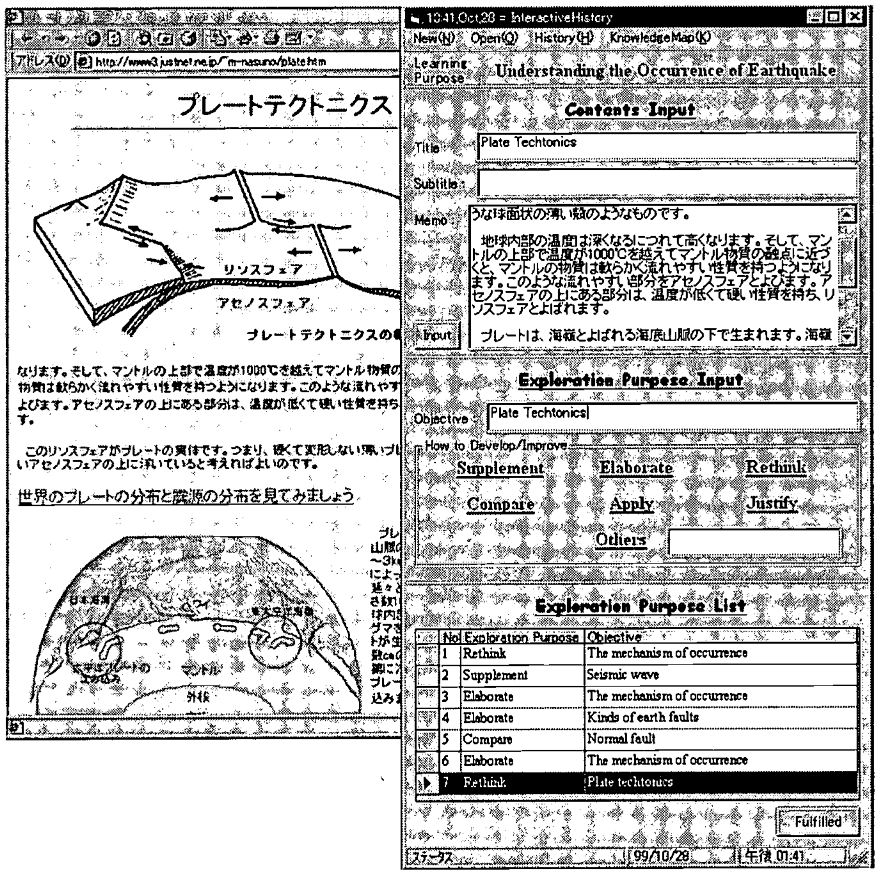


Figure 2. User Interface.

The system also provides another support for helping learners store part of the contents of the node visited currently with Cut&Paste function in the "Contents Input" section although they may not always need this support. In hyperdocuments on WWW, in addition, the title tags of the nodes do not always represent the contents of the nodes. If the learners want to change the node titles, they can input new titles in the "Contents Input" section, which new titles should represent the contents thc learners explored in the nodes.

Using the information inputted from the learners, the system generates the annotated exploration history as shown in Figure 1. In the annotated history, the nodes learners visited are sequenced in order of time. The starting node of each purpose is linked with the corresponding terminal node/s. There may be some primary exploration processes without terminal nodes since they have not been found yet. They can also click the nodes in the history to review the contents information, which they have inputted with Cut&Paste function.

Learners are not always required to input the above information whenever they visit nodes. Nevertheless, inputting the information during exploration may be troublesome for learners. On the other hand, it enables the learners to make their exploration more constructive, facilitating their exploratory learning. Without inputting, they may only browse in hyperspace.

History Manipulation

Directly manipulating the annotated exploration history, learners can reconstruct their exploration process without revisiting hyperspace. Each manipulation is done by means of mouse-clicking/dragging parts of the primary exploration processes. There are three basic manipulations: deleting and changing exploration purposes/links between starting and terminal nodes, and adding new primary exploration process.

Knowledge Map

The representation of knowledge map follows the visualization scheme shown in Table 1, which shows the correspondence of an exploration purpose to a visual representation of the relationship between the starting and terminal nodes. For example, an exploration purpose to 'Elaborate' is transformed into a set that visualizes the starting node as a total set and the terminal node as the subset. Following such correspondence, the system generates a knowledge map from the annotated exploration history. The knowledge mapping is executed on learners' demand before/after manipulating the annotated exploration history.

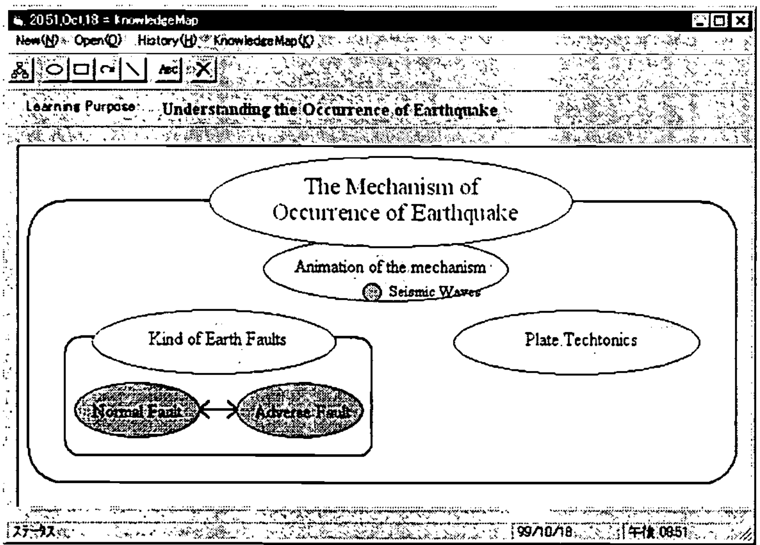


Figure 3. Knowledge Map.

Figure 3 shows an example of the knowledge map that is generated from the annotated exploration history shown in Figure 1. Viewing this map, the learner can reflect on his/her knowledge construction. For example, he/she can recall that he/she rethought the mechanism of earthquake occurrence by looking at the animation of the mechanism. He/she can also recall that he/she compared normal fault and adverse fault to elaborate the description about kind of earth faults.

Related Work

Let us next discuss the usefulness of the interactive history compared with related work on reflection support in hyperspace. As the retention support, there are several kinds of annotation systems that allow learners to take a note (Brusilovsky 1996). However, there is very little discussion of what kind of annotation should be done for the success in exploratory learning. In the interactive history, we claim that the reasons why learners search for the next nodes should be particularly noted down.

Current work on adaptive hypermedia/hypertext systems has often provided spatial maps and concept maps, which are originally used as navigational aid. Spatial maps can inform learners where they are, what they explored, and to what extent they explored (Domel 1994). However, the reasons why they visited the nodes are not clearly shown. In addition, these maps are not very helpful since learners do not need to learn the structure of hyperspace. Concept maps are more helpful for learners who have lower capability of exploring hyperspace since the direction of knowledge construction is presented to them (Gaines & Shaw 1995). However, learners who have higher capability of exploratory learning may not always construct the same knowledge structure as the structure of domain concepts that the designers of concept maps draw. In hyperspace, learners are free to identify relationships among the domain concepts visited in a self-directed exploration, and these relationships may be different to those defined in the concept maps (Thuering, Hannemann, & Haake 1995). The interactive history, on the other hand, provides them with a more proper support since it enables self-directed exploration. In addition, the reflection support can be provided even in ill-structured domains of which concept maps cannot be defined.

Conclusions

This paper has claimed that exploratory learning in hyperspace requires learners to reflect not only what but also why they have explored, and that the reflection support needs to adapt to their exploration process and knowledge structure being constructed by them.

This paper has also demonstrated the interactive history with knowledge mapping as a proper reflection support. The interactive history encourages learners to annotate and manipulate the exploration history to rethink their exploration process. It also generates a knowledge map from the annotated exploration history, which allows the learners to reflect on what they have constructed during exploration.

In the future, we need to evaluate and refine the interactive history. We would also like to classify exploration purposes in more detail and to represent learners' exploration process and knowledge structure more precisely.

References

Brusilovsky, P. (1996). Methods and Techniques of Adaptive Hypermedia. *Journal of User Modeling and User-Adapted Interaction*, 6, 87-129.

Carroll, J., Mack, R., Lewis, C., Grischkowsky N., & Robertson S. (1985). Exploring exploring a word processor. *Journal of Human-Computer Interaction*, 1, 283-307.

Conklin, J. (1988). Hypertext: An Introduction and Survey, *Computer*, 20, 9, 17-41.

Domel, P. (1994). WebMap - A Graphical Hypertext Navigation Tool. *Proceedings of Second International WWW Conference*, http://www.ncsa.uiuc.edu/SDG/IT94/Proceedings/Searching/doemel/www-fall94.html.

Gaines, B.R. & Shaw M.L. G. (1995). WebMap: Concept Mapping on the Web. *Proceedings of Second International WWW Conference*, http://www.w3.org/ Conferences/WWW4/Papers/134

Kashihara, A., Kinshuk, Oppermann, R., Rashev, R., & Simm, H. (1997). An Exploration Space Control as Intelligent Assistance in Enabling Systems. *Proceedings of International Conference on Computers in Education '97*, 114-121.

Kashihara, A., Uji'i, H., & Toyoda, J. (1999). Visualizing Knowledge Structure for Supporting Exploratory Learning in Hyperspace. *Proceedings of HCI International 99*, 667-671.

Murray, T., Condit, C., Piemonte, J., Shen, T., & Kahn, S. (1999). MetaLinks - A Framework and Authoring Tool for Adaptive Hypermedia. *Proceedings of World Conference on Artificial Intelligence in Education '99*, 744-746.

Nielsen, J. (1990). The Art of Navigating Hypertext, *Communication of the ACM*, 33, 3, ACM Press, 297-310.

Tauscher, L., & Greenberg, S. (1997). How people revist web pages: empirical findings and implications for the design of history systems. *International Journal of Human-Computer Studies*, 47, 1, 97-137.

Thuering, M., Hannemann, J., & Haake, J.M. (1995). Hypermedia and Cognition: Designing for Comprehension. *Communication of the ACM*, 38, 8, ACM Press, 57-66.

Acknowledgments

This research is supported in part by Grant-in-Aid for Scientific Research from the Ministry of Education, Science, and Culture of Japan.

An Evaluation of Interactive Multimedia Designed to Support Problem-Based Learning in Medicine

David M. Kennedy
Centre for Learning and Teaching Support, Monash University, Australia
david.kennedy@CeLTS.monash.edu.au

Norm Eizenberg
Department of Anatomy and Cell Biology, The University of Melbourne, Australia
n.eizenberg@anatomy.unimelb.edu.au

Gregor E. Kennedy
Biomedical Multimedia Unit, The University of Melbourne, Australia
g.kennedy@med.unimelb.edu.au

Abstract: In the medical and health sciences, a well described problem for students is the linking of discipline-based knowledge with clinical practice. The CD-Rom, An@tomedia has been developed to support a problem-based learning curriculum in undergraduate medicine. An@tomedia contains four primary perspectives, imaging, dissection, systems and regions and is intended to address a variety of student learning needs and approaches to learning. The evaluation of An@tomedia by students, tutors and lecturers is described.

Introduction

The development of problem-based learning (PBL) in medical education has, historically, focused on the whole student learning experience rather than the acquisition of content (Camp, 1996). PBL has been advocated in order to address problematic issues attributed to traditional medical courses—the creation of an arbitrary division between the basic and clinical sciences, and wasting student time in learning facts that are easily forgotten or not relevant to clinical practice (Finucane, Johnson, & Prideaux, 1998). The teaching of anatomy at The University of Melbourne over the past 10 years has integrated the structure of the human body with its clinical applications. In 1999 the medical school moved to a problem-based learning curriculum. With the advent of new computer-based technologies the development of resources to support the PBL approach included an interactive CD-Rom designed to enrich and engage the student more actively in the learning of anatomy. The software, An@tomedia, provides greater interactivity for the student by providing multiple perspectives (e.g., systemic and regional views) of anatomical knowledge linked to clinical applications in an interactive computer-facilitated learning (CFL) environment. The perspectives provide a framework for students to integrate anatomical knowledge with clinical applications and procedural knowledge. The software allows students to switch between perspectives in order to facilitate their knowledge construction, and address clinically-based problems. This paper reports the results of an extensive evaluation of the CD-Rom, including qualitative and quantitative analysis.

Student learning and An@tomedia

> "When medical graduates enter the workplace, they are not faced with situations labelled 'anatomy', 'microbiology', or the like. They are faced with patients with illnesses ..." [Bowden, 1998, p. 129].

How subject matter is experienced and how the student subsequently organises and integrates knowledge, is dependant upon the student's perception of the learning context (Ramsden, 1984). Students may adopt a surface approach (e.g., learning by rote) or a deep approach (e.g., a holistic approach, actively searching for meaning) (Biggs, 1989; Marton & Säljö, 1984).

The learning process may be supported by appropriate learning opportunities, including the use of carefully designed computer-facilitated learning (CFL) within the context of a subject. An@tomedia is designed to enable students to interact with anatomical knowledge and principles, from multiple perspectives. The use of multiple perspectives (and multiple pathways) in CFL has been advocated in order to:

- allow learners to access the material in a manner more suited to her or his needs (Reeves, 1992),
- support higher levels of cognition (Ramsden, 1992), and
- support a more reflective approach to learning (Laurillard, 1993).

In order to provide a richer learning environment in An@tomedia, there was a need to embed clinical, procedures, imaging, surface anatomy, and dissection components within the software, and integrate these with the more traditional systemic and regional approaches to the learning of anatomy. Figure 1 (Fig. 1) is representative of the final educational approach adopted. In Figure 1 (Fig. 1), students may deconstruct the body using Dissection and Imaging, or construct the body via Systems and Regions. An example involving the back (the first module to be completed) is highlighted. The figure shows a model of the educational design of An@tomedia in a three-dimensional space. The X-axis represents the anatomical regions (only three regions of the body are shown), the Y-axis represents anatomical systems (only four are shown), and the vertical axis represents students ability to construct or deconstruct the body by dissection or imaging. Students may move freely between perspectives, answer questions, and investigate clinical problems about the back.

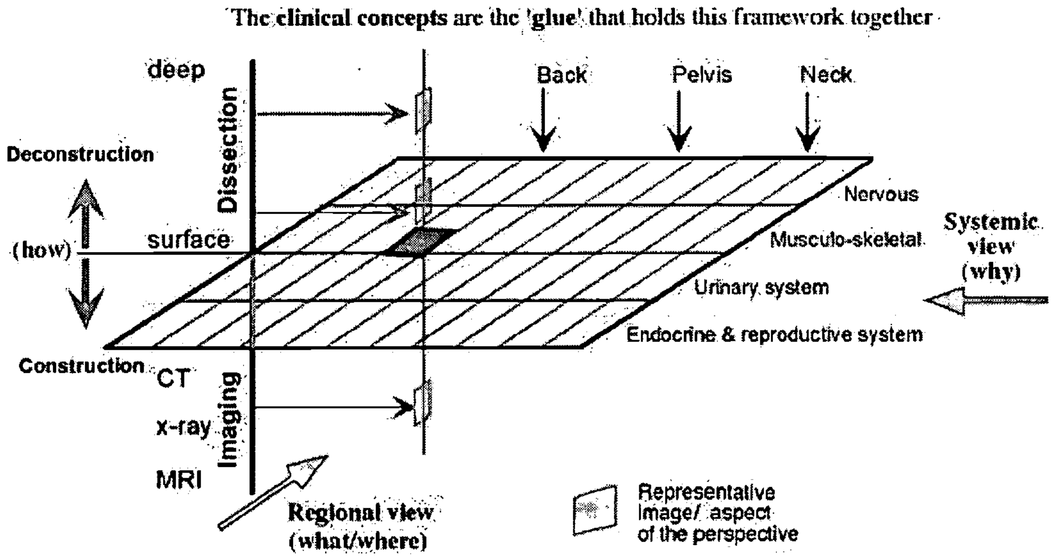


Figure 1: Graphical representation of the An@tomedia perspectives

Figure 2 (Fig. 2) shows the view seen by a student examining anatomy from one perspective, dissection. The remaining 3 perspectives are listed on the lower right—reached with a simple mouse click. There are questions for the student to answer (e.g., 'Can you identify a radicular artery'), and overlays of anatomical structures that may be highlighted by the student. The student may move between specific regions by clicking on the regions on the human symbol on the lower right.

In the An@tomedia CD-Rom, there is extensive linking of anatomical details with the clinical perspective. This has bccn done by the use of:

- high quality images (e.g., radiographs, detailed dissection images from real human bodies, and graphics with coloured overlays highlighting key anatomical details),
- integration of clinical questions and answers, and
- the facility for the student to examine anatomical concepts from multiple perspectives using multiple pathways.

The evaluation

The evaluation of An@tomedia has adopted a case study approach. The majority of the data was generated from students, their anatomy tutors, and content experts by the use of questionnaires comprising five-point Likert questions and open-ended free text responses.

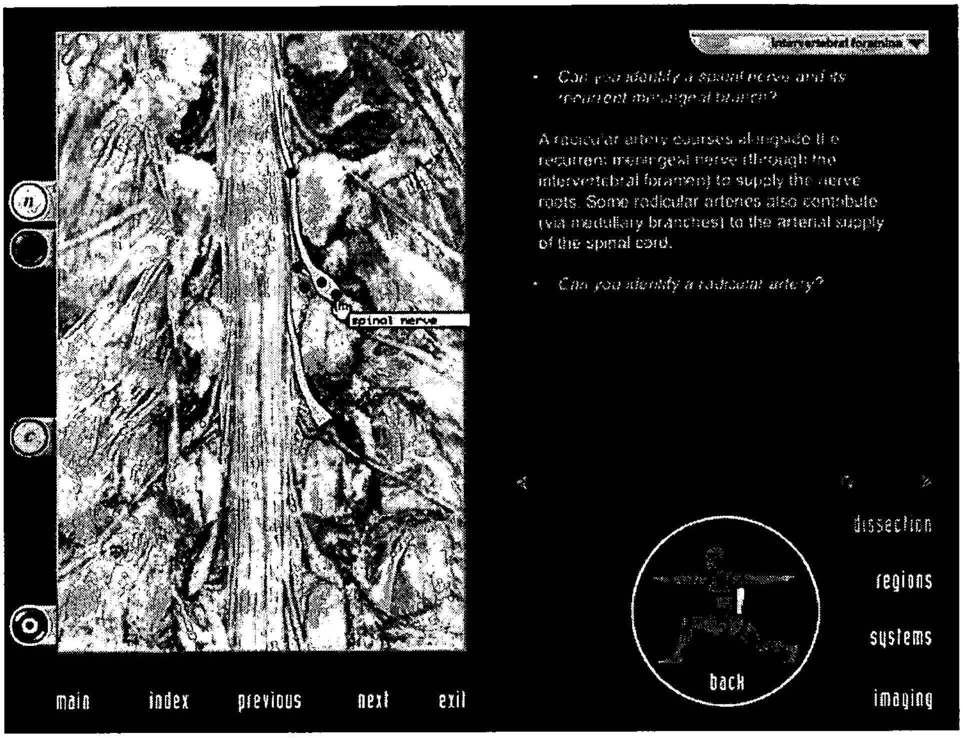


Figure 2: An image from the dissection perspective with identification questions, roll-overs, and overlays

The Likert-style questions in the student questionnaire overlapped approximately 60% with that of the tutors and lecturers (TLs). Some questions were more appropriate for students (e.g., It helped me understand anatomy) or TLs (e.g., I found the four perspectives were well balanced and integrated). Anatomy tutors and lecturers also answered specific questions on how they might use the CD-Rom as part of their own teaching program. An@tomedia is not intended as a replacement for an anatomy teaching program, instead it is intended to support integration of student knowledge, the anatomical with the clinical, and systemic with regional.

Results

The evaluation results highlight the strengths and potential weaknesses of the educational design of An@tomedia. Trends in the results suggest directions for improvement as well as the educational value of the multiple perspectives. Table 1 (Tab. 1) presents the mean scores and standard deviations of students (first column) and a combined tutors and content experts (second column). Responses were completed on five point Likert scales where a score of '5' was 'strongly agree', '4' was 'agree', '3' was 'neutral', '2' was 'disagree', and '1' was 'strongly disagree'. T-Tests were also undertaken to compare and contrast the student and combined tutor/lecturer (TL) responses. There was a ceiling effect for most items and the data suggested that all respondents were overwhelmingly positive about the software. The only question to have a significantly different response between students and the TLs responses involved the locating of information. Not surprisingly, the tutors and lecturers (all qualified doctors) had significantly less difficulty than the students in locating specific information. At the time of the evaluation (but since completed), the index and search engine had not been implemented, and this is thought to have been contributing factor to the student responses.

The students were also asked how they would prefer to use the An@tomedia CD-Rom (Tab. 2). It is significant to note that while over 90% wanted their own copy, 53% indicated they would use it in study groups. The first author observed during the evaluation process, pairs of adjacent students engaged in discussion of the key aspects of the different representations of anatomical structures (e.g., one student pair may have been looking at the radiological view while the other pair, the dissection).

Students were also asked a number of open-ended questions. Student comments about the best aspects of An@tomedia included:

- Anatomical content was superb. Images (dissection, imaging etc.) were beautiful.
- Explanations are very clear and highly comprehensive.
- Love the clinical relevance and concise exam style questions.

- It was simple yet complex. The diagrams to help answer the questions were fantastic and very helpful (helps you understand)
- It was a combination of an atlas and text book which is fantastic. It saves you having to flip (between an anatomical atlas and anatomical text) …

Question	Mean (SD) Score	
The content on the Anatomedia program.	Students (n=132)	Tutors and Experts (n=20)
Anatomedia complements the anatomy teaching program	4.5 (0.71)	4.6 (0.60)
Concepts were addressed and well explained.	4.2 (0.74)	4.1 (1.02)
The content on the back was comprehensive.	4.3 (0.84)	4.35 (0.88)
There was strong correlation between structure and function.	3.8 (0.99)	3.63 (1.21)
The clinical applications seemed relevant and appropriate.	3.9 (0.83)	3.95 (1.18)
While using Anatomedia:		
it helped me understand anatomy	4.2 (0.77)	
it helped me organise my knowledge of anatomy	3.8 (0.94)	
I found the ability to highlight structures in the images valuable	4.5 (0.67)	4.75 (0.55)
I found the layering of images valuable	4.6 (0.69)	4.84 (0.37)
I found the content to be engaging	4.0 (0.81)	4.15 (0.99)
Regarding learning the content:		
An@tomedia helped me understand anatomy from multiple perspectives	4.0 (0.78)	
An@tomedia enhanced my ability to interpret anatomy rather than merely describe it	4.0 (0.94)	
I found the four perspectives were well balanced and integrated		4.21 (0.71)
As a result of using An@tomedia students are likely to improve their		
knowledge of the anatomical basis of clinical procedures		4.15 (1.04)
application of anatomical knowledge to solve clinical problems		4.0 (1.08)

Table 1: Mean and standard deviation (SD) scores for first year medical students, tutors, and content experts

How would you best like to see Anatomedia used? You may have more than one option.	F	%
Own copy	122	92.4
Tutorials	43	32.6
Lectures	36	27.3
Study groups	70	53.0

Table 2: Students preferred use of An@tomedia for learning: Frequency and percentage

The student comments about the aspects that needed improvement included:

- Absence of a "search" mechanism for "random access" into a particular concept or principle.
- (add an) adequate index from which to link into appropriate slides illustrating the concept or principle.

The comments from the students regarding the need for an index and search engine were expected. However, it was necessary to undertake an evaluation before the first release of the program and integration into the new PBL curriculum in order to refine and improve the initial design.

The tutors were engaged in the role of supervisors, teachers and mentors, particularly in the activities in the dissection room. Comments from tutors included:

- [the best feature was the] Combination of aspects of atlas, textbook, and clinical text in one resource.
- The radiology component was fantastic – the resolution of the images very clear. The dissections were also impressive.

Tutors were also interested in An@tomedia as a teaching resource. They perceived two potential uses for the CD-Rom—as a precursor for students prior to dissections, and access during dissection classes to clarify and illustrate anatomical relationships. The latter has implications for resources—there would be a need to install video projection and computer facilities in the dissection laboratories and provide training for tutors to use the equipment.

Responses from the content experts (lecturers) were more diverse, with both very positive and very negative comments. The content experts included practitioners who were occasional lecturers, to full-time medical educators. Some comments were very positive.

- [the best feature was the] Integration of invivo, invitro eg., dissections/ imaging. Excellent dissections and graphics to highlight structures. Interactive format and quantity of information.
- [the best feature was the] Anatomical detail very good, especially the imaging component

Less favourable comments included:

- Everything is too static. It is a portfolio of drawings and pictures with (some) accompanying text. The CD is used as a filing system but under-used for constructive education.

In reflecting on the comments from content experts it is important to recall that An@tomedia is designed to be implemented as part of a PBL curriculum—it is not intended that An@tomedia become the sole resource for the teaching of anatomy. One outlook on teaching involves the view that a lecturer constructs learning opportunities for students—some of which may be facilitated by a computer. The teaching methods chosen as the focus of the learning opportunities, teacher-centred or student-centred or a mixture of both, are strongly influenced by the educational beliefs held by the lecturer (Bain, McNaught, Mills, & Lueckenhausen, 1998). For example, in response to the question 1(l) "Which of the factors above do you believe are the most important in influencing student learning?", one content expert replied:

- None of these factors are strong determinants. The cardinal determinate is what is in the exam. Wherefore, assuming that is what is shown is all that needs to be known, the most relevant qualities are: locate information, graphics clear, how much information, concise.

In all discussions with the An@tomedia development team, the need to provide a learning environment that addressed the traditional divide between discipline-based knowledge and clinical practice was paramount. An@tomedia has been designed to be one component within a particular educational context—one which is student-centred, rather than teacher-centred. In Table 2, only 27.3% of students perceived that An@tomedia would be appropriate for use in lectures—a teacher-centred learning environment. However, over 50% wished to use the CD-Rom as part of group activities, and over 90% wanted their own copy for personal study and revision. There may be a need in the future to include with the CD-Rom the background perspective that guided its development, and suggestions (for students and teachers) for ways in which it might be utilised, particularly if An@tomedia is to be used in other contexts.

Summary, conclusions and future directions

Two goals of An@tomedia were to be comprehensive and use multiple perspectives. These goals seem to have been achieved. The comments regarding the comprehensive nature of the four perspectives, allowing the student to move from one representation of knowledge (e.g., imaging and dissection) to the clinical applications has been highlighted (by students and TLs) as one of the most important strengths of An@tomedia. However, there are some students who think that there is too much information (generally, and on-screen).

In the second iteration of the software, the index has been completed to overcome the inherent difficulty of locating specific information. In addition, an extra navigational feature in the form of sequential numbering for each set of screens in a perspective has also be added to aid in the relocation of specific information. The lecturers and tutors were asked specific questions that focused on the use of An@tomedia for teaching. Their responses have highlighted the need to address the curriculum in which the CD-Rom is used. As indicated in the discussion, there are some issues of implementation and educational perspectives to be resolved if An@tomedia is to be used outside the context of the current PBL medical program.

While An@tomedia is focused on the content area of anatomy, the results of the evaluation indicate there are potential lessons to be learnt from the use of multiple perspectives to link structure and application in other subject areas, and the embedding of computer-facilitated learning in problem-based learning curricula.

Since the evaluation, the Abdomen and the Thorax (second and third modules respectively) have been completed and a number of typographical and graphical errors rectified as well as an improved introduction and starting screen. An@tomedia is now a pivotal part of the first year undergraduate medical program at The University of Melbourne. In 2000, the *Neck* will be completed. Sample images from the CD-Rom may be viewed at <http://www.anatomedia.com/>.

References

Bain, J., McNaught, C., Mills, C., & Lueckenhausen, G. (1998). Describing computer-facilitated learning environments in higher education. *Learning Environments Research, 1*, 163-180.

Biggs, J. (1989). Approaches to the enhancement of tertiary teaching. *Higher Education Research and Development, 8*(1), 7-25.

Camp, G. (1996). Problem-based learning: A paradigm shift or passing fad? *Medical Education Online, 1*(2), 1-6.

Finucane, P. M., Johnson, S. M., & Prideaux, D. J. (1998). Problem-based learning: Its rationale and efficiency. *Medical Journal of Australia, 168*, 445-448.

Laurillard, D. (1993). *Rethinking university teaching: A framework for the effective use of educational technology*. London: Routledge.

Marton, F., & Säljö, R. (1984). Approaches to learning. In F. Marton, D. Hounsell, & N. Entwistle (Eds.), *The Experience of Learning*. Edinburgh: Scottish Academic Press.

Ramsden, P. (1984). The context of learning. In F. Marton, D. Hounsell, & N. Entwistle (Eds.), *The Experience of Learning* . Edinburgh: Scottish Academic Press.

Ramsden, P. (1992). *Learning to teach in higher education.* London: Routledge.

Reeves, T. (1992, September-October). Effective dimensions of interactive learning systems. In A. Holzl & D. Robb (Eds.), *Finding the future: ITTE '92,* Proceedings of the Information Technology for Training and Education Conference. Lucia, Brisbane: University of Queensland.

Acknowledgements

The authors wish to thank the content writers, Dr Norm Eizenberg, Dr Chris Briggs, Dr Ivica Grkovic and Ms Priscilla Barker, and the Committee for the Advancement of University Teaching (CAUT), the Teaching and Learning (Multimedia and Educational Technologies) Committee (The University of Melbourne), for funding.

Web Raveler
An Infrastructure for Transforming Hypermedia

Andrew Kensler and Samuel A. Rebelsky
Glimmer: The Grinnell Laboratory for Interactive Multimedia Experimentation and Research
Department of Mathematics and Computer Science
Grinnell College
United States
rebelsky@grinnell.edu

Abstract: Adaptive hypermedia has the potential to change learning in an online environment. Interactive hypermedia systems, in which students can not only add their own pages and links but also modify existing pages, provide the potential to further support students. Yet the World Wide Web fails to live up to these potentials because the core Web technologies lack uniform support for adaptation or interaction.

Web Raveler is an infrastructure that supports uniform extension and adaptation of Web pages. Web Raveler mediates the dialog between Web clients and Web servers, transforming requests and responses so that, for example, faculty can make standard modifications to arbitrary pages, from adding annotation facilities to presenting pages in a form appropriate for the reader. Web Raveler is also extensible; by developing new plug-ins, faculty can add functionality to arbitrary pages.

In this paper, we discuss the architecture of Web Raveler and suggest some applications.

1. Background: Why Transform Pages?

Initial visions of hypertext emphasized a highly interactive information system, in which readers could annotate, contribute to, share, and link pages in the hypertext (Bush 1945) (Nelson 1974) (Landow 1997). Unfortunately, the World Wide Web provides a more passive model of hypertext, as most pages and browsers limit readers to scanning through pages and clicking on links. While newer technologies (e.g., Java applets, browser plug-ins, and even CGI scripts) can provide more interactivity, such interactivity is at the control of the page's original authors, and out of control of the readers. Compare this with Nelson's original description of hypertext, in which he writes "links may be artfully arranged according to meaning or relations in the subject, and possible tangents in the *reader*'s mind" (Nelson 1974, p. DM19, emphasis ours). To support such interactivity, readers need a way to transform existing pages to add these new facilities.

Such facilities can allow students to interact with each other in an collaborative manner. An annotation system for example could let students post notes and carry out on-line discussions in the context of a course web. The instructor might post materials on-line and students would attach comments to specific points or items on the page. Other students or the instructor could then respond to them in the same manner. Students divided into groups might post notes visible only to other students in the same group. The system would customize the page for each individual who views it.

At the same time, faculty are looking for ways to use the Web to provide different perspectives on the same material, letting the Web site adapt to the needs, background, or usage patterns of their students, e.g., (Brusilovsky 1996). Computers can adapt the pages to the user, customizing them specifically to suit the person viewing the page. This can be particularly powerful in the case of education. Adaptive hypermedia is much more powerful because it can present information to the student in the way that is most effective for them and allows them to learn best. For example, an adaptive lesson might choose different examples based on knowledge of the background of the student, or suggest different resources depending on which resources students have viewed in the past.

Systems that can customize the presentation of the material for individual users can significantly improve the experience. In the case of course web sites for education, they can adapt the material to the mode of learning that best suits the student, thereby making the learning experience much more engaging.

Adaptation may also mean adapting existing pages. That is, a teacher might select portions of other pages, add comments to other pages to help students use those pages, or even tie together materials from multiple pages. As (Landow 1997) suggests, students might also engage in scholarly activity not by writing new words, but by creating new associations (links) between existing pages.

These are three somewhat different domains: adding interactive facilities to individual pages, writing pages that adapt, and adapting existing pages. However, they share some key commonalties. In each case, pages must be modified according to some rules (to add facilities; to change the page according to information on the reader or student; to change the page according to specifications from the modifier). In each case, modification requires some knowledge about the reader, some of which are tied to individual pages (desired facilities and a collection of changes made through those facilities, such as notes on the pages; browsing history, education level, other preferences; specifications for modifying pages).

The Web has the potential to provide a richer, more interactive, and more uniform environment for students and teachers. But it needs standard mechanisms for modifying pages according to information about the reader.

2. A Solution: Web Raveler

To realize this potential, we have constructed an infrastructure for transforming hypermedia. Web Raveler is a Web page modification system designed to transform hypermedia on the fly. It sits between a user's Web browser and the Web servers on the Internet, transforming pages and resources as they go through. It supports multiple simultaneous users and keeps individual profiles so that it can customize pages differently for each user. Web Raveler runs each page through a series of plug-ins that modify the page based on the context of the page and the users profile. This transformed page is then what it returns for the browser to display to the user.

Web Raveler is simple, powerful, flexible, transparent, and extensible. Its power stems from it simplicity; it has one purpose, to intercept pages and apply transformations to those pages. Since it does not limit the kinds of transformations that can applied, it can be used for a host of applications, from adding new features to pages to extracting text from pages.

Web Raveler is also flexible in that can be used with existing tools and course webs since it filters the pages as the travel through. Instructor can continue using whatever tools they are most comfortable with for building their course webs and easily add Web Raveler to those course webs. This system can also adapt pages outside of the domain of the course web; it can actually transform any page available over the World-Wide Web. Thus users are not restricted to a small domain but can use it to enhance students' overall experiences no matter where they are on the Web.

Furthermore, Web Raveler is transparent. There is some minor initial setup involved with configuring the Web browser to use it, but once this is done, the users can browse the Web at will using the system. Everything is accessible and there are no funny URLs to bother with. Readers can simply use the Web browser as they always do, with no extra effort beyond the initial configuration.

Finally, Web Raveler supports a plug-in architecture to provide the infrastructure for new applications. Each plug-in interacts with the Web Raveler Server through a simple interface. Web Raveler takes care of the details, from communication with the Web browser and the Web server to storing user preferences, accounts, and other information. It simply passes each page to the appropriate plug-ins along with the data on the user and allows them to modify the page freely. Thus applications are only concerned with doing their specific adaptations, leaving the mechanics of the system to the Web Raveler system.

This architecture allows the Web Raveler system to provide a wide range of services to the user, while not restricting them in any way.

3. The Architecture of Web Raveler

Three main components comprise the Web Raveler system: the Web Raveler Account Server (WRAS), the Web Raveler Server, (WRS) and a group of plug-ins. (Fig. 1) illustrates the components and their relationships.

The WRS is a standard HTTP proxy server. When the Web browser needs a page, image or other resource, it sends an HTTP request to the WRS (step 1). The WRS checks to see if the request is from a user who is already logged in. If the user is not logged in, then it sends back an authentication response that the browser interprets by requesting a user name and password of the user. Then the browser resends the request, this time with the request bearing the user name and password of the user. When the WRS gets this information, it then passes it over the Internet to the WRAS (step 2). This server checks to make sure that the password is correct for that user, and if so, sends back the data for that users account (step 3). Otherwise, it sends a response back to the WRS indicating that the login failed, and the WRS sends back a response to the Web browser for the user to try to log in again.

Once the user has logged in, the WRS passes along the request for the page or image to the source Web server (step 4), which actually has the page. The Web server retrieves the requested resource from disk and sends it back over the Internet to the WRS (step 5). Since Web Raveler uses HTTP, the standard Web communication protocol, it can pass requests to any Web server.

After it has received the page, the WRS examines the users' settings, including specific options for each plug-in and what groups the user belongs to. It also examines the page for any embedded instructions regarding plug-ins. WRS then decides which of the available plug-ins should be applied the page and in what order. It executes each of the plug-ins in turn on the page, giving them the page and the information on the user (steps 6a,7a). Each plug-in may do anything that it wants with the data, typically transforming the page and returning the transformed page (steps 6b,7b). Each plug-in runs in turn on the page and then, after all have been executed, the WRS returns the page in its final form to the Web Browser (step 8), which then renders it for the user.

Note that pages (and, therefore, their authors), and not just readers, can specify which plug-ins to run. This facility gives authors some control over what can and cannot be done to their pages (since many authors may not want to permit some transformations to be applied to their pages). It also provides an infrastructure for adaptive hypertext, in that authors can specify that particular adaptations be applied.

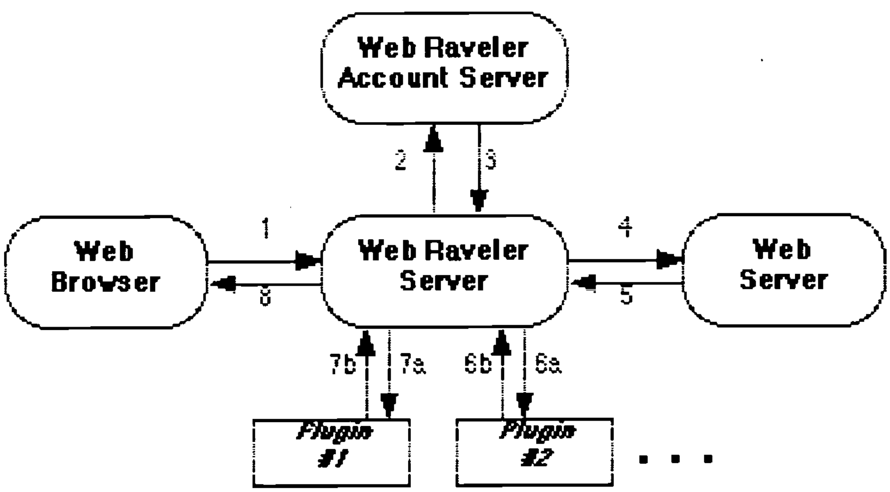


Figure 1: The Architecture of Web Raveler.

All of the components of Web Raveler were written in Perl and thus are portable to a variety of platforms, including Unix, Linux, Windows, and Macintosh. Our current implementation is running under HP-UX, and we are testing other platforms. We currently support Perl-based plug-ins. Perl is also a convenient language to use because of its powerful text-manipulation capabilities and many useful Web-related libraries. These make it easy to write plug-ins with significant capability. We are also developing a plug-in architecture based on SATIRIC, a contextual pattern language, which was developed specifically for transforming Web pages (Seaman et al. 2000).

3.1. Alternative Implementation Techniques

We have chosen the standard HTTP proxy server mechanism as our underlying implementation technique. There are, of course, other mechanisms for transforming Web pages as they travel between client and server. One might use a centralized CGI script that parses its URL and selects which server to select, as in (Becker et al. 1999). One might rely on server plug-ins, CGI scripts, or ASP scripts, as is sometimes done in an ad-hoc fashion for pages on a single server. One might write browser plug-ins, as in the case of ThirdVoice (ThirdVoice 1999). (Tab. 1) summarizes selected issues for each technique.

Type	Browser Requirements	Server Requirements	Domain
Server CGI/ASP	None	CGI Support	Local Site
Browser Plug-in	Plug-in Support	None	Whole WWW
CGI Proxy	None	CGI Support	Whole WWW
HTTP Proxy	Proxy Support	(None)	Whole WWW

Table 1: Potential Implementation Strategies

While server plug-ins and scripts provide authors with extensive functionality, that functionality is typically limited to the pages on the site or sites that server serves. These scripts also leave control in the hands of authors; readers cannot decide which transformation to use. Finally, they may require cookies or strange URLs to keep track of user information.

Browser plug-ins provide more freedom, as in the case of ThirdVoice, a plug-in might be applied to any page on the Web. However, not all plug-ins run in all browsers or on all architectures, a severe disadvantage in the typically heterogeneous academic environment. For example, many plug-ins are never released for all variations of the Unix platform. Plug-ins may also be difficult to disable.

CGI proxies also provide the opportunity to transform arbitrary pages. However, they require that readers select "alternate" URLs. For example, to read the EdMedia Web page through a CGI proxy, a browser might be required to use a URL like

`http://www.site.com/transformer?page=http://www.aace.org/conf/edmedia/`

Such URLs can confuse novice and experienced readers alike. CGI proxies typically require cookies or even more complicated URLs to keep track of the current user.

HTTP proxies, our chosen technique, provide all of the advantages of the other techniques, with few of the drawbacks. Readers employ standard URLs. The standard proxy protocol permits the server to request a password and the browser sends account information "automatically". Proxies support arbitrary URLs, and so allow authors to transform arbitrary pages.

4. Current Applications of Web Raveler

The Web Raveler system provides an infrastructure for the development of multiple adaptive hypermedia applications. In addition to mediating between them, it handles the details of communication over the Internet with the Web browser and the Web server. It also keeps track of the user settings and preferences. The plug-in architecture makes it trivial to develop new applications and add them to the Web Raveler system without the need to modify the Web Raveler program. Once plug-ins are placed in the appropriate directory, they automatically become active the next time the Web Raveler Server is started.

The first plug-in developed for Web Raveler was a shared Web annotation system, an update of (Luebke et al. 1999). This system allows user to attach comments to arbitrary Web pages and set different levels of access on them. This system allows students to annotate pages in a course web as well as linked external materials. Students divided into the different groups can mark their annotations as being visible only to members of their group, visible to the whole class, completely public, or private to themselves.

Another application currently under development is a trailblazing system (Glynn et al. 2000). This system allows teachers to record a series of Web pages, add notes to the pages and present them in a coherent "trail" that students can follow in the prescribed order. If a student visits a page, and that pages is on a trail the teacher has created, the system notifies the student about the availability of the trail.

A third application is a tracking system. A previous version of this was done using a CGI proxy system (Becker et al. 1999). However, Web Raveler affords many advantages for this. The tracking system will silently track where a user goes, recording how long they spend on each page, which links they follow and so forth. This information can then be collated to evaluate the effectiveness of a Web site. In an educational context, instructors can see how the different resources on a course Web site are being used and can take advantage of this to make the course Web site more effective.

Finally, we have just begun work on the adaptation plug-in that permits authors to write pages that can take advantage of the information Web Raveler gathers.

5. Related Work

There are many other filtering systems available, written in different languages, emphasizing different transformations, or using different technologies. These include OreO (Brooks et al. 1995), GrAnT (Schickler et al. 1996), Muffin (Boyns 1998), and part of Project Clio (Becker et al. 1999). The Web Raveler system is unique in supporting user accounts and preference data, so that different readers may select different transformations. Ours is also unique in that we support author-specified transformations, in addition to reader-specified transformations.

There are also other systems available that attempt to ease the construction of interactive course webs, most notably WebCT and First Class. WebCT primarily focuses on the creation of course webs. It does have support for annotations and on-line quizzes and exams. It also provides some forms of tracking. First Class is a client/server that primarily provides services to run a threaded discussion forum. Instructors can create message areas and then students can post to these.

These systems however still lack the true power of transformational hypermedia. They are limited to their own domain and cannot customize pages outside of the course systems constructed using them. They also restrict the instructor to using their tools to construct the sites. Preferably an instructor would create course materials using whatever tool they are most comfortable with.

6. Conclusions, Future Directions, and Other Issues

Successful educational use of the Web requires more than existing tools provide; it requires uniform systems for annotating and transforming Web pages, techniques for writing adaptive pages, and systems for adapting existing resources. Web Raveler provides a uniform system for all three applications, empowering teachers to build better sites and students to interact more freely with the Web.

The Web Raveler system is currently being used as the foundation for several adaptive hypermedia systems that have been implemented as plug-ins. In the fall of 2000, the Department of Math and Computer Science at Grinnell College will begin class testing with the Web Raveler system and these plug-ins. As suggested earlier, work on a number of plug-ins has begun.

There are certainly many other issues we must consider, including a uniform language for page authors to limit and specify transformations, a more user-friendly language for writing transformations, and a language for writing adaptive pages that use Web Raveler. We have not yet measured the overhead introduced by Web Raveler and its plug-ins. We expect to report on some of these developments and experiments at a future EdMedia conference.

7. References

Becker, R., McLaughlin, K. & Rebelsky, S. (1999). Project Clio: Tools for Tracking Student Use of Course Webs. In B. Collis & R. Oliver (Eds.), *Proceedings of the EdMedia 99 World Conference on Educational Multimedia, Hypermedia, and Telecommunication.* Charlottesville, VA: Association for the Advancement of Computing in Education. 981-986.

Boyns, M. R. (1998). The Design and Implementation of a World Wide Web Filtering System. Master's Thesis, San Diego State University.

Brooks, M, Mazer, S., Meeks, S., & Miller, J (1995), Application-Specific Proxy Servers as HTTP Stream Transducers, In *Proc. Fourth International World Wide Web Conference*,. Also available online at http://www.w3.org/pub/Conferences/WWW4/Papers/56/.

Brusilovsky, P. (1996). Adaptive Hypermedia, An Attempt to Analyze and Generalize. In P. Brusilovsky, P. Kommers, & N. Streitz (Eds.), *Multimedia, Hypermedia, and Virtual Reality* (Vol. 1077). Berlin: Springer-Verlag. 288-304

Bush, V. (1945). As We May Think. *Atlantic Monthly*, 176 (1), 101-108.

Glynn, C., Luebke, S., Heck, R., Ma, W., Mason, H., Nichols, E., Raulerson, E., Staicut, I., and Rebelsky, S. (2000). Blazing Trails on the World-Wide Web. In *Proceedings of the EdMedia 2000 World Conference on Educational Multimedia*. Charlottesville, VA: Association for the Advancement of Computing in Education.

Landow, G. P. (1997). *Hypertext 2.0: The Convergence of Contemporary Critical Theory and Technology*. Baltimore, MD: The Johns Hopkins University Press.

Luebke, S., Mason, H., and Rebelsky, S. A. (1999). Annotating the World-Wide Web. In B. Collis and R. Oliver (Eds.), *EdMedia 99 World Conference on Educational Multimedia, Hypermedia, and Telecommunications* (Seattle, Washington, June 19-24, 1999), 409-414.

Nelson, T. H. (1974). *Computer Lib/Dream Machines*. Self-published.

Schickler, M. A., Mazer, M. S., & Brooks, C. (1996). Pan-Browser Support for Annotations and Other Meta-Information on the World Wide Web. In *Proceedings of the Fifth International World Wide Web Conference*.

Seaman, J., Venugopal, V., and Rebelsky, S. A. (2000). Building and Transforming Educational Web Sites with SATIRIC and Contextual Patterns. In *Proceedings of the EdMedia 2000 World Conference on Educational Multimedia*. Charlottesville, VA: Association for the Advancement of Computing in Education.

ThirdVoice (1999). ThirdVoice.com. (Accessed 20 July 1999.)

Acknowledgements

Thanks to Rachel Heck, Sarah Luebke, Jared Seaman, and Vivek Venugopal for their helpful suggestions. The Grinnell College Capstone fund provided funding for this project, for which we are particularly grateful.

Developing Communication Skills Using INSPIRE Negotiations

Margaret J. Kersten
School of Linguistic and Applied Language Studies
Carleton University
Ottawa, ON., Canada
mkersten@business.carleton.ca

Gregory E. Kersten
Decision Sciences and MIS, Concordia University
Montreal, PQ, Canada
gregory@mercato.concordia.ca

Abstract: INSPIRE is a web-based negotiation support system that has been used for the last three years for negotiation training and research. It has also been used in teaching written communication skills. In this paper we discuss implications of using the system in teaching English as a Second Language and English for Academic Purposes in multilingual classes and point out the benefits that this new technology offers. We also show how extending classroom boundaries to remote regions of the world add to increased students' involvement and enhance language acquisition.

Introduction

Web provides people in different locations and time zones with a communication medium that is rich in functionality and content and which offers them the ability to use previously inaccessible computational resources. While the Web is currently used as a powerful source for the dissemination of information, it is increasingly being used as a means for active communication, and remote execution and control of complete software systems, thus adding another dimensions to the value it delivers. In education, its ability to access and run remote programs and databases allows users to extend classroom and laboratory boundaries across geographical and time zones.

The InterNeg Web site and its Web-based system INSPIRE have been constructed to exploit these technologies and their use in teaching [4-6]. They aim at providing people around the world with analytical knowledge and decision support techniques within the domain of negotiations. The INSPIRE system allows participants to analyze and solve real-like decision problems and conduct negotiations with people from different cultures.

The INSPIRE system is the first Web-based negotiation support system. It is based on analytical models rooted in decision and negotiation analysis [7-8]. Developed in the context of a cross-cultural study of decision-making and negotiation, the system has been primarily used to conduct and study negotiation via the World Wide Web as well as in teaching information systems, management science, international management and English as a Second Language (ESL) [4, 9].

In this paper we discuss the use of the INSPIRE system in the context of ESL teaching, and the teacher's and students' experiences. In Section 2 the system, the available resources and the negotiation case are outlined. Section 3 discusses the context and the teaching methodology used to adapt the system for ESL purposes. The implications for teaching communication skills, and the students' and teachers' experiences are discussed in Section 4. Comments about INSPIRE's usefulness for ESL/EAP teaching and the ongoing work on new Web-based resources conclude the paper.

InterNeg site and the INSPIRE system

The InterNeg project began in 1996 with the development of a simple Web-based negotiation support system called INSPIRE (InterNeg Support Program for Intercultural Research; http://interneg.org/interneg), [6]. During the last three years over 3,500 students used the system. The host InterNeg site offers services (see http://interneg.org/), including beginners' handouts and information on how INSPIRE can be used in different university courses. Research papers, summaries, examples of students' assignments, a glossary, an extensive bibliography and information about programs and organizations involved in negotiation are also available.

INSPIRE views a negotiation as a process occurring in a particular context. The system does not act autonomously like a third party arbitrator; rather each 'copy' acts solely to support a single negotiator. It supports asynchronous negotiations, thus ameliorating the time zone problem. To facilitate this type of negotiation the system saves the current state resulting from each user's actions in a form that can be retrieved when the counterpart logs in some time later.

INSPIRE negotiation phases

INSPIRE negotiations follow three phases: an antecedent phase, a concurrent phase, and a consequent phase [6]. The pre-negotiation phase involves an analysis of the situation, problem and opponent, specification of preferences, reservation levels, and strategy. In this phase users read the case, formulate their preferences using simple tables to distribute scores between issues and their values, verify the utility (ratings) of selected offers that are generated by the system and fill in a pre-negotiation questionnaire. The questionnaire contains, among others, questions about the expected compromise and the worst offer that the user is willing to accept.

The negotiation phase involves exchanges of messages and offers, evaluation of offers and the assessment of the progress of the negotiation. Offers comprise the negotiated issues and their values; each offer is formulated by selecting one value for each issue. The offer rating is automatically displayed beneath the table which contains the offer. An offer may be accompanied by a message. Users may also send messages without offers; this feature is often used to prompt their counter-parts by making an additional argument. On a number of occasions users sent messages to communicate with their counter-parts about topics outside of the negotiations; in fact a number of users maintained e-mail communication with their counter-parts after the negotiations were completed.

Users have two mechanisms to assess the progress of the negotiation. They may review the complete history of their negotiations, including offers exchanged, their ratings and the messages. They can also access a graph that displays the negotiation dynamics in their utility space. The negotiation is parallel on all issues. Participants may submit the same offer many times, or keep the option of an issue unchanged, but each submitted offer contains a value for each issue.

The negotiation ends when either a compromise has been achieved, or one of the parties terminates the process, or the time runs out (at a predetermined deadline). The post-settlement phase involves the evaluation of the negotiation outcomes generated by, and after, the negotiation activity. These outcomes include the information about the compromise. If the negotiators can improve their compromise, the INSPIRE provides them with up to five Pareto-optimal offers. In this situation the users may choose to continue their negotiations. The post-settlement phase ends with filling in the post-negotiation questionnaire, which however, is not mandatory.

Itex-Cypress Negotiations

The negotiation problem involves two companies: Itex Manufacturing, a producer of bicycle parts and Cypress Cycles that builds bicycles. Cypress Cycles, an established manufacturer of high quality mountain bikes, is launching a new line of bikes and requires a type of component that its current suppliers cannot provide. Their first serious discussions for the supply of these components are being held with Itex Manufacturing. Itex is seeking to increase its share of the component market and would like to have the prestige that would come with supplying Cypress, should a profitable contract be signed.

There are four issues that both sides have to discuss. The issues are: the price of the components, delivery times, payment arrangements, and terms for the return of defective parts. INSPIRE users are asked to negotiate on behalf of the company rather than for themselves and told that their companies are interested in achieving a compromise. They are also informed that there are other suppliers and buyers so a breakdown in negotiations is possible, if a good deal cannot be reached. There is no further indication as to what constitutes a good deal. Each side, however, is given a clear indication as to the desirability of the options (issue values) but only in terms of the direction and not specific trade-off values. By avoiding the specification of preference values, negotiators are able to establish their own priorities within each issue.

In writing the case an effort had been made to make it as much as possible 'culture neutral'. The negotiation situation is of the type that can be encountered anywhere in the world. Also the negotiators' names (which can usually indicate their cultural background) are substituted by pseudonyms. The case is fairly simple and well structured. It describes a negotiation problem that is familiar to users from almost any country, therefore no additional explanations are necessary. Language proficiency of the users was taken into consideration too. The comprehension of the case was tested on a group of students taking Intermediate English as a Second Language for Academic Purposes course at Carleton University.

The description of the case fits one and a half pages. Generally, users find the system very easy to use, and their evaluation of the overall system is favourable. Over 75% of INSPIRE users stated that they would use a system like INSPIRE in real-life negotiations and over 85% would use such a system to prepare themselves to conduct actual negotiations. While the feedback on the INSPIRE system confirmed our expectations, the absolute levels of user acceptance of the system are surprisingly high.

EAP/ESP context

The students

INSPIRE has been used at Carleton University to teach foreign language learners communication skills. The School of Linguistics and Applied Language Studies offers two English as a Second Language Programs. In the Intensive ESL Program the majority of the student population are international students. Some are either planning to enter a regular study program at an English speaking university in North America others learn English to gain a competitive advantage at the job market in their countries. The Credit ESL Program on the other hand, is a language support program for those students who have already been accepted to Carleton on the condition that within a year they receive a B- exit grade in the advanced course of English.

There are three language proficiency levels in the Credit Program: Introductory English as a Second Language for Academic Purposes, Intermediate English as a Second Language for Academic Purposes and Advanced English for Academic Purposes. The Advanced course has two options, i.e. general EAP and English for Special Purposes (ESP) for Academic Purposes for Engineering Students. The highest level of the Intensive Program and the introductory course of the Credit Program are in fact the same course in terms of the level of language proficiency. The difference is the students' status—visa students (Intensive) versus permanent residents (Credit).

Students enrolled in both programs come from all over the world and have a variety of educational backgrounds ranging from new high school graduates to professionals. The majority of the students however, are in their twenties and have a couple of years of college or university training (particularly those in the Intensive Program).

Over the last three years, the INSPIRE system has been used with the students enrolled the writing workshop at the highest level of the Intensive Program and in the Credit Program: Intermediate English for Academic Purposes and Advanced English for Academic Purposes (both the general EAP and EAP/ESP for engineering students).

Whole language, communication and negotiations

The presented language teaching approach is embedded in the theory of whole language. It is based on the belief that development of cognitive skills is interrelated with the development of language skills; that critical thinking and analysis should constitute an integral part of learning; that we learn language to communicate with others and therefore social context is important; that the learning objectives are best achieved when there is purpose and meaning; and that students' direct engagement and experience are crucial to the learning process.

The INSPIRE system lends itself to the theory and practice of whole language. While analyzing the negotiation process the students develop both the cognitive and the language skills. The dynamic in its nature, relationship between negotiation partners provides social context for communication; the role-play which evolves around finding a solution to a conflict of interest situation gives purpose and meaning to the communication that takes place

Negotiations require extensive use of communication skills. Although negotiations on the Web do not allow for the use of non-verbal clues (at least not yet), they stimulate the precision of expression in the written form allowing the students to work on developing their writing. The written messages can be carefully thought over and revised many times until the student feels that what he/she has written represents adequately his/her point of view. While writing these messages the students learn how to persuade, argue, convince, etc. They also learn to read, understand and follow instructions which are an integral part of the INSPIRE system. The speaking skills are developed through classroom discussions about the progress of individual negotiations, negotiating strategies and techniques. While negotiations are conducted outside of the classroom, these discussions take place during each class for the duration of negotiations.

The INSPIRE negotiations lend themselves to the thematic approach to language teaching. All the language activities evolve around the topic of negotiations, decision-making and conflict resolution. The conflict that is at the core of the negotiation keeps the students intellectually and emotionally involved. And although the negotiation case is only an assigned task, the communication that occurs is authentic.

The negotiations take about two weeks during which time the students are constantly exposed to the language of business negotiations used in a specific context for a specific purpose. The role-playing situation and the fact that there is a real person on the other side of the negotiation "table" keeps the students committed to the task. The level of difficulty of tasks and language activities grows gradually, and roughly corresponds to the three phases of the negotiation: pre-negotiation, negotiations and post-negotiation. In the pre-negotiation phase the students write and share their past personal experiences with negotiations, read the INSPIRE case and acquaint themselves with their role, read and discuss the example (this is when the vocabulary is introduced in a context), listen to a lecture on the INSPIRE system and take notes (they will need the notes later to write the introduction to their report or essay), rank the negotiation issues and options and fill in the pre-negotiation questionnaire.

During the negotiation the students are required to keep a Negotiation Journal where they record all negotiation related activities, analyze the situation, strategies, techniques and the dynamics, predict their opponent's behaviour, etc. They also share their experiences with their classmates on a regular basis, and engage in language activities such as discussing the language of e-mails, sentence combining, punctuation exercises, and play word games. This is also when the students start writing the introduction and the methodology sections of their report.

In the post-negotiation phase they fill in the post-negotiation questionnaire, evaluate their negotiations, their opponents, and themselves. Finally, they write a report or an essay in which they evaluate their negotiation experience using the information that was made available to them via the INSPIRE negotiation support system, through in-class discussions and the Negotiation Evaluation Questionnaire.

Organization

Before the negotiation begins, a brief presentation about INSPIRE is made. It is made clear at the beginning of the course that INSPIRE is an important module of the course. However, it is also stated that the final result of their negotiation (compromise or not) and its utility score are not used for grading purposes. This is important because the participants should be able to negotiate in as realistic a situation as possible and be in control of the process. Students may decide to break their negotiations with one company and initiate new negotiations with another.

A demonstration session follows the presentation and it is intended to familiarize the students with the Web, and INSPIRE. They are shown how to log on to INSPIRE, how to construct and send offers using the system, and how to incorporate changes in any of the offers or issues in subsequent visits. The session usually lasts an hour. The instructor uses hard copies of the forms used in the INSPIRE negotiation so that the participants can actually see what kinds of forms they will fill in.

During this session students log in and read the INSPIRE case. At this time they may conduct initial analytical activities: specify the relative importance of each issue and the options for the issues. This information is used to determine their subjective utilities for all possible offers. In many cases the session ends with the student making a first offer to his /her counterpart. Before the session ends, the participants are reminded that they will be notified by INSPIRE via e-mail whenever a message or offer from the counterpart is received by the system. When they receive notification the participants log into INSPIRE to read and evaluate the offer and submit a counter-offer.

Experiences

Students' experiences

Students were requested to record every activity they undertook related to their negotiation via INSPIRE. These logs were used for personal assessment of each exchange of offers/counteroffers and messages as well as for discussions. They also helped the instructor to catch and address any problems that may have occurred.

A few participants stated that INSPIRE helped them to see an intercultural point of view. A significant majority said INSPIRE did help them to refine their communication skills. They pointed out that they were more concerned with language accuracy and the appropriate level of formality than they normally are while communicating with their classmates. Those who had none or very limited experience with computer technology, were particularly appreciative of the fact that they were not only learning the language but also learning a new medium of communication. Despite the participants' limited experience with the Internet, their ability to achieve expected compromises suggests that the INSPIRE system and Web-based negotiations do not introduce a significant burden or add complexity to the already complex negotiation process.

Teacher's experience

INSPIRE required different preparation, handling and conduct of the negotiations than face-to-face methods. In contrast to in-class instruction, teaching negotiation through INSPIRE required first ascertaining the level of Internet expertise of the users. Appropriate training sessions on the Internet may need to be planned before the INSPIRE session starts.

For a teacher whose class conducts a Web-based negotiation the process involves preparation and handling of three major stages: (1) introduction to the system, (2) the first exchange of offers and messages, and (3) discussion following the negotiations, and/or preparation of report or essay guidelines.

The first hands-on class has always been conducted in the computer laboratory. In this session, participants were guided through such steps as logging in, reading the case, submission of rating of issues and packages, and finally the first offer. Deft handling of varying levels of experience and expertise among the participants is of crucial importance here. We found it useful to place one skilled and a less skilled participant next to each other. The role of faculty here is one of a facilitator and his presence after the submission of the first offer, was generally not necessary.

Typical problems that may arise in running an Internet based negotiation are: (1) system problems, (2) team problems, and (3) administrative problems. System problems include both hardware and software compatibility issues (INSPIRE requires Netscape 3, Explorer 4, or later browsers) and systemic problems (including power shutdowns, and network problems), which may occur in any given time. To ensure successful completion of a negotiation through INSPIRE instructors need to plan and develop effective administrative mechanisms. These may include identifying a module coordinator from a group of participants, who could help the group stay focused and productive during the negotiation. Another possibility is pairing less computer literate students with those who feel very comfortable with the new communication technologies. Once the students have begun their negotiation on INSPIRE there is very little intervention required from the instructors.

After the completion of the negotiations, participants usually want to compare their results. The analysis of experiences can be done in many ways, i.e. informal group discussions, formal presentations followed by questions, formal reports, etc. Individual introspection proved to be most useful for the executive development programs, while post-graduate students and ESL students preferred classroom discussions.

Implications for teaching communication skills

Preparation of tasks that keep students' interest for an extended period of time and motivate them to give the best performance they can has always been one of the challenges faced by language teachers. The INSPIRE negotiations have the elements of a game and a role play and provide the students with a "real counterpart" with whom they are going to exercise their skills of persuasion and argumentation. The combination of these factors contributes to raising students' involvement and to increased awareness of the need to use appropriate and accurate language. The students themselves are responsible for initiating responses and for the outcome of the negotiations. They control their moves and actions. Therefore the communication that occurs in form of email messages is authentic. The fact that the negotiator's identity is concealed reduces the intimidation factor: racial and gender biases are eliminated. And although the negotiation may miss on spontaneity, it certainly allows for the analysis of the situations, for the preparation of strategies and tactics and for revisions of messages. Finally, some students exchange email addresses with their counterparts and keep corresponding like the traditional "pen pal" friends.

The submission of offers and counteroffers which are accompanied by written messages, the Negotiation Journal, class discussions and the use of the resources available on the Web such as questionnaires, graphs and the possibility to check the history of the negotiations creates an environment in which the language is acquired. The words whose meaning may have appeared vague at the beginning become part of the users' active vocabulary. The language of argumentation and persuasion develops because it is needed to gain concessions.

Conclusions

Systems such as INSPIRE offer an opportunity for direct participation in a negotiation and thus create a platform for experiential learning which is deeply rooted in the theory and practice of negotiation training and in the theory of whole language. The computer is a medium of communication that fosters learners' autonomy, equality and learning skills. The opportunity to communicate not only in the class but also outside of class creates a new social dynamic [10], where the learners fully control the process and the outcomes and where race, gender and status barriers disappear. In this asynchronous negotiation the learners have the time to reflect, analyze and make as many revisions of their writing as they may find necessary. The conflict of interest embedded in the negotiation promotes richer written interaction. All this creates an environment where the cognitive and the linguistic development are interrelated [2].

The flexibility of Web based systems facilitates customization of the case material to reflect regional specifics. It is also easier to bring about a discipline-based orientation in teaching and training sessions. The systems can be tailored to reflect, say, a behavioral, decision theoretic or any other focus to suit local teaching and training needs. This is very useful for management teaching and training where different modules are often combined to reflect the particular focus of a course. Web pages are very good at representing context, and independent Web pages may be assembled by a dispatching system that determines which page to present, based on a given situation.

The successful use of INSPIRE in teaching communication skills in ESL courses prompted us to develop a dedicated Web site for this purpose (http://interneg.carleton.ca/interneg/training/esl/). The site contains a 16 hours class-time module and a detailed timeline of language activities. Over 200 students from Canada and Germany used the module. The materials available include students' handouts, examples, a glossary of terms, detailed instructor's notes, description of students' activities (e.g., examples of the Negotiation Journal, sentence combining, collaborative dictation and essay guidelines), and writing models. More information about the module, the timeline and specific activities can be found at the Web site.

References

[1] Edelsky, C., B. Altwerger and B. Flores (1991), *Whole Language. What's the Difference?*, Heinemann Educational Books, Inc., Portsmouth, 7-26.

[2] Goodman, K.S. (1986), What's Whole in Whole Language?, Scholastic-TAB Publications Ltd, Richmond Hill, 7-33.

[3] James, R. (1996), "CALL and the Speaking Skill", *System*, 24(1), 15-21

[4] Kersten, G.E., S. Köshegi, and R. Vetschera (1999), The Effects of Culture in Anonymous Negotiations: A Four Countries Experiment, IIASA, Report IR-0023, Laxenburg, Austria.

[5] Kersten, G.E. and S. Noronha (1999), "Negotiations via the World Wide Web: A Cross-cultural Study of Decision Making", *Group Decision and Negotiations*, 8: 251-279.

[6] Kersten, G.E. and S.J. Noronha (1999), "WWW-based Negotiation Support: Design, Implementation, and Use", *Decision Support Systems*, 25: 135-154.

[7] Kersten, G.E. (1985), "NEGO - Group Decision Support System", *Information and Management*, 8(5): 237-246.

[8] Kersten, G.E., et al. (1991), "An Analytic Basis for Decision Support in Negotiations", *Naval Logistic Research*, 38: 743-761.

[9] Madanmohan, T.R., et al. (1999), "Learning Business Negotiations with Web-based Systems: The Case of IIMB", in *Decision Support Systems for Sustainable Development*, G.E. Kersten, Z. Mikolajuk, and A. Yeh, Editors, Kluwer Academic: Boston. 215-239.

[10] Warschaer, M., Turbee, L., Roberts. B. (1996), "Computer Learning Networks and Student Empowerment", System, Vol. 24, pp. 1-14.

Acknowledgements

We thank the anonymous referees for their comments and suggestions. This work has been supported by grants from the Social Sciences and Humanities Research Council Canada and the Natural Sciences and Engineering Research Council Canada.

The effects of a hypermedia CAI system on the academic achievement of elementary school students in Korea

Su-Hee Kim
Won-Hyun Lee
Division of Computer Engineering, Hoseo University
Bae-Bang-Myon , Asan City, Choong-Nam, South Korea
shkim@office.hoseo.ac.kr

Abstract: This study examines the effectiveness of a CAI system on students' academic achievement. After developing an experimental hypermedia CAI system, an experiment using this system on a group of elementary school students was performed, and the data from the experiment were then analyzed statistically.

An experimental hypermedia CAI system with an emphasis on improving reading skills was developed using Hanol 3.0 on an IBM compatible PC. The pedagogical material for this experimental system came from the first chapter of a standard social science textbook for fifth grade students in Korea. The study involved 55 students in total, who were divided into an experimental group of 27 students and a control group of 28 students. For the final 15 minutes of a 40-minute class, the experimental group studied with the experimental hypermedia CAI system, while the control group studied in the traditional manner. This experiment was repeated for 19 class hours.

A post-test with 30 questions designed to measure academic achievement was conducted on both groups of students at the end of the experiment. The average and the standard deviation of scores for the experimental group are 25.18 and 3.43 respectively, and 22.57 and 2.96 for the control group.

In order to determine whether academic achievement for the experimental group was better than that of the control group, a *t*-test on the two populations was performed at the 5% level of significance. From the analysis of the *t*-test, it is concluded that the academic achievement for the experimental group is significantly better than that of the control group. This fact tells us that the experimental hypermedia CAI system had a positive effect on the students' academic achievement.

1. Introduction

Current computer technology makes it possible to store and retrieve information of several data types, including images, voices, and texts. Hypermedia (Conklin, 1987) is a database that consists of a collection of nodes containing unformatted multimedia data, which are interconnected by directed links and are retrieved non-linearly. There are many practical applications of hypermedia. In the field of education, computer assisted instruction (CAI) involving hypermedia technology raises the possibility of improving students' academic achievement using computers.

Many educators assume that hypermedia CAI systems stimulate students' motivation and curiosity and improve their ability to memorize new facts. However, few statistical studies have been carried out that can verify this assumption. This may be due to the fact that, while it is easy to develop a hypermedia CAI system, it is relatively difficult to carry out an experiment on a large sample of students over an extended period of time. Thus, though many researchers in the field of education are interested in measuring the effects of CAI systems on students' academic achievement, the only studies that have been carried out so far are those with small sample populations, measured over short periods of time.

Chou (1996) developed a hypermedia music CAI system and carried out an experiment to evaluate the system in an elementary school in Chungli, Taiwan. Sixty students of the sixth grade participated in the study for 40 minutes. Sixteen students were assigned to the experimental group and the rest were assigned to the control group. The experimental group studied with the hypermedia music CAI system, while the control group studied the same material in the traditional lecture format. A post-test was given to the students at the end of the experiment. The results of the *t*-test indicate there was no statistically significant difference between the two groups.

Matthew (1996) performed an experiment to compare the reading comprehension and attitudes toward reading of third grade students. The study compared students who read CD-ROM interactive storybooks with students who read traditional print storybooks. After reading, a comprehension test was assessed with open-ended questions and requests to retell the story. The results of the *t*-test indicate that there was no statistically significant difference in the reading comprehension of two groups but that there was a statistically significant difference in their ability to retell the story.

Like the studies just mentioned, the present study attempts to measure the effects of a hypermedia CAI system on students' academic achievement. However, the present study has the advantage of being based on an experiment that is performed over a longer period of time and with a larger sample.

2. The Experimental CAI System

An experimental hypermedia CAI system with an emphasis of improving reading skills was developed using Hanol 3.0 on an IBM compatible PC (Protectsoft, 1997). The pedagogical material for this experimental system came from the first chapter of a standard social science textbook for fifth grade students in Korea. The chapter is typically taught in 40-minute sessions over a total of 19 hours.

The characteristics of the experimental CAI system are the following. First, students interact with the system primarily using a mouse, which allows for easy mastery of the system. Secondly, the system contains a summary of the contents of the chapter being studied. Thirdly, important and difficult words in the chapter are given hyperlinks, which connect them to a glossary and which also allow users to have a sampled pronunciation of the word. Fourthly, photographs and other visual materials are included in order to stimulate students' interest and help them to understand the material. Fifthly, the system contains games and questions, which students may use to test their knowledge of the chapter. Finally, for the convenience of the user, the system contains hypermedia interfaces.

3. Test for the Evaluation of the Subjects

In order to evaluate students' academic achievement, a test was developed. The test consists of 30 questions based on the content of the relevant chapter from the text. The test was given to the students both before and after they studied the relevant chapter.

4. Subjects

Fifty-five fifth-grade students from two classes in two elementary schools in Cheonan, Korea participated in the study. They were ranked on the basis of IQ scores and school grades from the previous semester. They were divided into two groups based on this ranking, with the experimental group consisting of 27 students, and the control group consisting of 28 students. The detailed data are shown in Table 1.

SUBJECTS	ELEMENTARY SCHOOL NAME	GRADE/CLASS	MALE	FEMALE	TOTAL
Experimental Group	Anseo	5/1	4	2	27
	Inju	5/1	10	11	
Control Group	Anseo	5/1	4	2	28
	Inju	5/1	11	11	

Table 1 Sample Subjects

5. Procedures of the Experiment

Pre-test

In order to determine whether or not there was any difference in the prior knowledge of the relevant chapter between the experimental group and the control group, the aforementioned test was given to the subjects before the experiment.

Experiment

For the first 25 minutes of a 40 minutes class, all subjects studied together in the standard manner. For the final 15 minutes, the experimental group studied using the hypermedia CAI system in a computer lab with two assistants, while the control group continued in the standard manner. This experiment was repeated for 19 class hours, 4 classes per week over 5 weeks. A summary of the classes is given in Table 2.

	40-minute classes		Period
	First 25 minutes	Final 15 minutes	
Experimental Group	Standard manner	CAI	4 classes per week over 5 weeks
Control Group	Standard manner	Standard manner	19 class hours

Table 2 Unit Class Type and Period

Post-test

In order to determine whether or not the experimental CAI system had any affect on the academic achievement of the students in the experimental group, the aforementioned test was repeated on all subjects at the end of the experiment.

6. Statistical Analysis

Data collected from both the pre-test and the post-test were analyzed using the statistics software SAS (SAS Institute Inc. 1995).

Analysis of the Pre-test

The average and the standard deviation of scores for the experimental group are 9.40 and 2.22 respectively, and for the control group 9.42 and 2.96 (full score: 30). The scores were analyzed using a *t*-test. Table 3 shows the results of the *t*-test, where *N* represent the sample size of each group, *t* the *t*-value, *df* the degree of freedom, and *p* the observed significance level. For a *t*-value of -0.0360 with degree of freedom of 53, the *t*-test yielded a *p*-value of 0.9714. This result indicates that in prior knowledge for the relevant chapter, there was no statistically significant difference between the two groups at the 5% level of significance. Therefore, one can conclude that the experimental and control groups were well constituted.

Analysis of the Post-test

In order to examine the data from the post-test, the following hypotheses were tested using a *t*-test.

Null hypothesis: $\mu_c = \mu_c$

The academic achievement for the experimental group is equal to that of the control group.

Research hypothesis: $\mu_e > \mu_c$

The academic achievement for the experimental group is better than that of the control group.

	N	Average/30	Standard Deviation	Minimum Score	Maximum Score	t	df	p
Experimental Group	27	9.40	2.22	6	14	-0.0360	53	0.9714
Control Group	28	9.42	2.96	5	13			

Table 3: *t*-test for the Pre-test

The average and the standard deviation of scores for the experimental group are 25.18 and 3.43 respectively, and for the control group 22.57 and 2.96 (full score: 30). The scores were analyzed using a *t*-test. Table 4 shows the result of the *t*-test. For a *t*-value of 3.039 with a degree of freedom of 53, the *t*-test yielded a *p*-value of 0.0037. Therefore the null hypothesis is rejected, and one can conclude that, at the 5% level of significance, the academic achievement for the experimental group was significantly better than that of the control group.

	N	Average/30	Standard Deviation	Minimum Score	Maximum Score	t	df	p
Experimental Group	27	25.18	3.43	16	29	3.039	53	0.0037
Control Group	28	22.57	2.96	16	29			

Table 4: *t*-test for the Post-test

7. Conclusion

The question with which this study is concerned is whether or not a hypermedia CAI system can enhance or improve students' understanding of academic material. In order to answer this question, an experimental hypermedia CAI system was developed and then tested on a group of elementary school students in Korea. The data from the experiment, which were examined statistically, demonstrate that the experimental CAI system was indeed effective in improving students' understanding of academic material. This conclusion conflicts with the earlier study by Chou, who found a similar CAI system to have no effect on academic achievement. However, since the present study is based on an experiment conducted over a longer period of time and with a larger sample size, its conclusion is more credible.

One limitation of the present study is that the experiment involved a relatively homogeneous sample population: all subjects were elementary school students in Korea. Further research is therefore necessary to determine the extent to which the conclusion of this study may be generalized to students of other ages and/or cultures.

8. References

Conklin, J. (1987). Hypertext: an Introduction and Survey. IEEE Computers, 17-41, September.

Chou, H. (1996). Evaluation of a hypermedia music CAL system, Proceedings of Educational Multimedia and Hypermedia, Boston, Mass, June 17-22, 142-147.

Matthew, K., I. (1996). A comparison of the influence of CD-ROM interactive storybooks and traditional print storybooks on reading comprehension and attitude, Proceedings of Educational Multimedia and Hypermedia, Boston, Mass, June 17-22, 790.

Protectsoft (1997). User's Guide, Protectsoft.

SAS Institute Inc. (1995). SAS/STAT User's Guide, Version 6.3 Edition, SAS Institute Inc., Cary, NC.

Effects of Cognitive Style on Web Search and Navigation

Kyung-Sun Kim
School of Information Science and Learning Technologies
University of Missouri – Columbia
United States
kimk@missouri.edu

Abstract: This study examined how users with different cognitive styles locate information on a university Web site, a hypermedia-based information system. A hypermedia system is considered to be capable of accommodating cognitive style differences because of its multimodal attributes. Undergraduate students with different cognitive styles (field-dependence and field-independence) participated in the study. Findings suggest that the level of users' online search experience influenced effects of cognitive style on the search and navigational behavior. Only the field-dependent users with little or no online experience seemed to have difficulties in retrieving information on the Web.

Introduction

Hypermedia is one of the recently developed information technologies equipped with attractive interface and great capacity of improving access to information. By way of the World Wide Web (Web) and other networks, hypermedia has come to include remote databases and online resources (Ayersman, 1996). Naturally, the Web, with its attractive interface and capability of connecting to a variety of diffcrent resources, has become one of the most widely used information systems in the world.

Different from more traditional information systems (e.g. books), hypermedia is intentionally nonlinear (Nielsen, 1995). It presents a new information environment with which the user may not be familiar. Hypermedia permits the user to have considerable flexibility in choosing the sequence with which to access information, rather than forcing the user to access information in a fairly linear sequence. Such linear sequencing has long been prescribed by the technology of the book and the narrative structure used by most authors. Users who have not developed skills of information-gathering in the nonlinear environment often report discomfort and experience difficulties in using hypermedia, such as "cognitive overload" and "disorientation" (Nielsen, 1995; Conklin, 1987).

Despite all these problems, early research suggests that hypermedia is promising as an information system (Gary and Shasha, 1989; Egan et al., 1989). Other studies evaluating the effectiveness of hypermedia, however, have not been uniformly successful in showing the advantage of hypermedia over other existing information systems (McKnight et al., 1990; Marchionini and Shneiderman, 1988). These inconsistent findings have led to a suspicion that there may be variables, other than system differences, influencing the effective use of hypermedia systems. To explore and identify factors influencing the effective use of hypermedia, a number of studies have been conducted. Results from the research suggest that characteristics of users and tasks may be major factors affecting the use of hypermedia systems (Qiu, 1993; Ford et al., 1994).

This study investigates how some of user variables influence the use of the Web as a hypermedia-based information system. The focus of the study is on the user's cognitive style, and its effects on the search behavior are examined in relation to the user's online search experience.

Background

A study analyzing usability studies of hypertext systems has revealed that four of the ten largest effects were due to users' individual differences (Nielsen, 1989). Among different kinds of individual differences, cognitive style, especially field-dependence/field-independence (FD/FI), is one of the most frequently studied factors in the research of learning on hypermedia systems (Liu & Reed, 1994; Leader & Klein, 1996). The FD individuals who tend to be easily dominated by salient cues are more likely to be distracted in hypermedia systems where information units are presented through a variety of different, attractive media forms. In fact, several studies have shown that the FI individuals, less likely dominated by prominent stimuli, generally perform better than the FDs in finding information on hypermedia systems. The FIs tend to search information more efficiently and arrive at desired goals more quickly than the FDs (Ellis et al., 1993; Ford et al., 1994). Each group utilize a hypermedia learning environment differently although both of the groups have equivalent learning outcomes (Fitzgerald and Semrau, 1998).

Another kind of individual difference with a strong impact on the information-seeking process includes users' experience and expertise. Experience with online search and subject expertise have been found to influence the choice of search strategies and the search performance on information systems. Studies on linear information systems have revealed that online search experience, rather than subject expertise, plays the major role in determining the effective use of the systems (Hsieh-Yee, 1993). However, this finding is yet to be confirmed with hypermedia-based information systems.

The Study

Forty-eight volunteer students from a public university participated in this experiment. Their participation was financially compensated. All the participants were undergraduate students with different academic orientations. Fifty-four percent (n=26) of the participants were with soft science (social science, arts and humanities), and 46% (n=22) were with hard science (natural science and engineering) background. Half of the participants were male and the other half were female students.

The GEFT (Group Embedded Figures Test) and a questionnaire were used to determine the cognitive style and the level of online database search experience, respectively. Based on the results from the test (with scores ranging from 0 to 18) and questionnaire (with scores ranging from 0 to 4), participants were selected, and an individual lab session was arranged for each of the participants. Half of the participants were field-dependent (FD) and the other half were field-independent (FI): $Mean_{FD} = 8.25$, $Mean_{FI} = 15.96$. Also, half of them were novice and the other half were experienced online searchers; $Mean_{NOV} = 0.92$, $Mean_{EXP} = 2.96$. In the lab session, the participant was assigned search tasks for which he or she had to locate pertinent information within a university Web site. The Web browser used in the study was *Netscape 4.0*.

Independent variables for the study include users' cognitive style (field-dependent (FD) vs. field-independent (FI)) and online database search experience (experienced (EXP) vs. novice (NOV)). On the basis of their cognitive style and online experience, participants were evenly divided into four groups (FD-NOV; FD-EXP; FI-NOV; FI-EXP). Two dependent variables were adopted to measure search performance of the participants: the average time spent and the average number of nodes visited for the completion of a task. Additionally, the number of times each navigational tool chosen was counted to examine the user's search and navigational style.

The individual lab session started with a review of Web basics, designed to ensure that every participant was aware of the availability of different navigational/search tools and menus in the Web browser used and also general features of search engines. When the review was over, two search tasks were assigned to the participant. The same set of search tasks were used for all the participants. When the participant felt ready to start searching, he or she asked the researcher to start recording the search session. During the search session, all the screen displays consulted and keyboard/mouse inputs were recorded using *Lotus ScreenCam*. The participants were asked to make a bookmark of each Web page where he or she found relevant information.

Results

Average Length of Time Spent for the Completion of a Task

A two-way ANOVA was performed for the average length of time spent for the completion of a task. In this report, the level of significance was set at $p < .10$. The result indicated a significant main effect of cognitive style: $F_C\ (1,44) = 5.271$, $p < .03$. The FD individuals tended to spend more time than the FIs to find a piece of information: $Mean_{FD} = 130.3$ sec., $Mean_{FI} = 89.9$ sec. A significant main effect of online search experience was also found: $F_O\,(1,44) = 3.69, p < .07$. To find information on the Web, those with little or no online search experience spent more time than those with substantial online search experience: $Mean_{NOV} = 127$ sec., $Mean_{EXP} = 93.2$ sec. There was a significant interaction between the two independent variables: $F_{C \times O}\ (1,44) = 3.859$, $p < .06$. Figure 1 shows how the cognitive style and online search experience variables interacted with each other to influence the time spent for the completion of a task.

	df	F
Cognitive Style (C)	1	5.271*
Online Experience (O)	1	3.690*
C x O	1	3.859*
Within Groups	44	

* $p < .10$

Table 1. Analysis of Variance on the Average Time Spent for the Completion of a Task

For those with considerable online search experience, cognitive style seemed to have little impact: *Mean* $_{FD\text{-}EXP}$ = 96.1, *Mean* $_{FI\text{-}EXP}$ = 90.3. For those with little or no online experience, however, cognitive style seemed to play an important role in decreasing or increasing the length of time spent for the completion of a task. The FDs (FD-NOV) tended to spend longer time to retrieve information than the FIs (FI-NOV): *Mean* $_{FD\text{-}NOV}$ = 164.6, *Mean* $_{FI\text{-}NOV}$ = 89.5. Interestingly, the FDs with substantial online experience spent almost the same amount of time as the FIs (FI-NOV and FI-EXP) did for the completion of a task. It seems that, only among those with little online experience, cognitive style has an effect on the time spent for finding information.

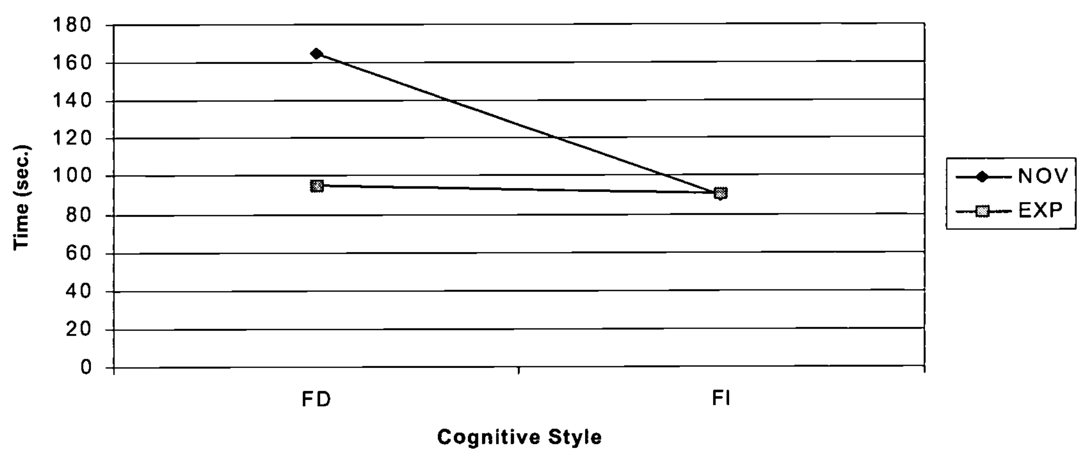


Figure 1. Average Time Spent for the Completion of a Task (sec.): Cognitive Style by Online Search Experience

Average Number of Nodes Visited for the Completion of a Task

A two-way ANOVA was performed for the average number of nodes visited for the completion of a task. At $p < .07$, a significant interaction between cognitive style and online experience was found: $F_{C \times O}\ (1,44) = 3.57$. As shown in Figure 2, the FI-NOV tended to visit a lower number of nodes than the FD-NOV: *Mean* $_{FI\text{-}NOV}$ = 7.3, *Mean* $_{FD\text{-}NOV}$ = 11.7. Among the experienced online searchers, on the other hand, little difference was found between the FIs and the FDs: *Mean* $_{FI\text{-}EXP}$ = 8.5, *Mean* $_{FD\text{-}EXP}$ = 7.8. The pattern was similar to what was found with the time spent for the completion of a task. No significant main effect was found, however. That is, no statistically significant difference existed between the numbers of nodes visited when the groups were compared on the participants' cognitive style or on the level of their online search experience.

	df	F
Cognitive Style (C)	1	2.029
Online Experience (O)	1	1.005
C x O	1	3.570*
Within Groups	44	

* $p < .10$

Table 2. Analysis of Variance on the Average Number of Nodes Visited for the Completion of a Task

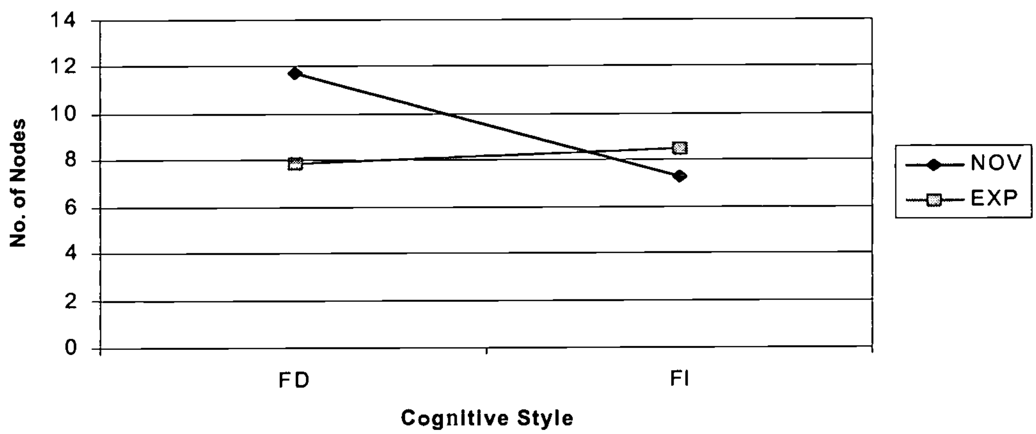


Figure 2. Average Number of Nodes Visited for the Completion of a Task: Cognitive Style by Online Experience

Use of Navigational Tools

In order to find whether differences in search performance were reflected in the navigational tools chosen, additional sets of two-way ANOVA were carried out using the number of times different navigational tools were used (such as embedded links, Back, Home, Go, History, search engines, etc.) as the dependent variable. Significant interactions were found for the use of embedded links and the Home button: for embedded links, $F_{C\,x\,O}\,(1,44) = 5.002, p < .04$, and for the Home button, $F_{C\,x\,O}\,(1,44) = 3.728, p < .07$. The pattern of interactions was similar to the one found with the time spent and the number of nodes visited for the completion of a task. The FDs with little or no search experience (FD-NOV) used embedded links and the Home button significantly more frequently than the rest.

In addition to the interaction effects found in the use of embedded links and Home button, a significant main effect of online experience was found in the use of jump tools: $F_O\,(1,44) = 6.568, p < .02$. Here, jump tools include Go, History, Location box used for an "active" jump. The result revealed that the experienced online searchers used jump tools more frequently than the novice searchers: $Mean_{EXP} = 0.60$, $Mean_{NOV} = 0.005$.

Discussion

Results from this study suggest that the level of users' online search experience influences the effect of cognitive style on the search performance. That is, among those who had little or no experience with online searches, the FI individuals tend to outperform the FDs. In order to complete a search task, the FIs spent less time and needed to visit fewer nodes than the FDs. However, the difference created by participants' cognitive style disappeared in those participants who had considerable online search experience. Among the experienced online searchers, no significant difference was found between the FDs and the FIs in terms of the time spent and the number of nodes visited for the completion of a task. This implies that difficulties that the FDs face in finding information on the Web may be overcome as the FDs gain experience and develop their search strategies while using online databases. Despite presentational and structural differences between traditional "linear" online database systems and the "non-linear" Web, skills required for using online databases seem to be transferred to the use of Web sources.

With regard to the choice of navigational tools, a similar interaction effect was observed. In the group of individuals with little or no online search experience, the FDs used embedded links more frequently than the FIs. The frequent usage of embedded links can be interpreted as a linear rather than a non-linear way of navigation. It is because other tools (such as Go, History list, or a typed URL) allow the user to jump to more temporally removed point whereas embedded links do not. Findings from the study implies that the FD-NOVs navigate the Web in a more linear mode than the rest. In fact, this might be the way in which we would expect the "typical" FD would navigate. The FDs prefer a well structured set of stimuli. As they tend to be passive in learning (Witkin et al., 1977), the FDs would not enjoy imposing a structure of their own. Thus, the FDs are more likely to navigate the Web in a linear mode. Previous studies on the use of hypermedia systems found that the FDs tended to explore a hypermedia system in a linear mode, following the sequence encouraged by the system (Liu & Reed, 1994). This finding is, however, only partly supported by our study. In our study, only the FDs with little or no online experience demonstrated the linear mode of navigation. The way in which the FDs with considerable online search experience navigated the Web was different from the way in which the FDs with little online experience did. The FDs with substantial online search experience had a navigational style, reflected in their use of tools, which was rather similar to the FIs'. Their search performance, reflected in the time spent and the number of nodes visited for the completion of a task, was also comparable to the FI's.

In this study, the FDs with little or no online experience tended to use Home button more frequently than the rest. The use of Home button can be viewed as one possible indication of the user's "getting lost," because the Home button is often used when people wish to start over, abandoning whatever they have been doing. Based on this interpretation, the result implies that the FD-NOVs get lost more often than the rest. It is known that the FDs tend to be easily distracted in a complex field by cues that may not be relevant to the goal (Witkin et al., 1977). Hence, the FDs are expected to become easily lost through the pursuit of more dominant but possibly irrelevant cues. Again, findings from our study supports the hypothesis only partially. Among the FDs, only those with little or no online experience tended to get lost more easily than the rest, including the FDs with substantial online search experience.

The FDs, especially those with little or no experience with online databases, seem to need special attention from interface designers and those who train Web users. Interface designers may want to incorporate devices that can help the FDs be better oriented and less likely to get lost. Providing a graphical map of their search progress would be an example, and several studies have found it to be effective in terms of resolving the problem of disorientation (Chen & Rada, 1996). With the browser interface, it might also be helpful to provide a visible history list, showing all sites the user has visited and functioning like a map, at the same time. Such a list should be readily available, rather than requiring the user to make an active search for it through several pull down menu listings (which is often found in "linear" online systems). This would be useful to the FD users because the list could be used as a map showing what has been visited and also provides an easy way to return to some temporally distant, previously visited sites. Web search trainers might examine the finding that online database search experience was particularly beneficial to FD users. The exact reason is not clear, however. It may be because the heavily text-based design of both the Web and online databases appear the same to the user even though they may have very different features and intents. It may be because the Web has inherited many interface features from the traditional linear online systems. It may also be that the knowledge and skills for using online databases are useful regardless of the system used. Obviously more research is called for to investigate these potential explanations.

References

Ayersman, D.J. (1996). Reviewing the research on hypermedia-based learning. *Journal of Research on Computing in Education*, 28 (4), 500-525.

Campagnoni, F.R, & Ehrlich, K. (1989). Information retrieval using hypertext-based help system. In Belkin, N.J. & Rijsbergen, C.J. (Eds.) *Proceedings of the 12th Annual International ACMSIGIR Conference* (pp.212-220). New York: ACM.

Chen, C. & Rada, R. (1996). Interacting with hypertext: a meta-analysis of experimental Studies. *Human-Computer Interaction, 11*, 125-156.

Conklin, J. (1987). Hypertext: An introduction and survey. *IEEE Computer, 20*, 17-41.

Egan, D.E. et al. (1989). Behavioral evaluation and analysis of a hypertext browser. *CHI'89 Wings for the Mind Conference Proceedings*, 205-210.

Ellis, D., Ford, N. & Wood, F. (1993). Hypertext and learning styles. *The Electronic Library, 11* (1), 13-18.

Fitzgerald, G., & Semrau, L. (1998). The effects of learner differences on usage patterns and learning outcomes with hypermedia case studies. *Journal of Educational Multimedia and Hypermedia, 7*(4), 309-332.

Ford, N, Wood, F.E. & Walsh, C. (1994). Cognitive styles and searching. *Online and CD-Rom Review, 18* (2), 79-86.

Gary, S.H. & Shasha, D. (1989). To link or not to link?: Empirical guidance for the design of nonlinear text systems. *Behavior Research Methods, Instruments and Computers, 21* (2), 326-333.

Hsieh-Yee, I. (1993). Effects of search experience and subject knowledge on the search tactics of novice and experienced searchers. *Journal of the American Society for Information Science, 44* (3), 161-174.

Leader, L.F. & Klein, J.D. (1996). The effects of search tool type and cognitive style on performance during hypermedia database searches. *Educational Technology Research & Development, 44* (2), 5-15.

Liu, M. & Reed, W.M. (1994). The relationship between the learning strategies and learning styles in a hypermedia environment. *Computers in Human Behavior, 10* (4), 419-434.

Marchionini, G., Lin. X. & Dwiggins, S. (1990). Effects of search and subject expertise on information seeking in a hypertext environment. *Proceedings of the 53rd Annual Meeting of the ASIS*, 129-142.

Marchionini, G. & Shneiderman, B. (1988). Finding facts and browsing knowledge is hypertext systems. *IEEE Computer, 21* (1), 70-80.

McKnight, C, Dillon, A. & Richardson, J. (1990). A comprehension of linear and hypertext formats in information retrieval. In McAleese, R. & Green, C. (Eds.), *Hypertext: The state of art.* (pp. 10-19). Oxford, England: Intellect Books.

Niclsen, J. (1995). *Multimedia and Hypertext: The Internet and beyond.* Cambridge, MA: Academic Press.

Nielsen, J. (1989). The matters that really matter for hypertext usability. *Proceedings of ACM hypertext '89*, 239-248.

Qiu, L. (1993). Analytical searching vs. browsing in hypertext information retrieval systems. *Canadian Journal of Information and Library Science*, 18 (4),1-13.

Witkin, H.A. et al. (1977). Field dependent and field independent cognitive styles and their educational implications. *Review of Educational Research, 47*, 1-64.

The Often Missing but Essential Component for Online Learning: a Learning Resource Catalogue

Tony Koppi
Lisa Hodgson
Jason Bayly
Educational Development and Technology Centre (EDTeC)
University of New South Wales
Australia
t.koppi@unsw.edu.au
l.hodgson@unsw.edu.au
j.bayly@unsw.edu.au

Abstract: This paper is concerned with the four main integrated components of online learning: an administration management system; an authoring system; a learning resource catalogue; and a delivery system. The four components are set against the evolution of the concept of 'learning objects' which strongly influence how learning resources are authored and upon which a learning resource catalogue is based. Learning objects are generally small discrete chunks of learning materials that are reusable and can articulate with other learning objects to make a learning environment. Learning objects can be described in standard terms (i.e., metadata) through the use of a web application and those data can be submitted to an online searchable database to enable their use in other contexts and combinations.

Introduction

A change to educational management, funding and expectations over the last several years in numerous countries has resulted in a more technologically mediated educational environment. The use of technology to aid in the delivery of courses has resulted in a diminishing of the physical boundaries of the university while increasing the potential student pool. International and geographically removed students are increasing as a viable market for any institution as Educational delivery becomes more globally available and location is no longer such a restricting component. Professional students more and more are requiring continuing education and postgraduate qualifications while demanding that their studies fit into their existing lifestyle and work commitments. As a result access to courses has become a highly influential factor for potential students and institutions can no longer rely on academic reputation alone. Additionally, research-intensive universities are addressing the increasing time demand on their academics to be subject matter experts, lecturers and accomplished researchers. Institutions not addressing these issues will miss out on this increasing student market in the evolving consumer driven model of education.

Most institutions worldwide have made educational technology a prime emphasis as a solution to addressing these issues and tapping into the changing student needs.

The implementation of technology in education has passed through three broad phases. Each of these phases came about as a proposed solution to the primary weakness identified after the practical application of each phase.

The first phase of educational technology arose from the idea that technology could be utilised to communicate with the masses. Educational institutions adopted this notion as a strategy for increasing student markets in the evolving consumer driven model of education. In its early adoption, educational technology components were designed by academics keen to embrace this new delivery method. However the vast amount of technologies that emerged due to the boom of the Internet, quickly overwhelmed the academics whose area of expertise was not technology. Two components were identified as being essential and central to this phase's implementation of an online learning system: the authoring system and the delivery system. In its most basic form one example of this system would be an HTML editor and a web browser.

The second phase came into being to address the lack of technological expertise in the academic environment. This involved the addition of technologically trained staff to the university environment and centralised units to aid academics in developing these educational technology components. With the centralisation of specialised technological staff came a more institution-wide recognition of educational technology. It is at this stage that a new component to the online learning system was added: an administration management system. While this phase served its initial purpose, it pushed to the forefront a new issue. Although deemed beneficial, educational technology developments were proving to be highly resource intensive in terms of both time and money. Additionally, the cost effectiveness of such developments to the institution was poor as it usually only benefited a few academics and their students.

The third phase is the phase we are currently entering. The Learning Object model has been proposed as the new solution in educational technology. Loosely derived from an object-oriented programming model, it primarily aims to address the issues of reuse of materials. The learning object model is characterized by the belief that we can create independent chunks of educational content that provide an educational experience for some pedagogical purpose. These chunks are self-contained although they may contain references to other objects; and they may be combined or sequenced to form longer educational interactions (Quinn, 2000). While a learning object is not necessarily a digital object the remainder of this paper will focus on learning objects that are exclusively digital.

The new essential component for this model is a system for storing and cataloguing these learning objects, here called a learning resource catalogue. If this latest model for educational technology is to succeed, the three components identified from the earlier phases must be tightly integrated with this new, but often missing, essential fourth component.

This paper briefly examines the concept of learning objects then considers their use in the four main components (exclusive of hardware) required to facilitate online learning environments – administration and management, authoring, delivery and learning resource cataloguing. Each component is considered in sufficient detail so as to define their ingredients, complexity, scope and to identify their inter-relationships. This will enable the relevance and importance of the learning resource catalogue to be appreciated. The strength of any system or framework lies in the integration of the components.

The learning object model

A learning object is "any entity, digital or non digital, which can be used, reused or referenced during technology supported learning" (IEEE's Learning and Technology Standards Committee, 2000). Learning objects are also fundamental to the IMS system (IMS, 2000).

Material that may be thought of as 'content', if developed as assemblages of small, discrete learning modules or 'chunks', may be considered to be composed of 'learning objects'. If these learning objects are discrete enough, they may be re-used in conjunction with other learning objects in different contexts. The concept and practice of developing digital learning resources as learning objects has a profound influence on the development of learning resource catalogues (as discussed below).

The learning object model has been proposed by many in the educational community as an optimal solution to many of education's long-standing problems with the development of educational technology materials. The main problems that the learning object model aims to address are: the time and expense involved in development of learning materials; the sharing of expertise and knowledge between academics and scholars, and the globalisation of education.

There are benefits to be gained in making and submitting learning objccts to be reused by others. Such benefits could include: the prestige of having made a popular and useful resource; peer acknowledgement of teaching quality; contribution to promotion prospects; financial gain if the learning objects compete in a market economy, and a route to publication (measured by citations) without the formal publications system.

There are benefits to utilising learning objects made by others. Such benefits include: savings of time and expense; being able to compare and select teaching resources from various sources; being able to readily benchmark, and gaining teaching insights and expertise from others.

Types of learning object

The concept of a learning object is still evolving. A learning object can vary in size and complexity. In its simplest form a learning object is context free and may be an image, video or piece of text such as a poem. This simple form has a very large reuse potential because it can be used in a wide range of contexts, disciplines, learning strategies and so on. From this simply beginning learning objects can grow in complexity to include context, learning objectives, pedagogy and so forth. In general, the more complex a learning object, the more limiting is its potential for reuse.

The four main components of online learning

Apart from hardware considerations, for the creation of efficient online learning environments, several components are necessary. Essentially these are: an administration management system; an authoring system; a learning resource catalogue; and a delivery system.

(1) Administration management system

The online administration management system should include facilities like student enrolment, student profiles, class lists and available courses. Fixed-cost financial transactions may also be facilitated by this system but other costs will depend upon usage of option resources at a later stage (e.g., printing and library borrowing). Such an administration management system would allow faculty members to view the student records and profiles from their desktop computer. Students would be able to view their own records, course information and class lists, for example.

An enterprise-wide online administration management system requires high-level institutional management commitment because of the associated costs and institutional changes that necessarily accompany the adoption of such an approach. Institutional commitment to this change must exist at the top as well as with faculty members. One will not work without the support of the other.

(2) Authoring system

From a digital perspective, an authoring system consists of tools that operate at two levels: firstly, the tools to create learning objects that may be thought of as 'content' and secondly, the tools to aid in the modification and sequencing of learning objects into a cohesive learning environment. As indicated above, there are many types of learning object that include 'content' as well as the activities and methods that are all part of a learning environment.

The creation of the learning objects, and their subsequent use, will depend upon the needs, educational rationale, learning objectives and delivery strategy that have been determined prior to the utilisation of any such tools. Content creation includes tools for web authoring, multimedia creation and simulations. Digital content creation may be relatively simple if it is concerned mainly with text and complex if it includes the use of several media such as video and graphics. Programming to varying extents is also usually required, particularly if several media are to operate together, and that programme itself may be considered to be a learning object that can be reused. The content may then reside in several files, databases and on different servers.

(3) Learning Resource Catalogue

In the overall picture, a learning resource catalogue (LRC) works a s follows. An instructor creates a learning object, then generates a description of it (i.e., creates metadata) by describing the object using a set of standardized terms, then submits the metadata to the learning resource catalogue. Another instructor would then search the catalogue based on the same standardised terms. Upon finding a description of an object that suits a particular purpose, the instructor can contact the creator through the catalogue system and negotiate reuse of the object. It should be noted that the learning object itself is not submitted to the database; only the metadata is stored in the database. An analogy is given by a newspaper advertisement for an object – the metadata is the advertisement and the object is in the home of the owner.

Once a LRC is heavily populated, it should be possible for users to find sets of objects that suit various purposes, and thereby significantly cut down on development costs associated with content creation of learning materials.

Once learning objects have been created, they should be catalogued in a searchable database for the purposes of reuse and keeping an inventory of the organisation's resources of learning objects. The inventory would then provide a starting point for any potential developments.

An LRC may also be known as a 'knowledge repository' or 'digital resource library'. However, these terms may not be synonymous and a LRC is here defined as a database of metadata describing learning objects. Digital learning objects are noted above as being discrete with qualities that enable them to be re-used in different contexts and by other teachers and students who wish to share these resources for the sake of efficiency.

Learning object metadata (LOM) should be derived from a learning object according to a standard method because the use of standards enables consistency of usage and communication. The IMS metadata standard (IMS, 2000) is rapidly becoming the international standard for LOM, and is based on the IEEE Learning Objects Metadata standards (IEEE, 1999). The essential functionality of a LRC is that LOM should be simple to generate and submit to a database that is easily searchable.

During the creation of learning resources with various authoring tools, it is not standard practice to derive and save LOM concerning those resources because the concept of a learning object and LOM are not yet sufficiently part of the academic culture. Likewise, it is not yet standard practice to submit that LOM to a searchable database. As a consequence it is difficult for individuals to know of, and to be able to locate, desirable learning objects. From an author's perspective, it means that many learning objects are being recreated, possibly within the same institution. This is wasteful in development time and money and also in delayed time to delivery that could have been faster had the author known of existing available learning objects. From a learner's perspective, it means that relevant learning objects that may have aided learning could not be located.

The IMS LOM system is extensive with nearly 100 fields (at the time of writing this paper) for describing learning objects. Deriving LOM for each learning object created by an author could be an undesirable task, especially if it adds considerable time to the development process. The derivation of LOM must be simple and quick and yet still conform to the IMS standard. In a manual system, even if done on the computer through a simple interface, the process must not be onerous and must provide help on demand. Should clarity and simplicity not be part of the process of generating LOM, the adoption of the practice as a routine will not occur. At the present time, such a manual entry system is available and in increasing use. In time, it may become possible to have a system of automatic LOM generation from learning objects.

Once LOM has been generated, the metadata must be lodged in a searchable database. The digital learning object itself must reside at a fixed location if the metadata is to be useful. If the learning object is on a website then the URL must be permanent or the LOM must be editable (manually or automatically) for the new location to be entered.

A user, having discovered the location of a useful learning object (by searching the database of LOM, i.e., the LRC), may then contact the owner for permission to use that object, should any restrictions have been placed upon its usage by the owner. Ideally, usage rights of the LRC by students should be controlled by the management system.

An example of a practical application of a LRC will be demonstrated at the presentation by reference to the Universitas 21 LRC. This is a LRC developed for the Universitas 21 international consortium of universities as a means of identifying, cataloguing, finding and reusing learning objects amongst the member institutions.

(4) Delivery system

An online delivery system should include the means of enabling the learning objects to be organised by teaching staff for access by the students for specific purposes. It also includes facilities for enabling communication and dialogue interactivity between the learners and with the teacher(s). Assessment and feedback are usually also part of the delivery system. (Several delivery systems, with various features, are available off-the-shelf these days.)

The delivery system must articulate with the products of the authoring processes. The delivery system, if it is prescriptive, will determine and limit the authoring freedom. Therefore, the choice of authoring tools, and subsequent products, should take into account the constraints of the delivery system. Should the authoring products, as determined by the learning environment needs, exceed the capabilities of the delivery system, then customised delivery mechanisms need to be programmed (usually at extra cost).

Ideally, the delivery system and the administration management system should also articulate. This would enable teaching staff to incorporate class lists and provide access for those students to various appropriate learning resources and discussion groups, for example.

Conclusion

The integration of the above four components provides a framework for learning enablement. The concept of digital learning objects is evolving and is not yet part of the academic culture. Preparing learning objects as the basis for flexible teaching and learning environments will maximise their reusability and facilitate efficient production environments. The authoring of learning objects in the production environment is essential for the development and usage of learning resource catalogues. Similarly, easily accessible learning resource catalogues, at both the local and partnership levels, are essential to enable the efficient development and re-use of learning objects. Of the main components of an online learning system, learning resource catalogues are invaluable for use in an authoring and delivery system where the learning objects are available to teachers and students alike. Moreover, in any one institution, the learning resource catalogue, management system and authoring and delivery system must articulate with each other for maximum efficiency of online learning developments.

Acknowledgments

The authors would like to thank Kelley Williams for her editing comments.

References

IMS (2000). IMS Global Learning Consortium, Inc. http://www.imsproject.org/

IEEE (1999). Learning Objects Metadata. http://ltsc.ieee.org/doc/wg12/LOM3.8.html

IEEE's Learning and Technology Standards Committee. (2000). http://ltsc.ieee.org

Quinn, C. (2000). Learning Objects and Instructional Components. Discussion paper for the IFETS discussion forum: http://ifets.org/discussions/discuss_feb2000.html

Background for designing net-based learning situations

Mika Korpi
Information Technology Research Institute
University of Jyväskylä
Finland
mika.korpi@titu.jyu.fi

Abstract: In this paper I will present the main constructivist perspectives, which must be taken into account when designing learning situations in net-based learning environments (NBLE), such as TopClass. The perspectives are: constructing the knowledge, metacognition and self-directedness, and situated and meaningful learning. Then I will highlight some problems and how they could be possibly solved. The main problem is that the instructor or tutor has not enough tools to monitor the students' net-based learning process to be able to support it intensely. A possible solution to solve the problem is to use different kinds of tools to make the processes more visual. This kind of tools could also help the learners to better understand their learning. Ideas for these tools are discussed at the end.

Introduction

When we use the new net-based learning environments (NBLE's) it is obvious that it takes very much time and trouble to design and implement the net-based learning situations. It is thus easy to forget the constructivist principles and design the courses based on the traditional behaviorist learning paradigm (Häkkinen 1996). It is however impossible to apply the traditional models to a constructivist, learner-centered approach. In the traditional models, the goals are given from above, most of the learning paths have been determined in advance, and the learners are not able to control their own progress in the material. These models have been criticized also for their content-centeredness and surface learning. In some cases the traditional models are justified and efficient, but if deeper learning and more efficient learning skills are required, the learners' previous experience, knowledge and skills need to be taken into account. The learners have also to be offered a chance to set their own goals and to evaluate their learning in interaction with others in as authentic contexts as possible.

After discussing some constructivist principles I will expose some problems in net-based learning environments from the instructors or tutors points of view. The problem is to keep in touch with the students and monitor their learning in net-based learning environments in order to support them. Lastly I will introduce an NBLE's student monitoring tools and some ideas about the better tools we will test.

Constructing the knowledge

According to the constructivist view of learning, knowledge is subjective with various possible viewpoints. Knowledge is contextual and is collaboratively built. Thus it is not a ready-made and unchanging package that could be given to the learners. The learners are active processors of knowledge and central actors in the learning process. They form their own views and assimilate knowledge into their existing cognitive structures, adding to or deepening them. The constructivist conception assumes that all learners have an ability to learn. Talents are not a predestined, unchanging quality.

It is unlikely that the learners would build their own knowledge without being interested in the learning domain, or without setting their own goals in some ways. Their own activity, intentionality and emotions play a very important role in learning. This is emphasized especially in net-based learning environments. For example, frequently different kinds of technical problems during the course annoy students and decrease their studying activity.

Situated and meaningful learning

If knowledge is not a ready-made and unchanging package that could be given to the learners, then a teacher's role is more creating environments and possibilities for the learners to learn. The most effective environment for learning resembles the real life as closely as possible, replicating its typical elements and problems. Learning becomes meaningful when the learning environment has a genuine connection to the real world.

Situated learning means that learning is placed in a social and cultural context. An important part of information is meaningful only in relation to its context. From the viewpoint of learning, it is important that learning is not separated from the reality of the learner or the society. Winn (1993) argues that situational learning takes place when the learners work with authentic tasks in real-world settings. Authentic, real-life situations can simulate an expert's ways of action.

Metacognition and self-directedness

An essential part of learning and knowledge building are also the metacognitive skills. These refer to the ability of directing one's own learning. It is important to have good facilities for learning, because contemporary life constantly offers new challenges, and in the rapid increase of information it is impossible to learn everything. Thus it is important to acquire general principles, i.e. skills related to learning, thinking, co-operation and regulation of learning. Metacognition means the learner's awareness of their cognitive and emotional processes, such as remembering, knowing, thinking, and their ability to control them. On the basis of metacognitive knowledge, the learners can consciously follow and direct their own processes of learning and thinking. Metacognitive skills include, for instance, setting goals, planning learning, choosing suitable material, making consistent decisions, receiving and taking advantage of feedback, and evaluating learning. These skills help the learner to choose the right learning strategies in virtual learning environments.

When the learner has good skills in self-direction and metacognition and a deep knowledge of the domain, we can call him/her an expert learner or a specialist. He can control his learning. The opposite of an expert is a novice, whose knowledge on the subject matter is more superficial and self-direction skills are weaker than those of an expert. A novice needs guidance and support in learning and self-direction to be able to strive for expertise. The goal of a novice learner should be to become an expert.

Especially the novice-learner needs supporting e.g. for solve more complex tasks than he or she could solve alone. It is important that the learner gets support when she or he needs it and just the necessary amount to get further. This is a problem in net-based learning environments, the main problem is that the instructor has not sufficient tools to monitor the students' learning process to support it.

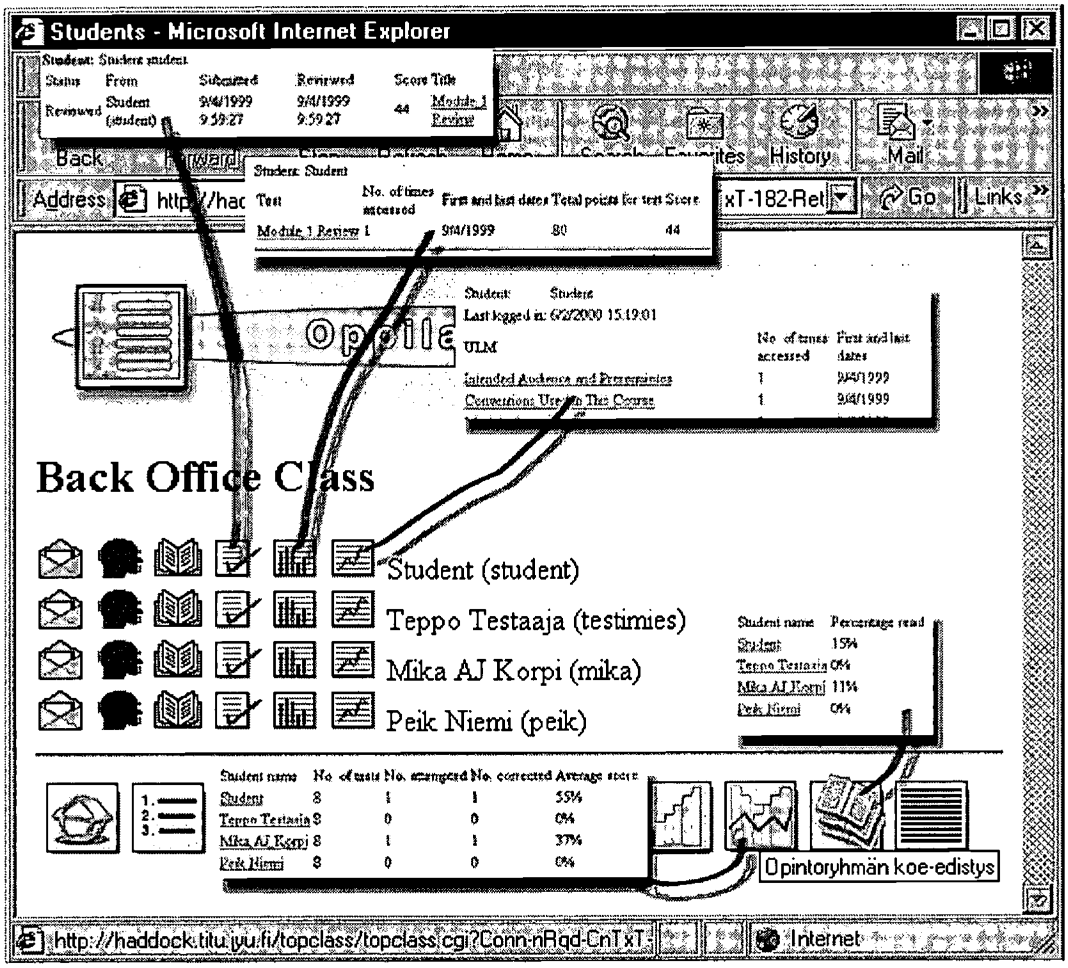
Supporting in NBLE

In net-based learning environments (NBLE), such as TopClass and Lotus Learning Space, the learner can be offered meaningful and authentic learning situations. It is easy for the learner to get different views to and make searches to the material but supporting is the problem. Net-based learning environments contain different kinds of discussion lists, shared workspaces, email, and chat facilities. It is also possible to create different help and hint systems. But how can the help-systems, tutors or instructors know when the student needs support if she or he does not ask for it? It is impossible or at least very hard to observe the learner closcly enough and get information about his or hers emotions. Server logs are very hard to read. Learning diaries would be one chance but they are not written "online" when things happen but afterwards when the strongest feelings have passed.

For example, TopClass has some tools to monitor the students. The instructors can view the status of the courseware for any of their assigned students or classes individually, and monitor how they are progressing. Picture 1 shows the different views that the instructors are able to see. The views are quite general telling just which percentage of the material has been read or how many points have been scored.

One possibility to enhance feedback would be a "feeling console" which gathers information about the learners' feelings and difficulties in their learning sessions. The console could also be used to obtain information about the problems in the environment. The console would consist of a few buttons and it could be very easy to use. It would be easier for the tutor to support the learner with the help of this additional information.

A visual log-analyzer could be another solution. At the moment one of our projects is developing such a tool. The tool can display different views of the log file to instructor, e.g. the student's navigations, when they have sent or read e-mail. The idea is that the instructor is able to quickly view pictures or animations of the students' actions in the NBLE. Both of these tools would help the instructor to obtain quickly and easily more information about the students to support them.



Picture 1: Top Class student and class monitoring tools.

Conclusions

The learner should be offered meaningful, authentic material that relates to real-world situations and problems. The learner needs also scaffolding, so she or he will be able to effectively build knowledge and develop his or her learning skills.

The four points of Goldman et al. (1998) sum up the main constructive principles that I presented in this paper.
1. Instruction is organized around meaningful learning and appropriate goals.
2. Instruction provides scaffolds for achieving meaningful learning.
3. Instruction provides opportunities for practice with feedback, revision and reflection.
4. Instruction is arranged to promote collaboration, distributed expertise, and entry into a discourse community of learners.

Scaffolding the student is the most difficult thing to achieve in NBLE. One way to make it easier or effective is to develop tools that provide different kinds of information about the students. With this additional information it is easier to scaffold the student when she or he really needs it.

References

Brown, J. S., Collins, A., & Duguid, P. 1989. Situated cognition & the culture of learning. Educational Researcher, 18 (1), 32-42.

Goldman, S. R., Petrosino, A. J. 1998. Design Principles For Instruction In Content Domains: Lessons From Research On Expertise And Learning. In F. T. Durso (Ed.), Handbook of Applied Cognition.

Häkkinen, P. (1996). Design, Take into Use and Effects of Computer-Based Learning Environments – Designer's, Teacher's and Student's Interpretation. University of Joensuu, Publications in Education, N:o 34.

Winn, W. 1993. Instructional Design and Situated Learning: Paradox or Partnership. Educational Technology 33 (3), 16-21.

From Intelligent Tutoring Systems to Intelligent Learning Materials

Jaakko Kurhila
Department of Computer Science
P.O.Box 26
FIN-00014 University of Helsinki, Finland
kurhila@cs.helsinki.fi

Erkki Sutinen
Department of Computer Science
P.O.Box 111
FIN-80101 University of Joensuu, Finland
sutinen@cs.joensuu.fi

Abstract: Special education offers a challenging background for designers of educational software. One learner group are those who have deficiencies in mental programming: they have difficulties in structuring a learning task in its entirety, and organizing the plan to go through it. Understood as a crew of collaborative co-learners, agents provide promising solutions to this area, to be applied also in other educational contexts.

Motivation

Special education suffers from the lack of computer science oriented research and moderate computer expertise in existing educational software. In fact, there are only few serious efforts of exploitation of state-of-the-art computer science methods and techniques to advance special education (see Klaus et al. (1996) and Edwards et al. (1998) for the *lack* of examples). Besides drills, there are only basic learning programs, but challenging and truly helpful learning environments do not exist. Most of the software for special education are for visually impaired users (Eriksson et al. 1997). There are also programs for motorically and/or hearing impaired, but cognitive impairments (e.g. people with learning difficulties) are rarely addressed. It seems that in the context of special education, computers are used mainly as assistive technology to overcome communication barriers, instead of educational tools to deepen the learning process.

Can one use those numerous adaptive learning environments that have been researched and produced for non-disabled education in special education? In general, no. The reasons are threefold, related to the user interface, the content, and the processing of the content (i.e. the storyboard of the program). In addition to the need of extra-ordinary input and output (Edwards 1995), the learning content (or the topic) is usually special. There is hardly any need for a Lisp course in the special education curriculum but the need for educating children to handle everyday life is essential.

Moreover, not only the topic must differ from standard educational software. The learning style among regular learner groups is rarely similar to that of non-disabled education. For example, let us assume a person cannot formulate problem-solving strategy for a simple task. In that case, the learning environment might have to partition the task into subtasks, so that the learner is lead to the final goal step-by-step (Kurhila and Sutinen 1998). These kinds of requirements result in programming-intensive solutions: the emphasis is no more in the quantity of information, but the way it is processed and presented to the learner. In order to deal with cognitive disabilities, the agents related to the user interface, the content and its processing, must cooperate with each other and the human cognition for a consistent learning experience. The challenges are deeper than finding another way for human-computer interaction. However, fresh solutions in the area of special education can contribute in a positive manner to regular education which after all consists of diverse learners, with special needs, though often hidden.

The shortcomings of available software and the challenges of special education provide an interesting scene to observe the functionality of agents in a versatile and diverse learning environment. Our view of the applicability of agents is based on our experiences in designing a learning environment to children with problems with their *mental programming* (Vilkki 1995, Korkman 1988). When simplified, we can characterize mental programming as the ability to uphold the motivation, ability to compose a problem solving strategy, fluency in solving various tasks, and ability to uphold attention. Therefore, learners with problems in these fundamental skills need a targeted support from the learning environment, whether computerized or not. In a non-computerized setting, this support is seen as auxiliary personnel, such as occupational therapists and neuropsychologists. We are exploring how these various tasks can be intensified by agent technology. Therefore, our architecture is that of multi-professional agents, or a crew of specialized agents.

Intelligent tutoring systems have traditionally emphasized a method to keep the learner within a narrow optimum solution path and optimizing the time consumption to acquire a new concept. Agents are conceptually ready to support more constructive learning processes: a learner builds her knowledge freely, not necessarily along the optimum learning path but along the paths supporting that particular learner's learning process.

A crew of Specialized Agents

Several computer-based learning environments either focus on drilling one or few skills or areas of knowledge, resulting in a biased learning process, or cover a huge amount of information, reflected as superficial learning outcomes. Contrary to these approaches, we aim at utilizing the full potential of the computer to intensify the diverse factors of the learning process. For that purpose, an agent-based architecture offers a valid platform for development: each part of the learning process can be supported by a dedicated agent.

As an example, the learner's activities can be intensified by an agent which helps her to go through the learning material, traversing trough the material in a personalized manner. At the same time, an agent supporting the teacher can recognize areas where students needs more tuition. However, a modern learning environment consists of more than the roles mentioned. A feedback agent might help teachers or administration staff to evaluate the overall learning process and its organization, with the help of other agents, a visualization agent might help the students to interpret their material in different formats, such as concept maps.

Our approach is consistent with the common definitions given for agents in the literature. For example, Russell and Norvig (1995) state an agent to be "anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors". A more demanding definition is formulated by Franklin and Graesser (1996). They define an agent by giving an exhaustive list of properties. An agent must fulfill at least the first four properties of their list. In other words, an agent must be reactive, autonomous, goal-oriented, and temporally continuous.

Although our agents are agents by definition, fundamental differences regarding the purpose of agents exist. The most noticeable is that our agents do not act on the behalf of the user or execute the task for the user but help the learner in conceptualizing and executing the tasks. In other words, we employ agents as an interpretation mechanism between different participants of the learning process. This means that agents – though autonomous – adapt to the human beings involved in the learning process. In a way, they are co-workers rather than auto-workers, a common emphasis in many of the prevailing agent-based frameworks.

To use an example from another context, an agent taking care of its master's business on the web-based stock market, is an auto-worker accomplishing a specified task for an optimal solution, whereas another agent with a co-worker's character would help its master to understand the secrets behind a long-term survival on the very same markets, and support him or her for life-long business learning.

Assistive and Adaptive Hypermedia – Ahmed

Ahmed is the first implemented prototype of the agent crew described above. Ahmed is an agent for the learner. There are no limitations regarding the content or the content presentation the agent can handle. Still, Ahmed can provide a personal learning experience to every learner. The adaptation mechanism is independent of the system, and at the same time dependent on the learning material.

A term "learning seed" or just "seed" is used throughout the following text when referring to one piece of a learning material in a learning space. This is to emphasize that the material can be more than merely an exercise, and more than a frame (a basic unit in a CAI program, as pointed out by Wenger 1987). A learning seed in Ahmed can consist of several different screens with several sequential or parallel visual, auditorial or functional elements with temporal values. The seeds can, for example, be states of a simulated world (Kurhila and Sutinen 1999).

Overview of Functionality

The description language used in our prototype learning environment in describing the learning seeds is defined for this purpose by using XML. Compared to e.g. HTML, the description language is significantly more expressive. It includes tags for buttons, graphics, text areas, and audio clips. The functionality of the learning material is secured with tags for parallel and sequential presentation of other elements with a duration attribute. Conditioning with an if-then-else structure enhances functionality.

The learning space is n-dimensional. The dimensions are not pre-determined by any means. Instead, they are inferred from the parameters in learning-seed headings in run-time. For example, if the heading of a seed contains "Skill: 56" and "Knowledge: 49", the seed is situated in point (56,49) in a learning space of two dimensions, called Skill and Knowledge (Fig. 1).

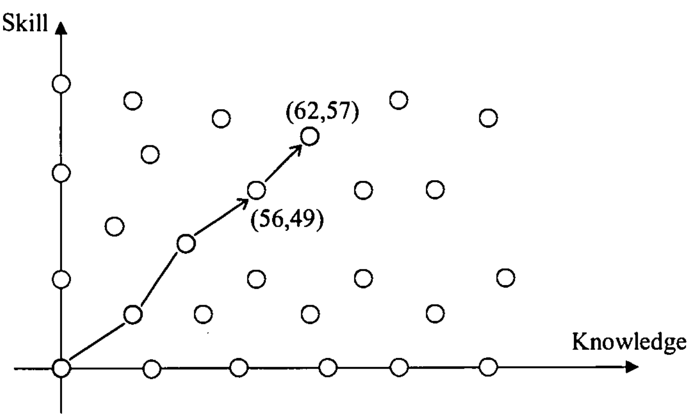


Figure 1: Parameters are used in situating the learning material into the learning material space. For simplicity, the space is here only two-dimensional

Every learning seed should be parameterized, since the parameters define the position of a seed in the learning space. However, not every seed needs to be located with respect to every dimension. For example, if the dimensions used in the space are "Skill" and "Knowledge", some seeds can be defined in the "Skill" dimension only. In that case, the seeds without an explicit location in "Knowledge" would be represented as a line covering every point in the "Knowledge" dimension. This procedure ensures that a person creating the learning material does not have to assign irrelevant parameters to the material. For example, if one learning spacc consists of arithmetic exercises, there is no purpose to assign parameters in the "Reading comprehension" dimension to those exercises.

The dimensions and their parameters are freely selectable for the person creating the material in the sense that they can be represented with arbitrary strings. It is natural to denote the dimensions with meaningful learning objectives such as "Multiplication skill" rather than abstract ones.

An activating learning seed normally makes it possible for a learner to do something. Every action can be equipped with an effect to the learner's position in the learning space. This is called a *relative movement.* For example, if the learner makes a choice which is parameterized "Skill +6" and "Knowledge +8", the learner's position in the learning space moves from point (56,49) to the point (62, 57) (Fig. 1). Because of the several choices the learner can make in a single learning seed, the learners are likely to follow different paths in the learning material space.

In addition to the relative movement described above, there is also another way to present the next learning seed to the learner. It is possible that the multiple-choice answers have an *absolute movement* to another learning seed. In such a case, the learner is not taken to the next seed by calculating the parameter values relative to the learner's profile but directly by following an absolute link. In other words, the learner is not guided in the space but in a static learning material graph (which still is a part of the learning space). The learning material can be arranged as a space of groups of static graphs, but the most common case of arranging the learning space may be to have learning seeds with only relative movements and occasional local graphs of seeds with absolute movements.

The multiple-choice answers in the learning material are not necessarily traditional "pick one from the choices". A seed may require a learner to choose a subset of given choices. The subset can also be an ordered subset. An example of an exercise with a subset of given choices is to find a meaningful combination of objects to construct a steam engine. An example of an exercise with an ordered subset is one with a task to organize different words into a meaningful sentence.

The parameters of the choices the learner makes are used in providing the personalization of the learning experience. When the learner makes choices, her profile can be constructed by saving the information in the parameters to the learner's profile file. While the learner is represented as a point in the n-dimensional learning space, every move of the learner in the space is saved to the learner's profile, so that the learning path of the learner can be represented numerically or even visualized as an animation for evaluation.

In a standard situation, the dimensions of the learning space can be viewed as learning objectives, since a learner strives to achieve a higher position in every dimension. However, dimensions are not necessarily related to any objective, but they might indicate any other aspect of the learning process as well, or only those learner's properties that a teacher wants to observe. As an example of a property to observe, we can consider "Motivation". To enable the measurement of motivation, every learning seed can contain the button "I don't care". This button is equipped with an effect (relative movement) to the "Motivation" dimension. But, because none of the actual seeds is parameterized with a "Motivation" value, choosing "I don't care" does not have an effect on the guidance of the learner in the learning space. Instead, it affects only the learner's profile: every time the learner presses the button, the action is recorded to the learner's profile, thus enabling the observation for the teacher.

It is also important to notice that the flexibility of the parameterization enables the use of nested or hierarchical objectives. For example, after the first answer it might be hard to assess the learning outcome whereas a series of questions gives more conclusions (e.g. concerning the type of error). A very simple example is the following. The learner is presented an exercise: 1 x 1. If the learner answers 2, it may very well be that the learner confuses adding and multiplication, or simply does not know how to multiply. However, this is hard to tell after only one answer, because it could have been a random error. By repeating learning seeds of the same kind, a correct conclusion can be made.

Other Characteristics of Ahmed

Because of the intended users, so-called single-switch input with automatic scanning of choices must be available all the time. Therefore, the login procedure and the answering to the exercises are designed to function with single-switch input. The login is conducted as follows. The learner starting the session is presented with the pictures of her class. The learner chooses a picture representing her (it can be a photo or a drawing). To ensure that none of the learners chooses the wrong picture and thus an incorrect profile, the learner has to choose her "secret picture". This corresponds to the password. It is also possible to require a sequence of secret pictures to diminish the probability of logging in with false pretenses. The pictures are in a single directory, so that it is fairly easy for the teacher to update the pictures of learners attending her class.

The ordered subset can also be picked up by a single-switch input. Still, it is possible for the learner to correct a misprint before giving the final answer. This is important, because misprints in answers are hard to interpret correctly by a computer. In addition, it is tremendously demotivating for a learner not to be able to correct an accidental misprint.

Another feature of Ahmed is the possibiliy to use learning material servers to store the different learning spaces. The learner chooses the learning material space when starting a session. Technically, every space is a directory. The learning material directory can be situated in a remote Web server as well as in the local hard drive.

This enables easy networking and centralized composing of the learning material.

To exploit the full potential of the schema, the learning material space should be complete, i.e. filled with learning material so that every point in the space has more than one learning seed. In practice this means that at least one thousand learning seeds should be prepared. Therefore, centralized learning material databases are a choice to consider, since composing the material is a tedious task.

To involve the teacher in the learning environment, we have implemented also a console for the teacher. If one of the learners presses the help button, a message is sent to the teacher's computer. One has to keep in mind that the learners in this learning environment can be severely disabled, so that they cannot draw the attention of the teacher by any other means. The message is merely help, because the schema was designed to be used in a classroom with a teacher always present. Technically the help functions properly even if the learning environment is expanded to the whole Internet, since every help message comes with the IP address of the sender's machine.

Discussion

When comparing Ahmed to the well-known and traditional four-component schema of intelligent tutoring systems (Wenger 1987), we can identify the same four concepts in Ahmed, as well. The *domain knowledge* in Ahmed is the contents of the seeds in a learning space. The *pedagogical model* corresponds to the dimensions used, the parameterisation of the seeds, and the parameterisation of the actions in the seeds. The *student model* is the trail (history of every visited seed and actions taken in them) of every individual learner. The *interface model* is the organization of the objects in seeds, since Ahmed itself is a *tabula rasa* if no learning material exists.

Both the strength and the weakness of this prototype is that the domain knowledge is completely isolated from the agent. The agent does not know anything about the learning material. It merely adds (or subtracts if the parameter has a negative value) the parameters together, and presents the equivalent learning seed to the learner. The advantage of this concept is that the material can truly be anything and yet the system can adapt to every learner independently. Every author of the learning material is able to create the parameters and the multiple-choice answer types based on her own experience, or some theoretical model.

The domain-independence of the system enables various possibilities. There can be exercises with right or wrong answers, but there also can be more adventurous problem solving with e.g. ethical values. An example of more adventurous problem solving could be to guide a child (or another living being the learner can relate to) to visit her Grandmother in a countryside, and there are no right or wrong answers, only different ways to cope with the problems until the final goal is achieved. Whereas an intelligent tutoring system might make the grandchild to hurry to the Grandma in the optimal time, with the minimum amount of money consumed, our system allows the child to observe the path as well, even with wolves along the route.

Because the domain knowledge is separated from the agent, the learner modeling is imperfect. The modeling can be adequate if the parameters and the content are suitable. The problem is that the person authoring the material should figure out in advance what kinds of answers the learner could choose. The parameterization of the learning material and the multiple-choice answers are not trivial either.

The impact of an computer-based educational system should always be validated empirically (Brusilovsky 1996, Brusilovsky and Eklund 1998). Although Ahmed has not yet been tested in classrooms, discussions with special teachers and other experts indicate that the idea behind Ahmed is useful and has potential. Empirical evaluation is waiting for meaningful learning material: to operate properly, Ahmed has to contain vast amount of learning seeds. For the learning material authoring, we are designing an easy-to-use tool to speed up the authoring process.

References

P. Brusilovsky (1996). Methods and techniques of adaptive hypermedia. *User Modeling and User-Adapted Interaction*, 6(2-3):87-129.

P. Brusilovsky and J. Eklund (1998). The value of adaptivity in hypermedia learning environments: A short review of empirical evidence. In *Proceedings of the 2nd Workshop on Adaptive Hypertext and Hypermedia*, Computing Science Reports, Report No.

98/12, Eindhoven University of Technology, Eindhoven, pages 13-19.

A.D.N. Edwards (ed.) (1995). *Extra-Ordinary Human-Computer Interaction*. New York, NY: Cambridge University Press.

A.D.N. Edwards, A. Arato, W.L. Zagler (eds.) (1998). *Proceedings of International Conference on Computers and Assistive Technology (ICCHP '98)*. IFIP World Computer Congress, Wien, Austria: Austrian Computer Society.

T. Eriksson, J. Kurhila, and E. Sutinen (1997). An agent-based framework for special needs education. In G. Grahne (ed.), *Proceedings of Sixth Scandinavian Conference on Artificial Intelligence SCAI '97*, pages 270-271. Amsterdam, The Netherlands: IOS Press.

S. Franklin and A. Graesser (1996). Is it an Agent, or just a Program?: A Taxonomy for Autonomous Agents. In *ECAI'96 Workshop on Agent Theories, Architectures, and Languages: Intelligent Agents III*, pages 21-36. Springer.

J. Klaus, E. Auff, W. Kremser and W.L. Zagler (eds.) (1996). *Proceedings of the 5th International Conference on Computers Helping People with Special Needs (ICCHP '96)*, Wien, Austria: Austrian Computer Society.

M. Korkman (1988). *Nepsy, A Proposed Neuropsychological Test Battery for Young Developmentally Disabled Children, Theory and Evaluation*. PhD thesis, University of Helsinki.

J. Kurhila and E. Sutinen (1998): Agents in an adaptive learning environment for special needs education. In A.D.N. Edwards, A. Arato, W.L. Zagler (eds.), *Proceedings of International Conference on Computers and Assistive Technology (ICCHP '98)*. IFIP World Computer Congress, pages 241-249. Wien, Austria: Austrian Computer Society.

J. Kurhila and E. Sutinen (1999): Sharing on open learning space by individualizing agents. *Journal of Interactive Learning Research*, 10(3/4):287-300.

S. Russell and P. Norvig (1995). *Artificial Intelligence: a Modern Approach*. Saddlc River, NJ: Prentice-Hall.

J. Vilkki (1995). Neuropsychology of mental programming: an approach for the evaluation of frontal lobe dysfunction. *Applied Neuropsychology*, (2):93-106.

E. Wenger (1987). *Artificial Intelligence and Tutoring Systems*. Los Altos, CA: Morgan Kaufmann.

Acknowledgements

Neuropsychologist Tuula Eriksson and special teacher Pirjo Turunen from the Ruskeasuo School in Helsinki gave us valuable insights to the multidisciplinary process of constructing a learning environment for special education. The software engineering project team at the Department of Computer Science, University of Helsinki, did the implementation of Ahmed. We are grateful to Sami Hakala, Jari Kätsyri, Kimmo Takkunen and Pekka Uronen, among others. Heidi Kukkula and Antti Pärnänen prepared the prototype learning spaces. The funding from the HeCSE Graduate School and the University of Helsinki to the first author is appreciated.

Hypermedia and Cooperative Learning

Tahar BENSEBAA
Institut d'Informatique, UNIVERSITE BADJI MOKHTAR BP 12 EL-HADJAR
23200 ANNABA , ALGERIE Tél et fax : (213) (08) 87 27 56
E-mail : t_bensebaa@hotmail.com

Yacine LAFIFI
Institut d'Informatique, UNIVERSITE BADJI MOKHTAR BP 12 EL-HADJAR,
23200 ANNABA , ALGERIE Tél et fax : (213) (08) 87 27 56
E-mail: ylafifi@yahoo.fr

Abstract: The educational hypermedias have become indispensable tools to enrich the pedagogical value through the formation. Meanwhile the cognitive overcharging and the disorientation, the hypermedia presents another drawback : the isolation of the learner.
This work presents the architecture of an hypermedia made in a way to reduce to the maximum the cognitive overcharge. This hypermedia is able to advice the disoriented learner thanks to a combination with an intelligent tutor. This tutor itself permits the learners to cooperate with each other dispite the distance between them.

1. Introduction

We witness day to an exponential growth of hypermedias, to varied and multimedia content, and of their users, whose number is considerably increasing day to day, thanks to the new technologies of diffusion: CD-ROM, Internet, Intranet, etc (Chick & Daoudi 1999). Hypermedia environments become indispensable tools to enrich the educational value in the teaching and the learning (Nkambou, Isaballe, Gauthier 1998). Hence, the multiple courses of reading the hyperdocument allow everybody to organize his/her own course in order to encourage his/her understanding and his/her memorization of knowledge. The initiative of learner is the basis strategy (Bensebaa 1991).
Whereas if the use of the hypermedia reinforces the autonomy principle of the learner, it also risks to reinforce his/her isolation. If it is undeniable that this autonomy can have some positive educational effects compared with the masterly teaching, such as the respect of the rhythm, of the learning length and in certain cases to permit a plurality of learning styles, it is undeniable that this relation man to " knowledge " stocked in machine lets only small place to the mediation by another person (tutor, teacher, parents, other learners). In some methods of teaching, such as the distance teaching, this isolation is reinforced by the existed geographical gates.
However, it also appears that the teaching, the learning, have always been considered as social processes requiring a collaboration between different actors. It is sufficient to think about all approaches of the adult formation based on the group dynamics (Derycke 1991).

In addition to the learner's isolation problem, thc hypermedias have other problems. Indeed, if the aspects of learner's interaction and participation to educative sequence can be now considered as efficient, the cognitive overload and the disorientation of the user in the hypermedia remain the major problems. It is also very current to note at the time of the use of an hypermedia, that the learner, after some minutes of navigation and research, doesn't know its position relatively to notions to be consulted. The big freedom allowed to the user which is the principal attraction of the hypermedia becomes its principal drawback. Its pedagogical mission of knowledge construction is so compromised.

2. Proposals

2.1. Break the Isolation

Several works and in particular those of Vygotsky showed the importance of the social dimension of learning: the social interaction is an essential element of the cognitive transformation (Derycke 1991).
Choplin et al. in (Choplin, Galisson, Lemarchand 1998) affirm from a didactic point of view that an activity of learning in science implies in general manner the set in motion of the student's conceptions (cognitive dimension), motivation (emotional dimension) as well as his/her relations with his/her peers and/or with the teacher (social dimension).

The survey of works or written of pioneers or visionary of hypertexts and hypermedias make appear that the dimension cooperative work was underlying since the beginning (see (Derycke 1991) for more details upon some researches on this topic).

The application of cooperation principles permits to eliminate the isolation of the learner. Therefore, cooperation depends upon a supportive community of actors who agree to help one another in activities aimed to attaining the goals of each person involved (Lewis 1996). So, cooperation consists in amplifying capacities of agents which are taken separately and to increase their performances (Ferber 1994). It is to help himself/herself by helping his/her partner (Leroux 1995).

2.2. Reduce the cognitive overload

The organization of the hypermedia separates the information from the knowledge. These are often encapsulated in the same node. Links are not structured and their conceptual values are not specified. Of where a difficulty for the author to create and to maintain an hypermedia and for the reader to navigate (Soula 1994).

2.3. Orient learner

This orientation is possible thanks to coupling the hypermedia with a tutor which is capable to judge the knowledge of the learner and also can advise, orient,...,the disorientated learner when it is solicited. For doing this, the tutor must rely on:

- the student's models,
- training objectives,
- a historic of the training session,
- an educational strategy family,

Beyond its role of orientation counselor, the tutor will inform learners upon cooperation possibilities. Those are deducted from student's models.

3. Proposed architecture

The figure 1 represents the proposed architecture of the system, we distinguish in particular:

3.1 Author interface

The organization of the hypermedia is based on the manipulation of predefined objects and on the separation between information and knowledge. So the following main characteristics (Soula 1994):

- each object in the hypermedia belongs to a specific type,
- a separation between information nodes and knowledge for the realization of links. Information corresponds to what learner wants to reach and the knowledge concerns the structure of the document that is how to reach it.

Thus, nodes and links are managed in the following manner:
1. all the nodes are instances of "typical nodes"; these "typical nodes" permit to create:

- multimedia nodes,
- "exercise" nodes for the control of knowledge. The assessment of answers is assured by pondered production rules triggered in forward chaining :

If *Answer* Then *Pedagogical-Objective* (*Credit, Debit*)

Where *Credit* and *Debit* represent points to be added or to be subtracted to the present capital of learner for the current objective.

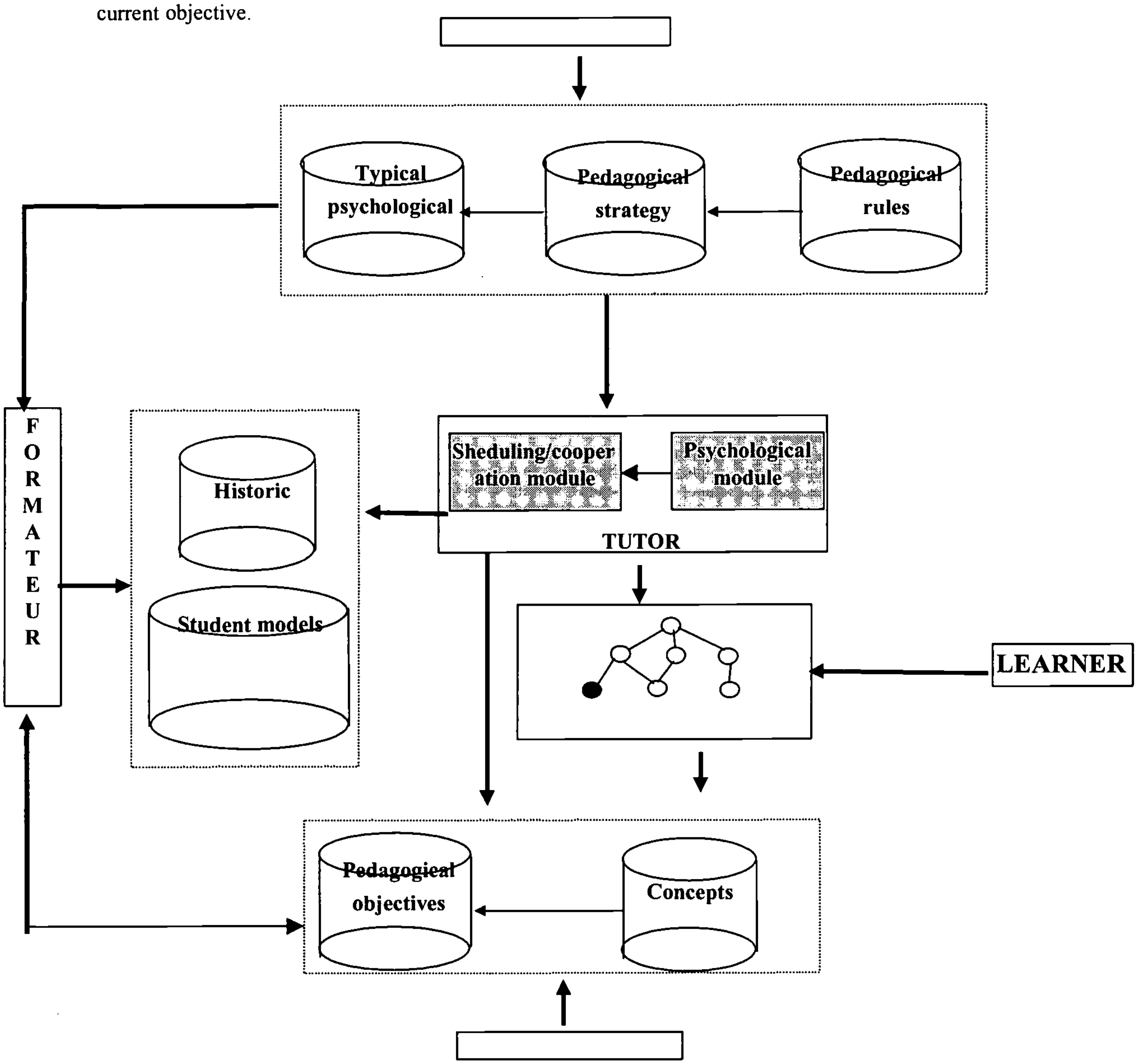


Figure 1: The Architecture of the system.

2. links can be:

- *Explicit* : managed entirely by the author, these links permit a non-linear reading of the hypermedia. They are activated by the learner by clicking_on an object of the node (called *hyperobjet*),
- *Implicit* : these links are managed automatically by the system. They can bee: following page, previous menu, beginning of the document, etc. These links permit the structuring of the document under hierarchical shape.

3.1.1. Hyperobjet

It is a knowledge activated by the learner by clicking on an object (elementary or composed). An hyperobjet is defined by: a name, a password identifying the owner and a list of couples: intention-action.

3.1.2.Intention-action

It is the element of an hyperobjet that defines a link. The intention carries on the reason of the link and the action on its realization. If the main feature of an hypermedia is to allow the reader a completely free course, the notion of intention-action offers information in order to permit that this course wouldn't be made " at the blind". Thus, the author associates an intention to every link that means a reason to this creation. This reason or intention represents a conceptual knowledge that may be useful to the reader. While consulting this intention, the reader will have precision on the action generated by the link and will either trigger or not the link.

3.1.3.Knowledge Base

It is structured as a set of concepts on the taught domain. These concepts are aggregated in educational objectives. An educational objective corresponds to a mental structure, an abstraction, sometimes represented by conceptual networks. It is constituted of a set of nodes. Two different objectives can share the same node. The author can create educational objectives, associate to them a difficulty level and establish prerequisite relations between them. The difficulty level can be determined according to the nature of the knowledge underlain by the educational objective (Bensebaa & Seridi 1997).

3.2. Pedagogue interface

It is through this interface that the pedagogy used by the tutor is defined. It consists to:
1. define a set of typical psychological profiles of target learners. A psychological profile is a general behavior of a learner. It is defined by assigning values to attributes representing the different psychological attitudes (weariness, attention, speed,...) that the system is capable to capture. Thus, it is possible to define several bases of different profiles corresponding to different target populations (Bensebaa & Lebbihi 1998);
2. then, associate to every typical psychological profile, an educational strategy. The utilization of this one by the tutor consists of the application of a set of educational rules in a determined order. An educational rule takes the form of a production rule:

If *Condition* Then *Action*.

Rules appear as filters in which we submit the acceptable educational objectives and that are going to eliminate those that appear too much distant of the corresponding educational principle. Thus, we have a big suppleness of the adaptation of teaching strategies (Bensebaa & Seridi 1997).

This manner to manage the pedagogy allows the system to accept different pedagogies and to adapt them according to the concerned domain and public.

3.3. Trainer interface

The person responsible of the training defines for every learner an " interval of teaching " thanks to the declaration of an initial profile (basc level of learner) and of a final profile (final objective of the teaching). A profile is a set of educational objectives.
Also, the trainer determines the student's initial psychological profile. It will permit the definition of the educational strategy to be applied. Finally, the trainer can accede to results on the evolution of the knowledge of learners, objectives that they have acquired, the difficulties which faced the learners (Bensebaa & Seridi 1997), etc.

3.4. Student's models

The student's representation is indispensable for an adaptive learning system (Ritter & Djahanguir 1991). A learner model has been considered a set of beliefs hold by the system about the learner (Ayala & Yano 1996). Learner models provide the information needed in order to support the progress of the learner and promote the opportunities of effective cooperation and learning.

In order to ensure its role of counselor for learner, the tutor is, actually, a real " spy ". Indeed, all actions of learner are analyzed and are listed in his/her models so that they indicate at every time his/her level of knowledge and his/her psychological state.

3.4.1. Knowledge student's model

It is composed of a set of educational objectives. It is putting up-to-date at each end of visit of a node by the student. This up-to-date takes into account for each objective:

- the previous state,
- the CREDIT (or DEBIT) in case of an exercise node,
- ...

For each objective, the level of learner is besides matched of a tendency of short term (acquired knowledge, putting into doubt or confirmed) usable by the educational rules.

This way to manage the model permits to question the knowledge that is not possessed sufficiently or never possessed (case where the initial profile of learner declared by the trainer has been overvalued) or, what is more grave, the prerequisite objectives, in the case of a very unfavorable report. If the corresponding educational rule is active, the tutor will be able to favour the election of the node composing the deficient objectives (Bensebaa & Seridi 1997).

3.4.2. Behavioral student's model

A student's good modeling permits to put him/her in an optimal learning situation with regard to his/her mental capacities and behaviors. Behavioral model is represented by a vector constituted of n psychological attitudes. This vector is used by the tutor to deduct or to approach one of the typical psychological profiles defined by the pedagogue. The feeding of attitudes is done via sensors placed at nodes level. The given values are of a quantitative nature (number of points, percentage, etc.) (Bensebaa & Lebbihi 1998).

3.5. The tutor

It is the main piece of this architecture. It is composed of two modules: scheduling /cooperation module and psycho-pedagogical module.

3.5.1. Scheduling/cooperation module

The educational objectives (therefore nodes that compose them) represent some susceptible objects, by their visit, to enrich the knowledge of a learner. Like a production rule, an objective possesses prerequisites, that is conditions on the state of the knowledge of learner. These prerequisites translate the fact that some knowledge must be assimilated sufficiently if we want the learner fully benefits of the nodes of the objective (Bensebaa 1991).

Real educational counselor, the tutor will propose, at every time that the learner solicits it, the best node adapted according to:

- the state of the knowledge of learner (where is he/she?),
- the final profile (what must he/she learn?),
- the educational strategy (what strategy of teaching?).

At the time of this choice, the tutor takes into account the set of student's models. It orients the learner to the node which corresponds better to her/his "knowledge state" and which represents the best opportunities of cooperation. So, it builds first the set of Pedagogical Objectives which are Candidates for orientation(POC). This set is the result of the intersection of two other sets:

- The first set is constituted of the Pedagogical Objectives that are Acquired at least by one learner (learner is concerned)(POA),
- The second one has Pedagogical objectives whose prerequisites are satisfied by the student's model of the concerned learner (AO: Acceptable Objectives).

If the set result of the intersection is empty then POA is equal to AO.

On the POC set will be applied an educational rules sequence (inter-objectives educational rules) of the chosen strategy until to isolate one that corresponds better to the state of the learner. Another sequence of educational rules (inter-nodes rules) applies to get the node(s) to propose to the learner.

An educational rule example is favor the educational objectives which were acquired by the maximum number of learners (maximize cooperation possibilities).

The learner can solicit the tutor for obtaining potential candidates for a cooperation. After this request, the tutor responds by presenting a set of learners classified according to their similitude profiles with the demander learner (same initial and final profile, same final profile,.....). This set is constituted by all learners whose knowledge student models satisfy the current pedagogical objective prosecute by the demander learner.

3.5.2. The Psycho-pedagogical module

This module deducts the educational strategy to be applied and proposes it to the scheduling/cooperation module. This operation is done by comparing the behavioral model to the different typical profiles, in order to classify the student in the nearest profile to his/her model. For doing this, we applied a method of classifiction based on the Main Components Analysis (ACP: Analyse des Composantes Principales) (Bensebaa & Lebbihi 1998).

Conclusion

We notice in the first that this architecture protects totally the flexibility and the freedom which is offered by the hypermedia. Then, coupled with a tutor, the hypermedia can fulfill correctly its pedagogical mission. Finally, the problem of the isolation of the learner is eliminated. The student has the possibility to solicit the tutor at any time for obtaining orientation and cooperation advice. He/she can solicit cooperative learners indicated by the tutor.

References

Ayala, G. & Yano, Y. (1996). Intelligent Agents to Support the Effective Collaboration in a CSCL Environment. World Conference on Educational Communications, June 17-22, 1996, Boston, Massachussets, USA. 19-24.

Beltran, T. (1991). Une architecture pour la surveillance et le guidage de l'apprenant dans un hypermédia éducatif. Premières journées scientifiques : Hypermédias et Apprentissages. Chatenay- Malabry, 24 et 25 Septembre 1991. 95-110.

Bensebaa, T. (1991). Conception et réalisation d'un tuteur pour la formation en milieu industriel. Application à la gestion d'un didacticiel cimentier. Thèse : INSA de Lyon, 1991.

Bensebaa, T. & Seridi, H. (1997). Architecture d'un hypermédia éducatif. Le journal du Multimédia , 20

Bensebaa, T. & Lebbihi, H. (1998). Couplage d'un hypermédia et d'un tuteur intelligent. Hypermédias et Apprentissages, 4ème colloque, Poitiers, France. 15-17 Octobre 1998. 197-199.

Chick, A. & Daoudi, A. (1999). Un modèle général d'adaptation des hypermédias. Conférence Internationale en Informatique. Annaba, Algérie. 21-23 Novembre 1999. 121-134.

Choplin, H., Galisson, A. , Lemarchand, S. (1998). Hypermédias et pédagogie : comment promouvoir l'activité de l'élève ?. Hypermédias et Apprentissages, 4ème colloque, Poitiers, France. 15-17 Octobre 1998. 65-70.

Derycke, A. (1991). Hypcrmédia et apprentissage coopératif. Premières journées scientifiques : Hypermédias et Apprentissages. Chatenay-Malabry, France. 24 et 25 Septembre 1991. 77-86

Ferber J. (1994). Coopération réactive et émergente. Revue Intelectica 2, 1994. 19-52

Leroux, P. (1995). Conception et réalisation d'un système coopératif d'apprentissage. Etude d'une double coopération : maître/ordinateur et ordinateur/groupe d'apprenants. Thèse : Université Pierre et Marie Curie, 1995.

Lewis, R. (1996). Editorial : cooperation or collaboration. Journal of Computer Assisted Learning 12,2,65.

Nkambou, R., Isabelle, C., Gauthier, G. (1998). Eléments d'apprentissage de l'apprenant dans la génération automatique d'activités pédagogiques accessibles à distance. Hypermédias et Apprentissages : 4ème colloque, Poitiers, France. 15-17 Octobre 1998. 55-57.

Ritter, C. & Djahanguir, D. (1991). L'articulation Hypermédia / Tuteur intelligent : un hypermédia éducatif. Premières journées scientifiques : Hypermédias et Apprentissages. Chatenay-Malabry, France. 24 et 25 Septembre 1991. 245-248.

Soula, G. (1994). Hypermédia et apprentissage en médecine. Techniques et sciences de l'éducation, 1994.

Problems of Student Communication in a Cross-cultural, International Internet Course Setting

John LeBaron
Graduate School of Education, University of Massachusetts Lowell
255 Princeton Street
North Chelmsford, Massachusetts 01863 USA
John_Lebaron@uml.edu

Jyrki Pulkkinen
Faculty of Education, University of Oulu
P.O. Box 2000, Linnanmaa
FIN-90401, Oulu, Finland
jpulkkin@ktk.oulu.fi

Patrick Scollin
Graduate School of Education, University of Massachusetts Lowell
255 Princeton Street
North Chelmsford, Massachusetts 01863 USA
Patrick_Scollin@uml.edu

Abstract: The design and distribution of cross-border higher education courses via global computer networks is a rapidly growing phenomenon (Davis 1998). This paper describes a recent international Web-based course and presents research that focuses on the challenge of international, cross-cultural graduate course design in education. Using quantitative and qualitative methods of inquiry, successes and failures of the effort to address cross-cultural concerns are reported. This inquiry builds on existing literature. It informs the work of teachers, researchers, course designers and program developers seeking to expand instructional horizons through international academic collaboration.

Introduction

From January through May 1999, a computer networked graduate education course connected students from the Universities of Oulu and Jyväskylä in Finland with peers from the University of Massachusetts Lowell in a shared, project-centered academic endeavor. The course, *Open, Flexible & Distributed Learning (OFDL)*, was offered in English via the World Wide Web. It represented a joint initiative of the three participating universities. Forty students were initially enrolled: twenty-one Finnish and nineteen American. Network access for students and instructors was user password controlled.

OFDL was created and delivered by Professor LeBaron and several colleagues at the University of Oulu Faculty of Education. The course addressed issues related to distance and distributed education in schooling and in higher education. It examined principles that support open and flexible learning. In addition to examining selected theories, methods and technologies, students were asked to work as peer collaborators, and to join the instructors and tutors in content-centered research and discussion.

The technical platform for this course, called *ProTo*, is the product of research and development at the University of Oulu, headed by Research Manager, Jyrki Pulkkinen. *OFDL* was among the first electronically networked, academic courses formally cross-credited between Finnish and American universities. However, several earlier international courses, primarily within Europe, have been offered via *ProTo*.

OFDL relied on electronic distribution for all aspects of study. *ProTo* functioned as a server-centered database designed on a research platform that supports constructivist principles of learning; that is, that students constructed knowledge and meaning through interaction, communication, and productive collaboration with instructors, peers, and relevant materials. *OFDL* was simultaneously credited at three universities: one in the USA and two in Finland. A revised offering of this international course is in progress during the spring of 2000.

The Course: *Open, Flexible & Distributed Learning*

This course aimed to examine issues related to online open and flexible learning. In addition, the course examined other selected telecommunications technologies used in the design and execution of distributed learning environments. Students worked individually or in teams to analyze and critique contemporary practices in this field. The instructor team comprised a lead professor and a course design manager supported by three graduate student assistants (one Finnish and two American).

OFDL ran from January through May 1999. Because this was a "location independent" course, the traditional academic schedule of weekly or thrice-weekly class sessions was abandoned. Rather, students and instructors regularly and frequently "checked in" to the Web-based environment. Since the much of the responsibility for such contact rested with the student, a high degree of discipline and self-motivation was required for success (Charp 1994, in Sherry 1996).

Due to the asynchronous and "distant" nature of the course, students maintained regular communication with instructors, tutors and peers. They were also responsible for reviewing online or library-based course materials, and to reflect this research in all written communication. The discussion forums offered tools for academically focused discussion. Students worked on thematic concentrations of their choice, but were expected to show mastery of the broader substantive context.

The *ProTo/OFDL* online "library" pointed to a collection of resources developed or selected by the instructors, tutors, and in some cases, students. This library was divided into five major categories. The first contained pointers to "core readings," which every student was required to examine critically at the earliest possible date. This reading provided common ground for subsequent peer communication. The next three library categories divided resources into the "cornerstone" content clusters described above (pedagogy, technology, management & social organization.) The fifth category (General Resources & Information) provided glossaries, bibliographies, and other useful course reference tools. The library was rounded out with multi media virtual lectures (e.g., streamed video, PowerPoint slides.)

The communications tools built into the *ProTo* environment were robust and straightforward. The following tools were available for student communication:

- threaded discussion forums for scholarly discourse and problem-solving,
- an embedded Web authoring tool where student work was developed,
- a "message board" for daily information updates posted by the instructional staff,
- an e-mail distribution list, for communication to all students and instructional staff,
- "ID cards" containing photos and biographical data for students, tutors and instructor,
- a virtual "café" where course members socially "chatted" either asynchronously or in real time,
- a "private notes" utility where students could "think aloud" and store thoughts for later consideration.

Characteristics of the *ProTo* Learning Environment

ProTo (Project Tools for Learning) is an easy-to-use learning environment that contributes to modern open and flexible studying on the Web. It provides comprehensive communications and collaboration functions to enable the instructors and students to work cooperatively toward meaningful learning goals. The Finnish Ministry of Education has supported the development of *ProTo*. A newer version of this authoring-learning tool, called *Learning Community Profiler*, is now being prepared for public distribution in educational markets.

ProTo runs on the Internet, or on corporate or campus intranets, based on TCP/IP Web protocols. *ProTo* stores all information about the users and courses on a central database server. The students, instructors and administrators may access the server from anywhere on the network using a standard Web browser with commonly used plug-ins. *ProTo* enables bi-directional "real-time" and asynchronous communication. At the same time the application also makes it possible to access networked multimedia and hypermedia in the *ProTo* environment (e.g., video/audio-on-demand, real-time video streaming). *ProTo*'s networked instructional model is based on constructivist learning principles that combine three elements (learning, technology and culture) to provide the fundamental dimensions for open and flexible learning. Students are expected to construct their knowledge and skills through personal experiences and social interaction in the learning community.

According to this model, technology is used in the learning environment differently from the traditional computer assisted learning (CAL) instructional software. Where traditional CAL technology was designed to be appropriate in terms of learning, new networked learning environment technologies should be appropriate in terms of culture (e.g., the distributed community of learners and teachers who come from different cultural backgrounds). This distinction is particularly important in international courses such as *OFDL*.

ProTo offers tools for learners to engage easily in structured learning on the Web, and enables teachers to create and organize open and flexible Web-based courses. The "cornerstones" of this open and flexible learning environment are threefold:

- *People* as members of a learning community (e.g. students, teachers and tutors) where the students' learning process is only one process among the others,
- *Technology* used to implement the course (which was selected considering the demands of a constructive learning process and needs of the learning community as a whole),
- *Learning culture* that supports productive collaboration in the learning community (which must be created during the course).

The *ProTo* technical operating environment becomes an active part of the whole learning process and is a dynamic part of learning community behavior.

The Research Agenda

A growing body of literature addresses problems in international student collaboration in networked course environments. Pulkkinen and Ruotsalainen (1999) report on cross-cultural challenges associated with an online *Lego Dacta* course distributed within the European community. Mestenhauser & Ellingboe (1998) present a comprehensive general discussion of the challenges of internationalization facing American postsecondary education. Jenkins (1997) offers some particularly interesting insights about cross-cultural miscommunication between faculty and teaching assistants of different nationalities. Murphy (1991) warns of disparities in perceptions about success in culturally diverse international distance learning environments that stress cooperative work.

Through various data collection and analysis techniques, research is examining the efficacy of efforts to build constructivist, international online learning activities. As McNabb (1995) points out, standardized assessment techniques typically fail to measure key indicators of student success in open and flexible learning situations. Rather than pursue standard research agendas that compare predefined student outcomes in networked versus non-networked environments (Wideman & Owston 1999), this agenda intends to evaluate efficacy in terms of the intentions that drove the design of *OFDL* in the first place.

Demographics of the Student Population

Twenty-six students completed the final course evaluation, eighteen from the USA (94.7% of active students) and eight from Finland (61.5%). This sample included thirteen male and thirteen female respondents, nine each from the USA, and four each from Finland. The mean student age of 35.5 years ranged from 25 to 56 years. All 26 (100%) had used e-mail prior to the course. Only one, an American, had never browsed the web prior to the course. Nineteen (73.1%) had never previously participated in an Internet based course. A majority of the Finns (five of eight) were experienced in the use of Internet-based learning environments. An overwhelming majority of Americans (sixteen of eighteen) were complete Internet learning neophytes.

Conclusions from this study should be considered in light of differences between Finnish and American culture and education. Few would disagrcc that Finns are a less voluble people than Americans. Many Finns take pride in their tendency not to talk unless they feel they have something worthwhile to say. Higher education in Finland is tuition free. Although most courses are offered during fixed semesters of time, it is quite common for students to complete work on their own personal timetables without forfeit of money or credit. Finnish students are assessed on a pass-fail basis. Thus, many of the pecuniary and scholarly pressures of American graduate work apply differently in Finland. When the student performance stakes vary so much between countries, unique challenges arise in designing tactics for international collaboration. Although a few students from both countries failed to complete the course (two American and three Finnish), an additional eight initially enrolled Finns never participated at all. (Rather than "drop outs," we might label them "never ins".)

The Study

Since a major aim of the course was to foster purposeful student collaboration across national boundaries, this particular issue is addressed. The following data sources support this paper:

- a summative student evaluation anonymously and electronically submitted after grades were filed,
- comments posted by students throughout the course inside the communications tools provided by *ProTo* ("discussion" and "comment" forums, e-mail, the synchronous "café"),
- work actually produced by students and student teams while the course was in progress.

The final course evaluation consisted of fifty-seven questions distributed across the following categories: Background information, General overview of the course, Comparing online with traditional classroom courses, Instructional activities, Course interaction, and the *ProTo* environment.

A series of questions relating to a general evaluation of the course were asked. Responses were based on a four-point Likert scale numbered 1 to 4 with 1 representing "Strongly Agree," 2 "Agree," 3 "Disagree," and 4 "Strongly Disagree." To simplify analysis, the four-point scale was reduced to two points "Agree" and "Disagree." Also calculated were the P values for the independent T-test. Due to the small number of respondents, however, these values are not reported here. Of the thirty-eight Likert scale questions posed, only the following five produced significant variations in agreement between Finnish and American students:

- *Mutual guidance and assistance among students promoted learning.*
  17 Americans agreed, 1 disagreed; 5 Finns agreed, 3 disagreed
- *You felt that you belonged to the learning community.*
  (fifteen Americans agreed, three disagreed; four Finns agreed, four disagreed)
- *You felt that you succeeded in the course.*
  (fifteen Americans agreed, three disagreed; four Finns agreed, four disagreed)
- *Compared to a typical classroom course, you worked harder.*
  (eight Americans agreed, eight disagreed; three Finns agreed, five disagreed)
- *Compared to a typical classroom course, you learned more.*
  (twelve Americans agreed, six disagreed; four Finns agreed, four disagreed)

These disparities in perception pertain to issues of community and student success. Notwithstanding their relative lack of prior seasoning in online learning, the Americans came away from OFDL with significantly more positive reflections on their course experience in these respects than did the Finns.

Even though the following four questions show little variation between Finnish and American views, they pose distinct general challenges for future course development:

- *Compared to a typical classroom course, you interacted with student peers more frequently.*
  (six Americans agreed, twelve disagreed; three Finns agreed, five disagreed)
- *Compared to a typical classroom course, you interacted with student peers more intelligently.*
  (seven Americans agreed, eleven disagreed; five Finns agreed, three disagreed)
- *Compared to a typical classroom course, you interacted with the instructional team more frequently.*
  (six Americans agreed, twelve disagreed; three Finns agreed, five disagreed)
- *Compared to a typical classroom course, you interacted with the instructional team more intelligently.*
  (nine Americans agreed, eight disagreed; three Finns agreed, five disagreed)

Comparative US-Finnish word counts were made in three random "snapshots" of the interactive course discussion areas. In making these comparisons, Finnish results were adjusted to account for the smaller number of active students, whether or not they actually completed the course. There were nineteen "active" Americans (the same number as those initially enrolled) and thirteen "active" Finns (eight fewer than original enrollmcnt). Since nineteen is 46.15% greater than thirteen, the Finnish contribution was multiplied by 1.4615 to arrive at an equalized count for comparative purposes. This produced the following US-Finn "talk" ratios:

- "Café" (3 separate snapshots), 3.12:1 (656 US words; 210 equalized Finnish words),
- "General discussion about course," 4.1:1 (1561 US words; 379 equalized Finnish words),
- "Comments-materials: core readings" 2.13:1 (9492 US words; 4456 equalized Finnish words).

True to cultural stereotype, the American students were significantly more talkative than their Finnish peers.

Analysis of the open-ended student answers to the final course evaluation revealed some interesting Finnish-American comparisons. In response to a question asking how students defined their success in he course, for example, American comments generally focused on the mastery of external knowledge; Finns focused more on personal performance. In roughly equal national proportions, twenty-one of the twenty-six respondents explicitly lauded the instructional team for the frequency, timeliness and quality of engagement. (This presents an interesting counterpoint to the rather dim student perceptions reported on the Likert scale questions about the "frequency" and "intelligence" of their interactions with the instructional team.)

Students were asked to describe barriers to their learning in the *OFDL*. Consonant with the relatively sharp lack of prior American experience in networked learning environments, fifteen US respondents mentioned problems either with their manipulation of the *ProTo* interface, or with the interface itself. Only one Finn did so. Finnish students seemed more concerned with the challenges of language and culture (five of eight) and a perceived lack of time to fulfill course requirements (again, five of eight). Significant numbers from both sides urged more face-to-face contact via video conferences.

Conclusions

If truly collaborative international study is to remain viable in the longer term, the relative student judgments of engagement and success must be positive and roughly equal across the participating national groups. Since Finnish perceptions about productivity, success and community were less optimistic than those of their American partners, subsequent iterations of *OFDL* must try to make the experience equally worthwhile for all students. Similarly, the sensing across both national groups about the questionable utility of interaction among peers and instructors bears close attention.

In this case, *OFDL* was the instructor's first venture not only into online course design but also into formal cross-national teaching. The time committed to all aspects of online course design, teaching and maintenance exceeded that of a very active traditional course by a factor of no less than four. Some of this may be attributable to the steep learning curve confronted in such a first-time effort. However, this factor is reduced to no better than two or three in the second iteration of the course. Under any circumstances, effective online teaching and learning is exceedingly time consuming. Administrative or professorial failure to recognize this reality will result in inferior teaching and dashed hopes for students and teachers alike.

The comparative US-Finnish word counts could be explained by the simple variation in difficulty between students communicating colloquially in their native tongues versus those struggling harder in a second language. However, the breadth of participation in the two groups produces more troubling results. The 11,709 counted US student words were spread across sixteen students (84% of the US total counted). The 3638 Finnish words were spread across six students (46% of the Finnish total counted). If active participation in the course dialogue areas was an important goal, then it seemed substantially better met for Americans than for Finns.

Whatever the study data indicate, a troubling fact cannot be escaped. Except in one case, the greatly desired cross-border project collaboration failed to materialize. Cross-cultural student discomfort may partly explain this failure, but the failure cannot be accepted. Simply enrolling in a course with peers from other nations may (or may not) marginally promote cross-border awareness, but true knowledge and sensitivity requires substantive, deep collaboration. Ironically, such collaboration occurred *within* the Finnish and American student communities, but not sufficiently *across* them. Clear, strategic, remedial thinking is needed.

The following ten lessons for the designers and teachers of international Web-based courses bear note:

1. Course designers and teachers should familiarize themselves with particular cross-border cultural and policy peculiarities before any academic offering is launched, and scale expectations accordingly.
2. Instructors and tutors must be able and willing to meet the substantial time demands of constant, supportive involvement.
3. The continuing presence of active tutorial support *within the participating nations* is critical to success.
4. A spirit of openness and encouragement must suffuse the instructional team membership at all times.
5. Specific activities can help to "break the cross-border ice," especially in the early stages of a course.
6. Exercises should be designed to promote substantive cross-border collaboration. (Such exerciscs must respect national cultural norms so that expectations are fair and realistic for both groups)
7. Quantity of student talk is less important than quality and distribution across a wide student base. (If participation is limited to a narrow subgroup within or across the national boundaries, a major course intention remains unmet.)
8. Orientation training is needed for students having had little or no prior experience in online learning.
9. No effort should be spared to humanize contact (e.g., via video conferences, audio clips, e-mail, other media and, where feasible, face-to-face communication).

10. The technical interface must be reliable, "bug free," and appropriately aligned to the speed, power and connectivity of client workstations.

The following Finnish comment poignantly illustrates the first of the above ten lessons. "Language problems and the discussion cultures in Finland and the USA are different. [It is] hard to find 'the shared language.' This doesn't mean that we should not have courses together, but students in both countries should be aware of this and take it into account."

Limitations and Pointers to Further Research and Action

Knowledge gained from this study cannot be generalized to other international course settings. Only one course was evaluated. The student sample size is small. The study is limited to two countries only, and to rather narrow cultural subgroups within those countries. Certain lessons, however, will assist teachers and course designers planning to launch fresh initiatives.

The analysis reported here has supported several beneficial revisions to the current iteration of *OFDL*, and could similarly contribute to the success of any such cross-border initiative. Future research efforts should be keyed both to the general intentions of the course, and to the unique cultural realities of the participating students. New research should be deeper and more methodologically varied. For example, qualitative interviews with randomly selected students would acutely enrich viewpoints on student perceptions, thereby arming teachers and designers with deeper perspectives for future planning and execution.

References

Charp, S. Cited in Sherry, L. (1996). Issues in distance learning. *International Journal of Educational Telecommunications*, 1 (4), 337-365.

Davis, N. (1998). Developing telecommunications within European teacher education: progress, plans, and policy. Paper presented at *SITE 98: Society for Information Technology & Teacher Education 9th International Conference*, Washington, DC, 7 p.

Jenkins, S. (1997). *Cultural and Pragmatic Miscues: A Case Study of International Teaching Assistant and Academic Faculty Miscommunication. ERIC*: Document No. ED411684, 35 p.

McNabb, M.L. (1995). *Perspectives about education*. Available online WWW: http://www.ncrel.org/tandl/change.htm

Mestenhauser, J.A. & Ellingboe, B.J., Ed. (1998). *Reforming the higher education curriculum: Internationalizing the campus*. Phoenix, AZ: American Council on Education/Oryx Press, 272 p.

Murphy, K. (1991). Patronage and an oral tradition: Influences on attributions of distance learners in a traditional society (a qualitative study). *Distance Education*, 12 (1), 27-53.

Pulkkinen, J. & Ruotsalainen, M. (1999). Open and flexible learning in an international context: Meeting diverse cultural challenges. In LeBaron, J. & Collier, C., Ed. *A place for technology: Technology in its place*. San Francisco: Jossey-Bass (under contract)

Wideman, H. & Owston, R.D. (1999). *Internet-based courses at Atkinson College: An initial assessment*. Centre for the Study of Computers in Education, York University. Available online WWW: http://www.edu.yorku.ca/csce/tech99-1.html

Acknowledgements

OFDL was made possible through a Fulbright Scholarship that assigned Professor John LeBaron to the University of Oulu Faculty of Education in 1998-99. Neither the design nor the execution of *OFDL* would have been possible without the dedicated participation of the course tutors: Patrick Scollin and Steven Tello in the USA, and Tarja Tervola in Finland.

Delivering Distance Education Using Synchronous Web Audio Technology

Daniel Y. Lee
Coordinator, Virtual University
Shippensburg University
Shippensburg, PA 17257 USA
DYL@ship.edu

Abstract: One of the key elements that is critical to the success of distance education is active collaboration between participants. "Two-way interaction with a given student and the instructor simply is not enough" (Palloff & Pratt, 1999). Online courses using the traditional Web functions lack spontaneous interactions among participants. Static Web documents and e-mail, the two most commonly used Web functions, provide only two-way interactions. Bulletin board and chat can often cause confusion and frustration. On the other hand, classroom videoconferencing is prohibitively expensive for many institutions, while desktop videoconferencing faces a serious bandwidth problem. The Web audio conferencing technology may be an efficient and affordable solution for many distance education courses that require spontaneous interactions and collaboration among participants. The purpose of this paper is to discuss the effectiveness of real-time Web audio as an ideal mode of delivery under the current state of technology and given the limited bandwidth of the Internet. Capabilities of the live Web audio technology are outlined. The comparative advantages of the Web audio technology are discussed.

Introduction

As computer-mediated distance education becomes more prevalent, some researchers have begun to voice their concerns about the effectiveness of Web-based courses. Effective learning can take place when there are active interactions between the instructor and students and among students. While the Web technology is touted as a medium to enhance such interactions, the loss of spontaneous communications among and between faculty and students can cause considerable difficulties for both teaching and learning. In particular, the most commonly used methods of delivery for distance education are subject to several limitations and/or drawbacks. Asynchronous communications such as e-mail and static Web documents do not provide sufficient interactions among participants. Even in the case of synchronous mode such as live chat can be confusing and ineffective (Hara & Kling, 1999). Classroom videoconferencing technology can overcome most of these deficiencies, but is costly to set up and maintain. Furthermore, students may have to travel some distance at certain times to take courses that are based on this technology, which defeats the purpose of distance education to some degree. Another potentially effective mode of delivery is desktop-based videoconferencing. However, for this method to work, all participants must have high bandwidth connections to the Internet, without which the picture quality would be poor and interactions ineffective. This bandwidth problem will not be solved until cable modems, DSL and ISDN connections are not only more widely available but also affordable.

The purpose of this paper is to discuss the effectiveness of real-time Web audio as an ideal mode of delivery under the current state of technology and given the limited bandwidth of the Internet. Capabilities of the live Web audio technology are outlined. The comparative advantages of the Web audio technology are discussed.

Distance Learning and Interactivity

Not surprisingly, studies find that interactivity plays a significant role for the success of a distance education course. For example, in a study of the effectiveness of corporate training, Millbank (1994) finds that an introduction of real-time interactivity increased the retention rate of the trainees considerably. "Without connectivity, distance learning degenerates into the old correspondence course model of independent study. The student becomes autonomous and isolated, procrastinates, and eventually drops out" (Sherry, 1996). In a recently released study that declares the 24 benchmarks essential to ensuring excellence in Internet-based learning, interactivity is found to be an important benchmark for teaching and learning effectiveness. "Student interaction with faculty and other students is an essential characteristic and is facilitated through a variety of ways, including voice-mail and/or e-mail" (National Education Association, 2000). However, while useful in some specific situations, the asynchronous communications such as e-mail or bulletin board don't seem to foster informal conversations and personal interactions that play an important role in a teaching and learning environment. Even the more costly solutions such as classroom videoconferencing or telephone conferencing do not seem to be well-suited to sharing different types of information, such as slide show presentations, application sharing, or group learning processes (Navickas, 2000).

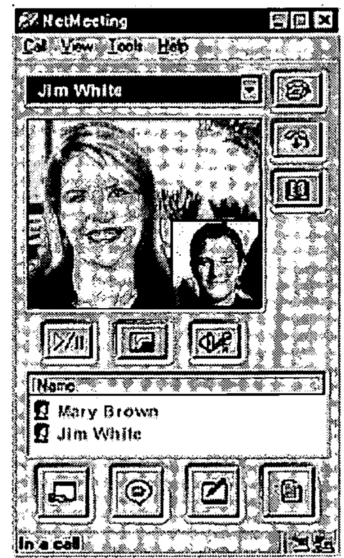


Figure 1. Microsoft NetMeeting

Interactions Using Live Web-Audio Conferences

One of the popular Internet conferencing software products is Microsoft NetMeeting (Figure 1). This software enables the user to communicate with both audio and video, collaborate in Windows-based programs, exchange graphics on an electronic whiteboard, transfer files, or use a text-based chat program. "Common uses of NetMeeting include real-time document collaboration, technical support in a helpdesk environment, training and distance learning, and conducting remote meetings" (Microsoft, 2000). While versatile, programs such as NetMeeting require relatively wide bandwidth. With a dial-up connection using a 28.8K modem, for example, users find that video quality tends to be poor and those with a low-end hardware frequently experience difficulty in maintaining connections.

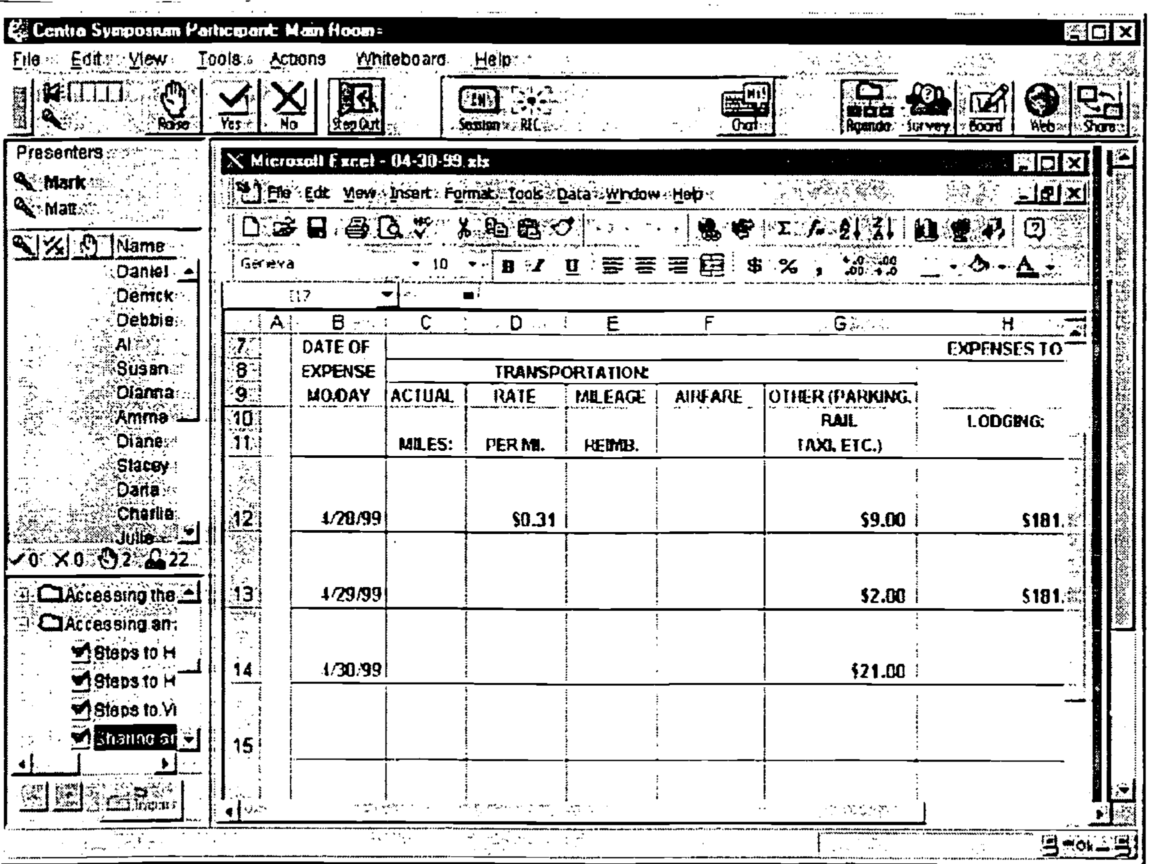


Figure 2. Centra Symposium User Interface: Application Sharing

Unlike desktop videoconferencing, however, the bandwidth problem is not as serious in Web-based audio conferencing. In addition, Voice-enabled online collaboration requires no special hardware configuration beyond a typical one used for any Web-based distance education courses. A computer with multimedia capability (sound card and speaker), a microphone, and Internet connection are all that is needed. On the software side, Web-based audio conferencing software that can provide low-bandwidth transport of voice using efficient encoding is required. Such software is usually based on a client-server technology, meaning that the server software (and hardware) provides information and manages connections while client software enables the user to access the server.

The Web audio technology enables the instructor to use all the functions of the Web used in the traditional online courses including HTML documents, multimedia presentations, chat, and bulletin board. In addition, the instructor can conduct synchronous collaboration with students via live voice conference, share applications with them in real time, and administer tests or quizzes with instant feedback, to name only a few.

The use of Web-based, synchronous audio applications is still very limited (Kötter, *et al*, 1999). Applications such as streamed audio are usually unidirectional; no interactions take place. These applications do not take full advantage of the truly interactive nature of Web audio. The Web-based IP audio conferencing technology carries Web audio one step further to integrate high quality audio and tools for dynamic interactions among participants.

Advantages of Using Web Audio Conferencing Technology

Unlike the classroom videoconferencing technology, the Web audio conferencing technology requires no expensive rooms, equipment or transmissions. This technology is available to students with a computer with a multimedia card, microphone, and Internet connection. While this is also true for desktop videoconferencing, one important difference between the two is that the Web audio conferencing technology can be used over low-bandwidth and dial-up connections. Indeed, the bandwidth problem cannot be ignored in distance education, as long as a majority of students use dial-up connections and the costs of ISDN and cable modem lines remain high.

In addition, instructors who deliver their online courses using the Web audio conferencing technology can integrate all other Web functions into their courses, including discussion board, chat, e-mail, and, of course, HTML documents.

In particular, Centra Symposium is a leading provider of Internet solutions for live collaboration over the Internet. While the main focus of Centra is on business applications such as sales, marketing and training, it has much potential for distance education as well. Centra99 makes collaboration between instructors and students easy by providing the following capabilities (Centra, 1999):

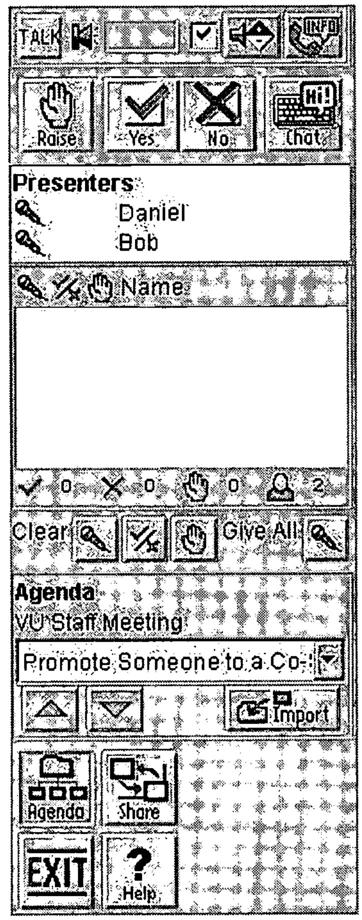


Figure 3. CentraNow User Interface

- Intuitive controls over assigning speaking rights among students. When a student has a question, he or she can "raise" hand by clicking on an icon and the instructor can grant the speaking right to the person. This way, the instructor can avoid confusion often seen in live chat and at that same time encourage participation of all students.
- Easy administration of tests and quizzes, and instant feedback from online evaluations
- Effective management of student accounts. Scheduling, confirming, and managing student accounts are easily handled.
- Application sharing capabilities between the instructor and students for hands-on experience (Figure 2).
- Whiteboard for shared visual communications among participants.

- Support for multiple instructors for a class
- Availability of break out groups and lab environment
- Cost advantages (no transmission cost, no high priced equipment, no onsite technician and/or administrator is needed)

Recently, Centra Software launched CentraNow (www.centranow.com) that is a scaled down version of the full Symposium product. CentraNow is available for free at the time of this writing, though the number of participants who can attend a particular meeting is limited to four (Figure 3 and 4).

Overall, this voice over IP audio conferencing technology is an attractive compromise between the traditional Web technology, which lacks real-time interactions, and the classroom videoconference technology, which is too costly for many institutions and also may require students to travel a great distance. Given these limitations of various other technologies, synchronous Web audio may be an efficient and cost effective way of delivering distance education courses.

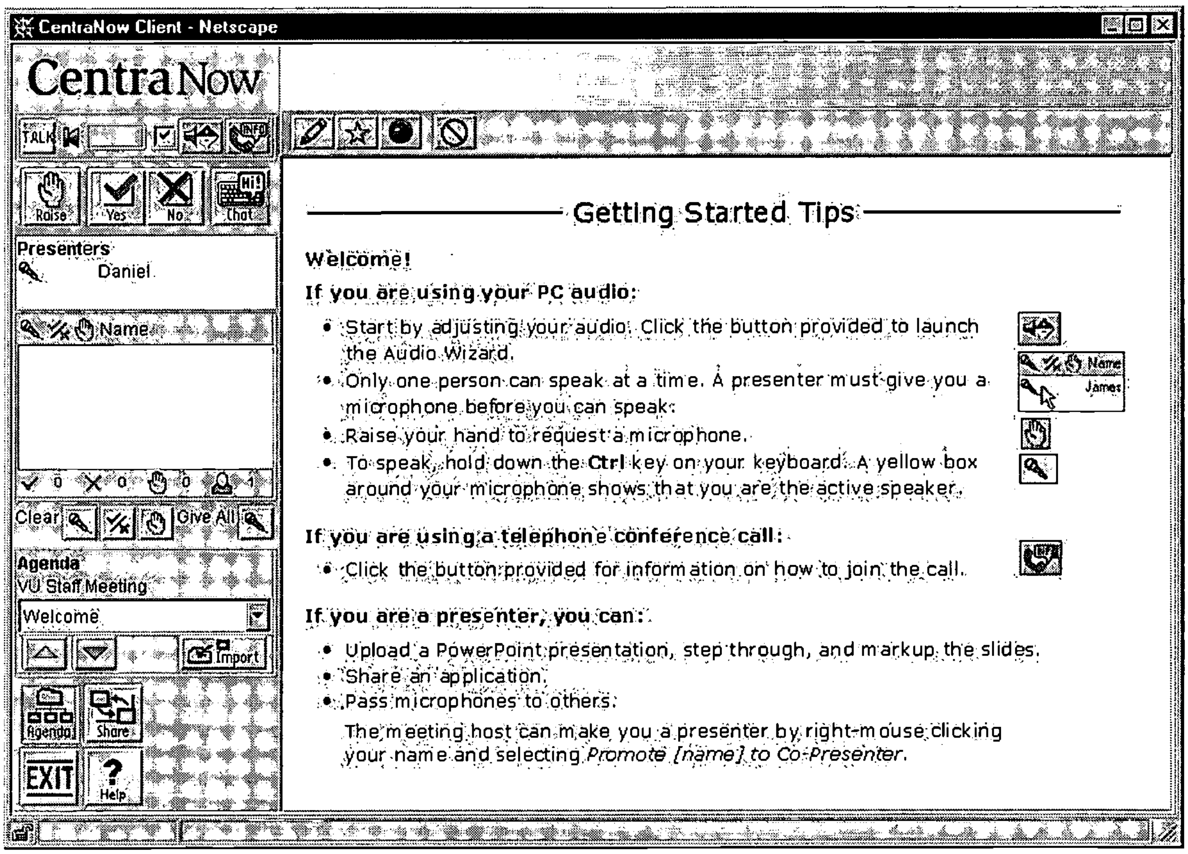


Figure 4. CentraNow User Interface Full Screen

Concluding Remarks

One of the key elements that is critical to the success of distance education is active collaboration between participants. "Two-way interaction with a given student and the instructor simply is not enough" (Palloff & Pratt, 1999). Online courses using the traditional Web functions lack spontaneous interactions among participants. Static Web documents and e-mail, the two most commonly used Web functions, provide only two-way interactions.

Bulletin board and chat can often cause confusion and frustration. On the other hand, classroom videoconferencing is prohibitively expensive for many institutions, while desktop videoconferencing faces a serious bandwidth problem. The Web audio conferencing technology may be an efficient and affordable solution for many distance education courses that require spontaneous interactions and collaboration among participants.

References

Centra Software (1999). eBusiness, eCommerce, eCollaboration. Centra Web site (www.centra.com/corportate/).

Hara, N., & Kling, R. (1999). Students' Frustration with a Web-based Distance Education Course: a Taboo Topic in the Discourse. Center for Social Informatics, Indiana University. Working Paper 99-01-C1.

Kötter, M., *et al* (1999). Voice Conferencing on the Internet: Creating Richer On-Line Communities for Distance Learning. *Proceedings of Ed-Media 1999*. Association for the Advancement of Computing in Education.

Microsoft (2000). Windows NetMeeting: Features. Microsoft Web site on NetMeeting (www.microsoft.com/windows/NetMeeting/) and similar Web sites.

Millbank, G. (1994). Writing Multimedia Training with Integrated Simulation. (Presented at the Writers' Retreat on Interactive Technology and Equipment). Vancouver, BC: the University of British Columbia Continuing Studies.

National Education Association (2000). "NEA and Blackboard, Inc. Study Finds 24 Measures of Quality In Internet-based Distance Learning." NEA Web site (www.nea.org)

Navickas, L. (2000). *Collaboration 2.0: Revolutionizing eBusiness Processes Through Live Collaboration over the Internet*. Lexington, MA: Centra Software.

Palloff, R., & Pratt, K. (1999). *Building Learning Communities in Cyberspace: Effective Strategies for the Online Classroom*. San Francisco: Jossey-Bass Publishers.

Sherry, L. (1996). Issues in Distance Learning. *International Journal of Educational Telecommunications*, 1(4), 337-365.

Web-based Foreign Language Learning in a Cooperative Environment: The Effects of Ability and Group Composition on Reading, Writing, and Listening Comprehension

Miwha Lee
Pusan National University of Education
Pusan, Korea
mlee@ns.pusan-e.ac.kr

Abstract: This study examined the effects of ability of the student and group composition on achievement in reading, writing, and listening comprehension in Web-based foreign language learning in a cooperative environment. Forty-four students were randomly assigned to heterogeneous and homogeneous groups. The results of the analysis showed that group composition as well as student ability significantly exerted differential effects on the learning outcomes. The implications of these results for Web-based small group work were discussed.

Introduction

Computer-assisted language learning (CALL) using Web-based multimedia courseware can provide a learning environment that facilitates positive interdependence and collaborative efforts among students. The students work together in small groups at the computer; their efforts are directed toward mutual, yet academically and socially beneficial, goals. In general, extensive research on cooperative learning has shown profound and positive effects on a wide range of students' cognitive and social-affective outcomes (e.g., Johnson & Johnson, 1999; Johnson et al., 1993; Sharan, 1990; 1994; Slavin, 1995). The computer as an instructional medium also has the potential for promoting interaction and collaboration among students (e.g., Cates & Goodling, 1997; Cavalier & Klein, 1998; Chen, 1995; Johnson & Johnson, 1996; Lee, 1993). During the past years, the Internet has been increasingly utilized as an effective instructional tool for language learning, since the Web can become a multimedia-based content provider with versatility and interconnectedness (Clinch, 1999; Harasim et al., 1996; Khan, 1997; McManus, 1995; Owston, 1997; Ritchie & Hoffman, 1996). For the present study, Web-based multimedia courseware was developed for computer-assisted foreign language instruction, as discussed later.

One of the key features that characterize cooperative learning settings and distinguish then from other learning settings is the increased opportunity for interaction among students of diverse ability, beliefs, and value systems in the learning process. Researchers have explored interaction as one of the mediating variables in the relationship between cooperative learning and social and academic gains (Hettinger, 1995; Huang, 1995; Lee, 1993; Webb, 1989). In a cooperative-learning environment, hence, students are typically grouped heterogeneously. The rationale for heterogeneous grouping is based on the assumption that students can encounter wider diversity in heterogeneous groups than in homogeneous groups. Of particular interest in the present study are ability of the student and ability composition of the group. Although research indicates that both high- and low-ability students gain social benefits by working in heterogeneous groups, the cognitive effects of ability grouping, heterogeneous or homogeneous, have been inconclusive (e.g., Cavalier & Klein, 1998; Huang, 1995; Mevarech et al., 1991; Webb, 1989; Webb & Lewis, 1988).

The purpose of this study was to examine the effects of ability of the student and the influence of heterogeneous and homogeneous group composition on achievement in reading, writing, and listening comprehension in computer-assisted foreign language learning with Web-based multimedia courseware in a cooperative learning environment. The achievement in reading, writing, and listening comprehension of high- and low-ability students were compared in heterogeneous and homogeneous groups featuring individual and group accountability.

Method

Subjects

The subjects were 44 undergraduate students enrolled in a required one-semester foreign language course at a national university in a metropolitan city in Korea. All the subjects had some previous experience with computers (e.g., word processing, Internet, telecommunications, games, and/or programming). All students have taken English as a first foreign language and French, German, Chinese, or Japanese as a second foreign language in middle and high schools.

Procedure

Before the study began, students were asked to complete a background survey, which was given in order to assess students' previous experience with computers and language learning and to provide a better description of the subjects. The pretest was administered to all students to identify those with high or low ability. Stratified random sampling was used to assign students to heterogeneous and homogeneous ability groups. Heterogeneous ability groups contained one high-ability student and one low-ability student. Homogeneous ability groups contained two high-ability students or two low-ability students. Students were unaware of the ability composition of the group. Students then received an overview of the courseware and instruction for cooperative work. They were instructed to work cooperatively as a group on the task, to help each other learn, and to make group decisions on the course of their actions in the learning process. Students were not assigned specific roles within a group, nor were they allowed to divide the work. Students worked for 50 minutes each day, 2 days each week, for 15 weeks, a total of 30 instructional sessions for one semester.

Web-based multimedia courseware

For the purpose of this study, Web-based multimedia courseware was designed and developed for French language learning. This courseware appears to be one of the first courseware for computer-assisted French language instruction in Korea. The courseware was designed to be adaptive to individual learning situations on a non-real time basis. Students can navigate the hyperlinked multimedia contents without a pre-ordered learning schedule. Through their exploration and navigation, thus, they can design their own instruction. The contents of the courseware are divided into two levels: beginning and intermediate. Each level consists of 15 coherent but independent lessons. Each lesson is composed of six sections: reading, writing, listening, speaking, grammar, drills, and games. These sections require either passive or active learning modes in terms of data manipulation.

The reading section shows paragraphs in a variety of styles and includes interpretations and in-depth explanations regarding morphological, lexical, syntactical and semantic-pragmatic rules and expressions used in each sentence. The writing section enables students to gain pragmatic competence in their writing skills. It provides questions related to context-based composition. The listening section presents simple expressions with immediate text feedback to improve students' listening comprehension. The speaking section is designed with an emphasis on conversational practice, based on given situations presented as a picture. Concerning the grammatical rules of the previously presented sentences, the grammar section provides charts, pictures, examples as well as explanations about those points. The game section is an additional unit designed to motivate students through games, songs, or puzzles, which may not deal with the lesson directly.

The courseware also includes the interaction facilities: help, bulletin board, announcements, and e-mail. The help component includes general instructions regarding the instructional system. The bulletin board deals with management-related interactions such as a recommended learning schedule and important dates.

The announcements show FAQ's (Frequently Asked Questions) on subject materials or technical problems. The e-mail allows for individual communications. These interaction facilities were designed to provide various types of asynchronous communications among three different user groups: teachers or tutors, students, and system administrators.

In designing and developing the user interface of the courseware, a special emphasis was placed on user-friendliness and efficiency. A simple, intuitive design with a text-based menu, rather than a complicated design, was preferred. In addition, the courseware utilizes well-designed TrueType fonts, which support Unicodes such as 'Lucida Sans Unicode,' 'Berdana,' and 'Times New Roman.' The basic color of the courseware was carefully selected based on the color-effectiveness studies (Moore, 1996; Pett & Wilson, 1996; Weinman & Heavin, 1996). Considering the current access speed to the Internet via modems or LANs (Local Area Networks) in schools, a minimum level of animation was used in order not to interfere with students' concentration level in the learning process (Jeong & Yoon, 1998). For the consistent and systematic delivery of information, the subsequent hyperlinked information is presented in the same page. To this end, the interface was developed using Active Server Page (Hillier & Mezick, 1998) and Dynamic-HTML (HyperText Markup Language) (Homer, 1997).

Research Design and Data Analysis

The study employed a 2 x 2 factorial design. The between-subjects factors included Ability (high, low) and Group Composition (heterogeneous, homogeneous). The within-subjects factor, Achievement, included Reading, Writing, and Listening Comprehension. The analysis of variance (ANOVA) was performed to determine the interaction effects as well as the main effects of ability and group composition on achievement in reading, writing, and listening comprehension. The analysis of covariance (ANCOVA) was also conducted, with students' previous experience with computers and the pretest results serving as the covariates. The level of significance was set at .05 in this study.

Results and Discussion

The means and standard deviations for achievement in reading, writing, and listening comprehension are presented in Table 1. The results of the analysis of variance are shown in Table 2.[1]

Reading. Significant main effects were found for Ability, F (1, 40) = 7.208, $p < .05$, and for Group Composition, F (1, 40) = 14.029, $p < .05$, and significant interaction effects were also found for Ability and Group Composition, F (1, 40) = 7.268, $p < .05$. These results indicate that student ability and group composition exerted differential effects on achievement in the reading posttest, as shown in Tables 1 and 2. High- and low-ability students tended to achieve differentially across the groups of different composition on the reading posttest. The students in heterogeneous groups scored higher than did those in homogeneous groups. This pattern is more noticeable among low-ability students than high-ability students.

Writing. There were significant main effects for Group Composition, F (1, 40) = 4.401, $p < .05$, and significant interaction effects for Ability and Group Composition, F (1, 40) = 3.759, $p < .05$. Yet, main effects for Ability were not statistically significant. Both of high-ability and low-ability students working in heterogeneous groups tended to score higher on the writing posttest than did those working in homogeneous groups. These results indicate that the achievement of high-ability and low-ability students was dependent on the group composition in which they were working.

Listening Comprehension. No significant effects were found for Ability or Group Composition or for the interaction between Ability and Group Composition. The results indicate that the differences between the posttest means were not statistically significant, probably due to the relatively large standard deviations, as shown in Table 1.

This study examined the effects of student ability and group composition on achievement in reading,

[1] It should be noted that students' previous experience with computers and the pretest results were not significantly correlated with the achievement scores. The results of ANCOVA were rarely changed. For a purpose of clarity, hence, the results of ANOVA are presented in this section.

writing, and listening comprehension in computer-assisted foreign language learning with Web-based multimedia courseware in a cooperative learning environment. The results of the analysis of variance indicate that group composition as well as student ability significantly exerted differential effects on the learning outcomes. Both high-ability and low-ability students working in heterogeneous groups showed higher achievement than did those working in homogeneous groups. These results corroborate and lend further support to the previous studies that heterogeneous group composition benefits students of both high ability and low ability (Larson et al., 1984, Webb, 1982a; 1982b; Yager, 1986). The cooperative learning methods, in non-computer settings, often call for students to be grouped heterogeneously by ability (e.g., Sharan, 1994; Slavin, 1995). The findings of this study suggest that ability grouping can also be utilized as an effective and practical method in Web-based instructional settings.

Suggestions for future research should be noted. First, a comparative study of group learning with individualized learning in Web-based instructional settings may be worth further investigation. Second, this study employed pairs; the findings may not generalize to larger groups. Some research suggested the importance of group size as well as group composition in computer-based cooperative learning (Guntermann & Tovar, 1987). Finally, this study has focused the product of group learning. Future research should also analyze the intra-group dynamics among students in the learning process.

Table1. Means and Standard Deviations of the Achievement Scores by Ability and Group Composition

		Reading	Writing	Listening	Total
Ability					
High	M	8.39	8.22	5.43	22.04
	SD	1.23	2.13	2.43	4.76
Low	M	7.38	7.00	4.43	18.81
	SD	1.94	2.55	2.06	5.54
Group Composition					
Heterogeneous	M	8.64	8.27	5.18	22.09
	SD	1.33	2.19	2.42	5.26
Homogeneous	M	7.18	7.00	4.73	18.91
	SD	1.68	2.47	2.19	5.04
Total	M	7.91	7.64	4.95	20.50
	SD	1.67	2.39	2.29	5.34

Table 2. ANOVA Results for the Achievement Scores by Ability and Group Composition

	Source of Variation	Sum of Squares	DF	Mean Squares	*F*	*P*
Reading	Ability	12.750	1	12.750	7.208	.011
	Group Composition	24.817	1	24.817	14.029	.001
	Interactions	12.856	1	12.856	7.268	.010
Writing	Ability	17.892	1	17.892	3.719	.056
	Group Composition	19.442	1	19.442	4.401	.046
	Interactions	18.041	1	18.041	3.759	.050
Listening	Ability	11.600	1	11.600	2.316	.136
	Group Composition	2.759	1	2.759	0.551	.462
	Interactions	11.697	1	11.697	2.335	.134
Total	Ability	125.586	1	125.586	5.818	.021
	Group Composition	122.144	1	22.144	5.659	.022
	Interactions	126.632	1	26.632	5.867	.020

References

Cates, W. M. & Goodling, S. C. (1997). The relative effectiveness of learning options in multimedia computer-based fifth-grade spelling instruction. *Educational Technology Research and Development*, 45(2), 27-46.

Cavalier, J. C. & Klein, J. D. (1998). Effects of cooperative versus individual learning and orienting activities during computer-based instruction. *Educational Technology Research and Development*, 46(1), 5-18.

Chen, M. (1995). A methodology for characterizing computer-based learning environment. *Instructional Science*, 23, 183-220.

Clinch, B. J. (1999). Web-assisted language learning. *Proceedings of Ed-Media 99*, Seattle, WA. 1334-1335.

Guntermann, E. & Tovar, M. (1987). Collaborative problem solving with Logo: Effects of group size and group composition. *Journal of Educational Computing Research*, 3, 313-334.

Harasim, L., Hiltz, S., Teles, L., & Turoff, M. (1996). *Learning networks*. Cambridge, MA: MIT Press.

Hettinger, G. (1995). Raising the level of the debate: The effects of computer-mediated communication on group dynamics and critical thinking skills. *Proceedings of AECT*, 186-193.

Hillier, S. & Mezick, D. (1998). *Inside programming Active Server Pages*. Redmond, WA: Microsoft Press.

Homer, A. (1997). *Instant IE4 dynamic HTML: Programmer's reference.* Birmingham: Wrox Press.

Huang, J. C. (1995). Effects of types of feedback on achievement and attitude during computer-based

cooperative condition. *Proceedings of AECT*, 219-226.
Jeong, H. & Yoon, A. (1998). Interface design of electronic-dictionary developing system: Considering end-user's knowledge. *Proceedings of '98 HCI*, 18-20.
Johnson, D. W. & Johnson, R. T. (1996). Cooperation and the use of technology. In Jonassen, D. H. (Ed.). *Handbook of research for educational communications and technology*. New York: Simon & Schuster Macmillan.
Johnson, D. W. & Johnson, R. T. (1999). *Learning together and alone: Cooperation, competition, and individualistic learning.* (5th Ed.). Needham Heights, MA: Allyn & Bacon.
Johnson, D. W., Johnson, R. T., Holubec, E. J., & Roy, P. (1993). *Circles of learning: Cooperation in the classroom.* (4th Ed.). Alexandria, VA: Association for Supervision and Curriculum Development.
Khan, B. H. (Ed.). (1997). *Web-based instruction*. Englewood Cliffs. NJ: Educational Technology Publications.
Larson, C. O., Dansereau, D. F., O'Donnell, A., Hythecker, V., Lambiotte, F. G., & Rocklin, T. R. (1984). Verbal ability and cooperative learning: Transfer of effect. *Journal of Reading Behavior*, 16, 289-295.
Lee, M. (1993). Gender, group composition, and peer interaction in computer-based cooperative learning. *Journal of Educational Computing Research*, 9(4), 549-577.
McManus, T. (1995). Special considerations for designing Internet-based education. In. D. Willis, B. Robin & J. Willis (Eds.). *Technology and Teacher Education Annual*. Charlottesville, VA: Association for Advancement of Computing in Education.
Mevarech, Z. R., Silber, O., & Fine, D. (1991). Learning with computers in small groups: Cognitive and affective outcomes. *Journal of Educational Computing Research*, 7(2), 233-243.
Moore, F. C. (1996). The do's & don'ts of web site design. [On-line]. http://www.webspertise.com/
Owston, R. D. (1997). The World Wide Web: A technology to enhance teaching and learning. *Educational Researcher, 26(2)*, 27-33.
Pett, D. & Wilson, T. (1996). Color research and its application to the design of instructional materials. *Educational Technology Research and Development*, 44(3), 19-35.
Ritchie, D.C. & Hoffman, B. (1996). Using instructional design principle to amplify learning on the World Wide Web. [On-line]. http://edweb.sdsu.edu/clrit/.
Sharan, S. (1990). *Cooperative learning*. New York: Praeger.
Sharan, S. (Ed.). (1994). *Handbook of cooperative learning methods*. New York: Greenwood Publishing.
Slavin, R. E. (1995). *Cooperative learning: Theory, Research, and Practice.* (2nd Ed.). Englewood Cliffs, NJ: Prentice- Hall.
Webb, N. M. (1982a). Peer interaction and learning in small cooperative groups. *Journal of Educational Psychology*, 74, 642-655.
Webb, N. M. (1982b). Group composition, group interaction, and achievement in cooperative small groups. *Journal of Educational Psychology*, 74, 475-484.
Webb, N. M. (1989). Peer interaction and learning in small groups. *International Journal of Educational Research*, 13(1), 21-39.
Webb, N. M. & Lewis, S. (1988). The social context of learning computer programming. In R. E. Mayer (Ed.), *Teaching and learning computer programming*. Hillsdale, NJ: Lawrence Erlbaum.
Weinman, L. & Heavin, B. (1996). *Coloring Web Graphics*. New York: New Riders.
Yager, S., Johnson, D. W., Johnson, R. T., & Snider, B. (1986). The impact of group processing on achievement in cooperative learning groups. *Journal of Social Psychology*, 126, 389-397.

A Paradigm Shift in the Technology Era in Higher Education

Carl Lee
Central Michigan University
PE 206E, Department of Mathematics, Central Michigan University
Mt. Pleasant, MI 48859
Carl.M.Lee@cmich.edu

Abstract: This article presents a paradigm shift from the traditional curriculum model of setting goals and objectives to a new curriculum model of setting standards and responsibilities to assist instructors and students in changing from teacher-centered learning to student-centered learning in the technology era. The student-centered learning environment is diverse and allows students with different learning styles and intellectual abilities to prosper at their own pace. Teaching pedagogy and classroom learning are much behind the evolving of technology. In the advanced technology era, not only the traditional lecture and note taking approach will be seriously challenged, but also the static use of technology will be seriously challenged as well. This article addresses two fundamental obstacles in shifting from teaching-centered to learning-centered strategy in technology era at higher education. A case study is presented to illustrate how to deal with these fundamental obstacles.

Introduction

This article presents a paradigm shift from the traditional curriculum model of setting goals and objectives to a new curriculum model of setting standards and responsibilities to assist instructors and students in changing from teacher-centered learning to student-centered learning in the technology era. The use of technology in the teacher-centered learning environment is usually static, such as report writing, projects, powerpoint presentation, web material distribution and classroom demonstration. The student-centered learning environment is diverse and allows students with different learning styles and intellectual abilities to prosper at their own pace. A proper integration of technology is crucial for a successful student-centered learning model.

Background

Imagining that every student comes to the class with a laptop computer on and ready for learning. There are already universities requiring every student purchasing a laptop computer. The message is becoming clear that sophisticated computer technology will be at the fingertip for students and instructors in classrooms. The technology will soon not only be used for writing reports, doing research, or occasional class aid, but, more importantly, it will be available for class learning in every classroom. However, teaching pedagogy and classroom learning are much behind the evolving of technology. In the advanced technology era, not only the traditional lecture and note taking approach will be seriously challenged, but also the static use of technology will be seriously challenged as well. Faculty and students will have to face dramatic changes in the process of teaching and learning. Instructors will have to rethink the way of teaching and students will have to accept the role of being active learners. The concept of active learning, with instructors and students participating together as they develop the understanding of the subject matter, has received much attention in the recent decades (e.g., Lambert & McCombs, 1998; Stage, Muller, Kinzie & Simmons, 1998). In the student-centered model, students are provided with situations to deal with. Teachers are assumed responsibilities of guidance and facilitating the process of knowledge discovery, while students are involved with the process of discovering the knowledge themselves. Student-centered models are consistent with the constructivism learning theory, where both place significant emphasis on the learners' active participation and on the development of knowledge construction.

Obstacles Faced in the Paradigm Shift

Technology plays a crucial role in helping the learner-centered model more meaningful and more diverse. However, many obstacles are yet to be overcome in order to make student-centered curriculum a reality in higher education. These include

1. Instructors and students are not familiar with the concept of student-centered learning. As the consequence, instructors and students tend to think that student-centered approach means students are 'customers'. Therefore, instructors tend to resist against the approach. Students may quickly act themselves like 'customers'.
2. Student-centered learning creates many organizational problems in the development of an adequate curriculum. It takes several semesters of gradual changes to feel comfortable with. Many may choose to withdraw back to the more familiar teacher-centered approach.
3. Students are used to the step-by-step, more predictable teacher-centered learning. It is a difficult philosophical shift for students thinking they are the ones who develop their own learning and discovering knowledge themselves. A study conducted in (Lee, 1999) indicated that, although students would like cooperative learning or working on projects, the lecture and note taking is still their favorite learning style (Lee, 1998).
4. In the current higher education system, student opinion survey is the common teaching evaluation tool for tenure and promotion. Many instructors think that the change from the familiar teacher-centered and very organized approach to a diverse and unpredictable teaching environment will affect their student opinion scores.
5. The integration of technology into student-centered curriculum is a challenging task. Regardless how much technology knowledge we know, it is never fast enough to catch up with the technology evolvement. This introduces a serious obstacle for instructors to integrate technology into curriculum effectively.

Two Fundamental Issues Before Accepting the Student-Centered Learning

Research related to framework on how student learns (APA, 14 Principles, 1995; Alexander and Murphy, 1997) has suggested 14 principles to explain how learning takes place. These 14 principles can be classified into four dimensions as (1) cognitive and matacognitive dimension, (2) motivational and affective dimension, (3) developmental and social dimension, (4) individual differences. These principles shows how complex a learning process is. The success of learning is the result of all dimensions interacted together. The student-centered learning is a process that attempts to take all four dimensions into account to assist student learning. In order to accomplish all these dimensions, it is not surprising, that many obstacles need to be overcome. Literature has provided many useful framework and guidelines for creating student-centered classrooms and curriculum (e.g., Glasgow, 1997; Stage, Muller, Kinzie & Simmons, 1998). However, before accepting and implementing the model, two fundamental issues on motivation for instructors and students to accept the model seems to be overlooked. These fundamental issues are

(1) What should be an adequate operational definition of 'students'? The success of education depends on how much a student is learning. Student-centered learning focuses on students and their involvement in actively constructing the knowledge themselves. Therefore, it is the first critical step to find an acceptable operational definition of 'students' .

(2) How to motivate the instructor and students work together as facilitator and learners rather than teacher and student relationship? In the traditional teacher-centered learning, instructor defines the goals and objectives of the course. He/she then teaches the topics to meet these goals and objectives. If the learning outcomes are not adequate, it is often to hear from the instructor : 'students do not work hard; students are not as smart as old days'. Students often blame the instructor : ' I do not understand what he/she said; the pace is too fast!' There is usually true to certain degree for both sides. However, once such a relationship between instructor and students begins to build up, it is no longer much fun for teaching or learning. Similar blames could happen if the student-centered learning is implemented without the agreeable operational definition of 'students' and a fundamental change in rethinking the roles and the relationship between instructor and students.

Operational Definition of 'Students'

Are students 'customers'? This has been a very controversial question among different groups of individuals. It is fair to say that there is no the right answer for this question. It is not possible to define students strictly based on any business model. The philosophy of total quality management tends to overlook the nature of feeling, attitudes, motivations and intellectual differences among students. However, some basic principles and tools are useful to help us sought out causes and effects, and to provide ways to deal with the causes. One essential step is to look for a compromised acceptable operational definition of 'students'. A closer investigation about the roles students play in the higher education environment, one begins to notice that students have several roles in the higher education. A cause and effect chart helps to identify these roles based on Deming's quality improvement philosophy (1986). Three major roles that students play in the higher education can be identified:

(1) Students are considered as customers in the service-oriented environment, including registration, financial aid, library, student life related services. The main goal for these service-oriented departments is to assist students in making their learning smoother. To these departments, students are their major customers. Therefore, the typical quality concept of 'customer satisfaction' can be defined and pursued.

(2) Students are considered as clients at the departmental level. At each departmental level, students receive advising, placement, course scheduling and so on. Students act similar to the situation where a client asks for consultation from a doctor. The client has the right to request a satisfied technical assistance, while the client must also follow doctor's direction for proper medication and so on. Students are similar to clients at the departmental level, since they receive advising and placement based on the assumption that students will continue to study and meet the curriculum requirement.

(3) Students are considered as work-in-progress at the classroom level. Students are considered similar to parts or unfinished works when they come to a class. The knowledge and skills learned from the class continue to improve the work for the ultimate customers of employers and society. In the process of building the works, quality of the work should be constantly measured. In the mean time, the facilitator's quality will also be measured based on the process of building the quality works. Therefore, in the classroom environment, students are more similar to works-in-progress. The quality is measured based on the requirement from the ultimate customers, the potential employers and socicty, not only based on what the instructors think about what the works ought to be.

This operational definition of students attempts to clarify confusion of the roles that students play. Any oversimplification could introduce controversy among different groups. It is important to provide quality services and quality education for our 'students'; customers, clients and works-in-progress. The above definition helps to clarify the possible causes of the obstacles discussed above. It will help instructors and students in understanding their roles in a student-centered learning environment. This operational definition is by-no-means to be exhausting in defining all of the roles students play.

Shifting Paradigm from Curriculum Goals and Objectives to Standards and Responsibilities

The second fundamental issue is about reasons for accepting the student-centered model. Most instructors were trained in the teacher-centered model. It is an approach that is predictable, and we all feel comfortable with. Students are used to the model as well. Therefore, without a profound reason, it is difficult to convince instructors and students to make such a dramatic change. This is also very important for distance learning. This fundamental issue can be dealt with by the proper shift from setting goals and objectives based on the instructor's point of view to setting standards and responsibilities for both instructor and students.

The term 'standards' in this situation is different from the 'outcomes standards', such as the standard that students graduating from a certain program must pass a certain test. In stead, it refers to 'the process standards'. That is, I the process of learning, students are asked to learn each topic at a certain level of standards. These standards are determined based on the requirement of higher level courses, the preparation for career needs or society needs, depending on the types of courses and levels of courses. For an example, standards for a n introductory statistics can be defined based on the courses that have the prerequisite of this course and/or the adequate knowledge and skills for understanding day-to-day information in our every day life. In order to accomplish standards defined for a course, each topic in the course should also have a set of standards for the topic. In most cases, these standards are similar to the goals. However, when setting up the goals, the instructor often relies on his/her own experience and the past understanding of the career needs. When setting up the standards, the instructor will need to communicate with the related higher-level course instructors, and some key professional fields where students are hired. If the standards are defined adequately, it is usually easy to communicate with students with regards to reasons of setting these standards. Students are appreciative of the instructor's efforts to help them setting up these standards.

The term 'responsibilities' is not only for students, but also for instructors. It is necessary that a clear explanation of different 'responsibilities' for instructors and students are communicated with students. Once a set of standards is developed for the topic, various concepts will be covered, and therefore, students should receive a set of responsibilities for the level of understanding of each concept. In many cases, the responsibilities for students are similar to objectives. However, since they are developed to meet the standards, a rubric system for assessing the level of understanding should also be developed. One important strategy to communicate the responsibilities to students is to emphasize that these responsibilities are for both students and instructor, Students are responsible for learning the knowledge under the instructor's guidance. The instructor is responsible for designing appropriate activities and using various teaching strategies to facilitate student learning. Computer technology, cooperative learning, use of web sites and so on, in this stage, play a crucial role in helping the instructors in designing and carrying out student-centered learning activities.

A Case Study

Statistics is considered a difficult and boring subject by many college students. Lee (1997) developed a model called the PACE model for teaching introductory statistics to help student learning. P stands for Projects, A stands for Hands-on Activities, C stands for cooperative learning in a Computer classroom environment, and E stands for Exercises. A typical class begins with conducting a hands-on activity as a group project and collect data for further analysis. In the process of conducting the project and collecting data, group discussion is conducted to discuss the pros and cons of the project and the process in the data collection. Computer is used right after the data is collected for each group to conduct analysis or computer simulations, and for report presentations. The computer technology is used to help simplifying computation and understanding the concepts. Re-enforcement is carried out by exercises and projects. The PACE model is a student-learner centered strategy for teaching introductory statistics. Several studies were taken to assess the effectiveness of the model (e.g., see Lee (1998, 1999)). Noticeable difference in problem-solving strategy was found from students who were taught by the PACE model from those who were from the traditional class. The PACE model students were 'looking for similar activities and projects conducted in the classes' to solve problems; while students from traditional class were 'seeking for formulas' to solve the same problems. On the other hand, we also noticed that the motivation and expectation remained similarly low in both classes. One main reason for the similarly low motivation and expectation is hypothesized to be that students were not experienced to the stage to be able to visualize the entire picture of the benefit of basic statistical concepts in their career or in their day-to-day life activities. A fundamental change in helping students realize such a 'big picture' is necessary. This has lead me to the develop the paradigm of integrating 'standards and responsibilities' into the process of teaching and learning. Such a paradigm is becoming important in the use of advanced computer technology, since students will be more independent in their own learning. It will become extremely important to maintain students' motivation and expectation. Otherwise, higher education could easily be a place of 'diploma manufacturing'.

The paradigm of using standards and responsibilities were implemented in the Fall, 1999 PACE class. The class size was twenty eight. Students were mainly business school students. This is a course that block their way for business school, admission. Students are typical on-campus students who, generally speaking, had low expectation, little motivation, and came with rather weak mathematics background. At the beginning of each topic, students were given a sheet of standards and responsibilities, and were summarized and discussed after finishing the topic. An example of standards and responsibilities for the topic of Exploratory and Graphical Methods is given in the following:

Standard: Students will be able to summarize a real world data using proper graphical and quantitative tools so that the summary will be useful, meaningful and valid, and will be able to use computer to analyze the data, and summarize the results, and present the results in written and orally.

The corresponding responsibilities: In order to accomplish this standard, students will learn:

1) Collecting real world data properly, and explain possible sampling errors in the process of data collection.
2) Distinguishing quantitative and qualitative types of data, and the corresponding graphical methods for summarizing them.
3) Computing descriptive summaries such as mean, s.d., median, percentile, z-scores by hand and by computer.
4) Explaining the meaning of variation and giving appropriate real world cases to explain the magnitude of variation and possible factors associated with the variation.
5) Describing histogram, stem-leaf plot, box-plot, time-series plot, and explaining their differences and usages in real world applications.
6) Demonstrating empirical rule, and using the concept of rare events in real world applications.
7) Using the Z-scores to explain the concept of rare events in real world applications.
8) Demonstrating various shapes of histograms, and their relationship with mean and median.
9) Properly matching the relationship between statistical summaries, histograms, box-plot and time-plot.
10) Applying the tools learned from this topic to analyze a real world case, and presenting the report in written and orally.

A similar list for each topic was developed, and was given at the beginning of the topic. Several assessment activities were conducted through out the semester. First, students were asked to conduct a self-assessment by rating the degree of accomplishment for each responsibility, and reasons for why they did or did not accomplish well of the specific responsibility, then, list actions that will be helpful to help them accomplish these responsibilities. Two other assessment activities were conducted at the end of the semester. One was the same self-assessment activity adding an overall assessment of the approach. The other was an assessment on the affect domain of their learning, which include attitudes, beliefs, motivations, learning styles, use of computer, and other background information.

Several observations were summarized below from the self-assessment and overall evaluation.

(1) Through out the semester, one significant difference of the interaction between instructor and students was immediately notices: When students came for individual help during the office hours, there were no students making excuses about how difficult it was, or asking to explain the entire the topic covered in class. Students usually came with a specific question and was able to pinpoint where they did not understand. This is a reflection of the understanding of their responsibilities for each topic and willing to accept their role as active learners. As a result, students were informed, and instructor was aware of specific difficulties students encountered. This attitude has significantly changed the classroom atmosphere.

(2) Although students tended to rate their level of understanding somewhat higher than their test scores indicate, the relative level of difficulty of each responsibility, and reasons were very useful information for continuous improvement. Here are some examples from students' self-assessment for the topic Exploratory and Graphical Methods:

> *'The problem areas in this section are stem-leaf plot, time-series plot, their relationship and applications.*
> *I still do not see the use of steam-leaf plot, box-plot. I think this is because we have sued histogram a lot for rare events and variation, and so on. More applications using box-plots or stem-leaf plot will be good.*

The two concepts that have been rated lower level of understanding most often were 'the use of Z-scores for interpreting rare events' and' the rclationship among summaries and various plots. This information is very valuable for continuous improvement in teaching and learning. Instructor can find out the problematic concepts and redesign strategy to help student learning.

(3) The overall assessment of the strategy was very encouraging. In the class of 28 students, everyone indicated this is helpful, especially this keeps them informed what standards they should accomplish, and how they can accomplish the standards in every topic. When asked 'is it worth of the effort to develop the standards and responsibilities for this or for other courses. Every student indicated yes for this course as well as for other courses.

Conclusion

The role of technology in education continues to evolve. Any prediction on how much technology will impact the education would be meaningless. Technology provides unlimited opportunity for instructors to create fascinating innovation to help student learning. However, since it is more and more difficult to catch up with the change of technology, the hurdle for instructors in integrating technology into curriculum becomes even larger. The success of a student-centered learning strategy relies upon, first, understanding various teaching strategies, second, accepting some strategies, third, willing to implement and assess at least a strategy, and fourth, willing to continue to improve the strategy. This process involves both students and instructors, and their understanding and accepting of the roles, respectively. In order to create an adequate atmosphere, it is important that students, instructors and administrators have a common language of the operational definition of 'students'. In addition, to create a high expectation and motivated learning environment, a shift from teacher-centered curriculum of setting goals and objectives to student-centered curriculum of standards and responsibilities provides a bridge to connect instructors and students for the common ground of pursuing high quality of education.

Reference

Alexander, P. & Murphy, P.K. (1998) The Research Base for APA's Learner-Centered Psychological Principles. In How Students Learn - Reforming Schools Through Learner-Centered Education (Edited by Lambart,N. and McCombs, B.) American Psychological Association, pp. 25-60,Washington, DC.

American Psychological Association Board of Educational Affairs (1995, Dec.). Learner-Centered Psychological Principles: A framework for school redesign and reform [On-line]. Available: http://www.apa.org/ed/lcp.html.

Deming, W.E. (1986) Out of the Crisis, MIT Center of Advanced Engineering Study: Cambridge, MA.

Glasgow, N.A. (1997) New Curriculum for New Times, A Guide to Student-Centered, Problem-Based Learning. Corwin Press, Inc.

Lambert, N. and McCombs, B. (1998) Introduction: Learner-Centered Schools and Classrooms as a Direction for School Reform. In How Students Learn - Reforming Schools Through Learner-Centered Education (Edited by Lambart,N. and McCombs, B.) American Psychological Association, pp. 1-22,Washington, DC.

Lee, C. (1997) Promoting active learning in an introductory statistics using the PACE strategy. Proceeding , 6th International Symposium on Mathematics Education at Mexico City, p. 199-206.

Lee, C. (1998) An assessment of the PACE strategy for an introductory statistics course. Proceedings, The 5th International Conference on Teaching Statistics, p. 1215-1221.

Lee, C. (1999)A comparison of students' beliefs and attitudes towards statistics between technology-rich environment and the traditional lecture. Proceedings, the International Conference on Mathematics/Science Education & Technology at San Antonio, pp. 133-138.

Stage, F.K., Muller, P.A., Kinzie, J. & Simmons, A. (1998) Creating Learning Centered Classrooms - What does learning theory have to say? ASHE-ERIC Higher Education Report Volume 26, # 4, George Washington University, Washington, DC.

Professional Development through Flexible Delivery

Geraldine Lefoe
Centre for Educational Development and Interactive Resources
University of Wollongong
NSW, Australia 2522
glefoe@uow.edu.au

Abstract: This paper provides an overview of a staff development initiative at University of Wollongong, a regional university in Australia, located on the outskirts of the largest urban area in Australia with a population of approximately 500,000. It provides a model for professional development in flexible delivery through the use of video and a website. This site provides access for staff to key concepts and in depth materials on flexible delivery, identifies support services and their roles and provides up to date policies and procedures to implement the changes in teaching practice. It highlights the challenge for staff developers to "practice what we preach".

Introduction

In recent times there has been a dramatic change in technology which has seen a convergence between distance and on campus education (Walker and Walker, 1997). Technology has been used to enhance interaction between students off campus and their lecturer on campus (Agostinho, Lefoe and Hedberg, 1997, Agostinho, Hedberg and Lefoe, 1998). Technology has also been used to improve access to content both on campus and at a distance. Online learning facilities are being offered locally and by overseas institutions. Students may now be just a block away, a suburb away or on another continent. On campus students may only attend lectures two or three times a semester, if at all, but may have in depth discussions or "chat" regularly online with the subject facilitator and other students (Wills et al, 97).

Effective staff development is one of the keys to ensuring success in this dramatic move. By placing staff in the learner's shoes this project provides opportunity for teachers to actively engage in the learning environments that are being advocated for their students. Success in using these learning environments can only occur when the staff member is as comfortable in the learning environment as the student is.

Background

The University of Wollongong is located on the South Coast of NSW, Australia, strategically developed to meet the needs of students in the Illawarra region. The main campus is in Wollongong, with centres located in Sydney and Berry, and an international centre in Dubai. This has been expanded in the Year 2000 to include a campus in Nowra (one hour drive) and access centres in Batemans Bay (3 hours drive) and Bega (6 hours drive). The intention with the new campus and access centres, was to establish a South Coast Educational Network (SCEN),

"to develop a comprehensive cross-sectionally articulated plan for the delivery of effective post-compulsory education and training across university, TAFE, secondary school and other training sectors" (Illawarra Regional Information Service, 1996. P1)

The vehicle for this expansion would be a network of educational providers operating as development partners through SCEN. Within this network the University of Wollongong decided there was the need for a degree program that could be delivered flexibly. "The network would draw upon emerging educational technological developments to expand the availability of, and improve the accessibility to, relevant educational programs" (Illawarra Regional Information Service, 1996. P1)

The SCEN initiative had implications for the delivery of a large number of subjects in a different format to current traditional practice. The rapid growth of flexible delivery at University of Wollongong would require access to a variety of resources and an understanding of alternative delivery methods.

Flexible delivery, in this situation, is defined as an approach to teaching and learning which increases access to education for a wide range of students by offering greater student control over time, place and, potentially, pace of study. Technology, where appropriate, is utilised to support communication and access to information and to move towards a more student centred approach to teaching and learning. The most appropriate delivery medium, (eg a lecture, a video or a book), can be chosen to meet the learning outcome and the student's needs. Interaction, (learner-learner and teacher-learner) can be facilitated through face-to-face contact or through supporting technology such as videoconference, Internet, phone, fax. (Bell and Lefoe, 1998)

Role of development support units

From the broader perspective of the current higher education environment, both individuals and faculty units have been buckling under the combined weight of devolved responsibility for management, administration, technology implementation, professional development and a generally increased workload. Historically, many of the teaching staff developed subjects in the traditional lecture/ tutorial format on their own.
The move to flexible delivery of subjects means thinking differently about this process and moving into a team based environment, especially where the development of resources is involved. Support structures are critical to ensure that this journey through chaos and confusion results in quality outcomes for all involved.
In order to be successful, the move to flexible delivery could only occur where this support infrastructure was put in place and teaching staff could tap into what they needed when they needed it. In recognition of this the university had a variety of support units, many of whom had undergone change during recent restructuring in order to meet these emerging needs (Curtis, Lefoe, Merten, Milne and Albury, 1999).

The degree support structure in the University of Wollongong includes:
* Centre for Educational Development and Interactive Resources (Includes Educational Development Lecturers, Interactive Multimedia Unit, Audio Visual Unit and Electronic Publishing) The Centre has principle responsibility for supporting faculties in their adoption and utilisation of technology within their teaching practice. It also provides a role in quality control of resources.
* Learning Development Unit (includes Lecturers in Learning Development and Tertiary Literacy officer) Their approach of providing all students with assistance in making the transition into tertiary and discipline based studies is an innovative and systemic approach to learning support (Skillen, Merten, Percy and Trivett, 1998).
* Academic Registrar's Division which has principle responsibility for student administration
* Information Technology Services provides the infrastructure for improved use of technology at all locations.
* The library provides an outreach librarian whose role is to support lecturers and students involved in flexibly delivered subjects.

The purpose of the resource

This staff development resource brings together information about the roles and responsibilities of all the support units as well as providing academic staff with experience in flexible delivery through the use of the resources. The rcsource models the practice of flexibly delivering professional development. It utilises various media and includes an interactive dimension in a web-based learning environment. It models the cnvironment that will be used by academics in teaching in other locations and on campus, whilst providing access to people, policies and procedures to support development of subjccts in a more flexible mode.

Description of the resource

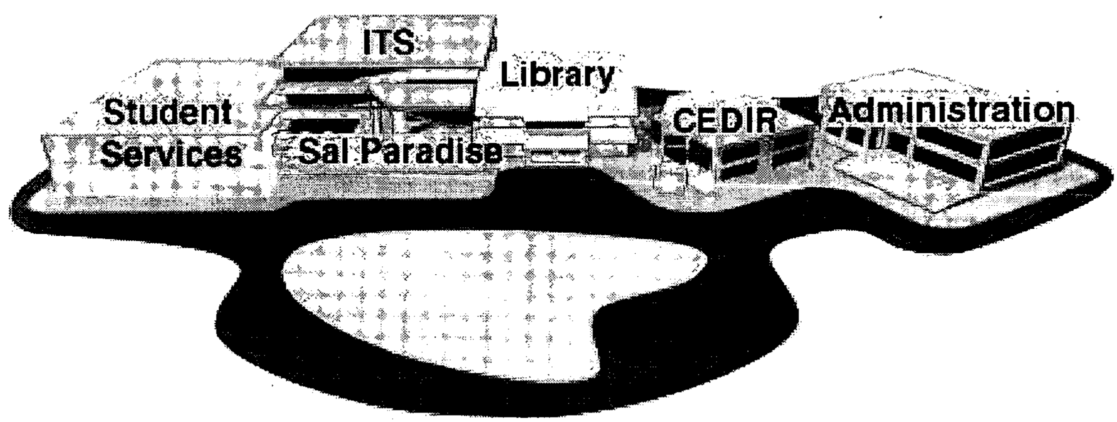
The staff development package includes two integrated resources:

1. A video which provides case studies of teaching methods utilised by staff currently engaged in flexible delivery in a number of faculties.

2. A web site (http://cedir.uow.edu.au/Projects/FlexDel/) which links teaching staff to support staff for subject development as well as utilising information from an existing CDROM, Teaching at a Distance, developed by the University (in collaboration with several others) for a consortium of universities in Australia (PAGE) (Wills et al, 1998). The existing material has been redesigned to be specific to the needs of University of Wollongong teachers. An interactive dimension to the resource has been added through a discussion forum, which allows for asynchronous discussion between different people by removing the restrictions of time and place.

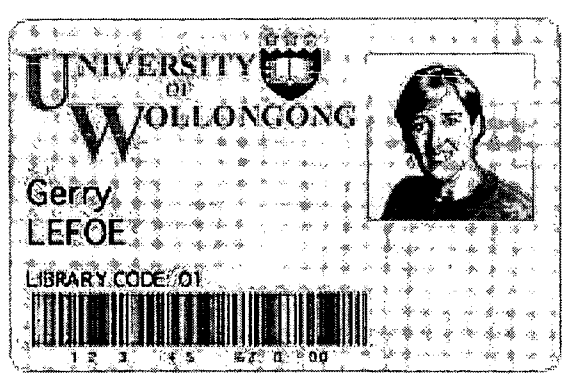
The website provides four levels of resources for teaching staff.

* Level 1 - Provides information about flexible delivery and its implementation at University of Wollongong and the various support teams for curriculum development including Centre for Educational Development and Interactive Resources, Library Services and Student Support Services. Images of people in their roles at University of Wollongong are used at this first level to personalise the information and introduce the topics. It defines the role of the various groups and the support for subject development that they are able to provide. Its purpose is to encourage teaching staff to consider contacting these people for support and to identify them on campus. This level also introduces a discussion forum.



* Level 2 - A detailed overview of each support area and important issues that should be considered in initial planning and design. The project also draws on other resources created by Centre for Educational Development and Interactive Resources such as the National Council Open Distance Education Flexible Learning web site

Ray Stace
Robert Corderoy
Gerry Lefoe
Richard Caladine
Sandra Wills



Click on the card for more information

(http://cedir.uow.edu.au/ncode).
* Level 3 - Provides more detailed information on topics covered in Level 2 information. This information is usually provided as downloadable files that can be printed, where required.

* Level 4 - External Web based resources.

Using the resource

This professional development initiative was designed to meet the needs of academic staff to

- highlight, through the use of the video, modes of flexible delivery that are being used on campus
- provide a learning environment which models the practice of flexible delivery
- identify in a cohesive way the support units on campus
- clarify the new roles and directions for these units
- provide interaction with other teaching staff who are engaging in this practice through the discussion forum
- support academic learning needs about flexible delivery

The resource will be used in a number of ways for professional development. At the individual level it can be used at a time or place which meets the need of the staff member. It will also be utilised at the small group level and in faculty staff development programs to support initiatives in this area. The University of Wollongong has a compulsory subject for new lecturers, Introduction to Tertiary Teaching, which has elective modules on such things as redesigning subjects for flexible delivery. This initiative provides the starting point for this module and for others related to thinking differently about teaching and learning.

Conclusion

Planning for flexible delivery has meant making drastic changes not only in thinking about curriculum development, but also in the whole infrastructure of the university from administration to information services. The University of Wollongong now has in place many structures, some of which were under utilised when implementing new ways of teaching. This resource provides a link for academic staff, not only to information about flexible delivery at many levels, but also to staff who are able to work in a team based environment to improve subject development and to provide support to staff as they make changes in their teaching practice. As the University of Wollongong expands to include other locations, professional development for teaching staff can model the changing practices for teaching and learning. "Practising what we preach" is an important component of professional development.

References

Agostinho, S., Hedberg, J., Lefoe, G., (1998) Constructing Problems in a Technology-Mediated Learning Environment. Educational Media International 35:3.

Agostinho, S., Lefoe, G., Hedberg, J. 1997 'Online Collaboration and Problem Solving for Effective Learning: A Case Study of a Post Graduate University Course', AUSWEB97 http://ausweb.scu.edu.au/proceedings/index.html

Bell, M. and Lefoe, G. (1998) Curriculum Design for Flexible Delivery - Massaging the Model. In Corderoy, B. (Ed) Flexibility: The Next Wave, 15th Proceedings of Australian Society for Computers in Tertiary Education. University of Wollongong.

Curtis, S., Lefoe, G., Merten, M., Albury, R., and Milne, C., (1999) Passing Through the Pain Barrier: making a flexibly delivered degree. "Cornerstones: What Do we Value in Higherr Education. HERDSA Conference, Melbourne. http://herdsa.org.au/vic/cornerstones/toctitle.html#P

Illawarra Regional Information Service (1996) South Coast Post-Compulsory Education Curriculum Options (Unpublished report)

Lefoe, G., & Corderoy, R. M. (1998) Tips for effective Online Teaching and Learning. Teaching in The Community Colleges (Electronic) Journal Vol3 Spring 1998 ISSN 1089-2877

National Council of Open Distance Education: Flexible Learning web site (http://cedir.uow.edu.au/ncode)

Professional Development for Flexible Delivery (http://cedir.uow.edu.au/Projects/FlexDel/)

Skillen, J., Merten, M., Percy, A. and Trivett, N., (1998) "The IDEALL approach to Learning Development: a model for fostering improved literacy and learning outcomes for students", Proceedings of the Australian Association of Research in Education 1999. http://www.swin.edu.au/aare/conf98.htm

Walker, J.H. and Walker, M.G., 1997 'Review of Research in Open and Distance learning in Australasia and the Pacific.' In Osbourne, J., Roberts, D., and Walker, J., (Eds) Open, Flexible and Distance Learning: Education and Training in the 21st Century 13th Biennial Forum of Open and Distance Learning Association of Australia pp 491 - 499

Wills, S., Nouwens, F., Dixon, S., and Lefoe, G. (1997) Teaching at a Distance about Teaching at a Distance in Kevill, R., Oliver, R., Phillips, R. (eds) ASCILITE '97 What Works and Why, 14th Annual Conference of ASCILITE. (Pp 628 - 635) Perth W.A Curtin University of Technology Printing Services ISBN 1 86342 623 x

Mathematical Statistics in the Net – The Pythagoras Learning Environment

Jarkko Levasma
Tampere University of Technology
Digital Media Institute
Department of Mathematics
Hypermedia Laboratory
Korkeakoulukatu 1, P.O.BOX 692
33101 Tampere, FINLAND
jarkko.levasma@tut.fi

Abstract: Pythagoras is one of the pilots in the Open Learning Environment (OLE) Project that develops pedagogically and technically appropriate learning environment for the net. On the Pythagoras pilot a learning environment of the same name was developed as an aid to teaching in secondary and upper secondary schools with a mission to make Pythagoras into a commercial net-product and to study its use in teaching. The Pythagoras Learning Environment comprises theory, interactive exercises, a question tool and communication tools. In the implementation of Pythagoras use was made of Java Remote Method Invocation and Servlet technologies among others, which offer a flexible and efficient way of producing WWW systems. A teaching experiment was arranged for Pythagoras to study the usability of Pythagoras and users' opinions. The students particularly enjoyed doing research using the question tool. It may be concluded on the basis of the teaching experiment that using the net as a tool for learning offers considerable advantages over conventional study.

Introduction

The article describes the Pythagoras pilot as a part of the Open Learning Environment (OLE) Project (Ruokamo, Pohjolainen 1999). On the Pythagoras pilot a learning environment in statistical mathematics was produced for the net (Pythagoras Learning Environment). The article presents the background to the pilot, the parties involved in the research, development and in the teaching experiment and the aims of the pilot. This is followed by a presentation of the functionality of the Pythagoras Learning Environment and its technical realisation. A teaching experiment was arranged with Pythagoras and the realisation and results of this are presented in the article. The article further considers the commercialization of the Pythagoras. The article concludes with some conclusions drawn on the basis of the research and development work.

Background to the pilot and co-operating parties

The first version of the Pythagoras Learning Environment was created in the Distance Learning in Multimedia Networks Project (ETÄKAMU) research project on the pilot in natural sciences (Pohjolainen, Ruokamo 1999). This was carried out on the responsibility of the Hypcrmedia Laboratory of the Tampere University of Technology (TUT). At the time of ETÄKAMU the main responsibility for the research and development work on the Pythagoras rested with Heikki J. Mäenpää, M. Sc. (Eng.). The content selected for the Pythagoras was statistical mathematics as problems in statistical mathematics lend themselves particularly well to computer presentation. The Hypermedia Laboratory has produced numerous net courses in mathematics, the latest of which is the introductory part of a course on matrix calculation (Matrix Calculus 1) using a development version of the A&O Open Learning Environment (Pohjolainen, Ruokamo, Nykänen 1999). The research findings of the Pythagoras pilot and the experience gained serve as a basis for development work on A&O.

Edita Ltd has supported the OLE Project and the Pythagoras pilot in particular. A number of teachers from comprehensive and upper secondary schools in the Tampere Region have been involved in the development of Pythagoras. Among the most active members were: Jussi Kytömäki (Ylöjärvi Upper Secondary School), Päivi

Portaankorva-Koivisto (Moisio Secondary School), Riikka Uotila (Ylöjärvi Upper Secondary School) and Pauli Koivula (Teisko Secondary School and Tampere Upper Secondary School for Adults). These teachers not only participated in the development work of the learning environment but also took part in arranging the teaching experiment and in making the teacher's guide.

Aims of the pilot

In the first year of the OLE Project the main aim of the Pythagoras pilot was to make Pythagoras into a commercial net product. This means that the technical and pedagogical features of Pythagoras were to be developed to a standard at which it would be possible to market and use it over the net. Commercialization as a whole involved many other considerations, and the main responsibility for these was with Edita Ltd. The other aims of Pythagoras were to create a learning environment that would be user-friendly, versatile, interactive and exploit the latest technologies.

Structure and functions of the Pythagoras Learning Environment

Pythagoras is a hypermedia-based learning environment. The concept learning environment subsumes certain essential characteristics compared with mere learning material, which is to be addressed later in this chapter. In management of a learning environment the main factors are the roles of the users and the rights and duties inherent in those roles. Pythagoras is used and managed over the net. There are three main user roles: student, teacher and maintenance person. A group of students and a teacher together constitute a teaching group, which Pythagoras takes as a basic unit for management purposes.

Technical framework

The basic framework of Pythagoras is a group of linked hypermedia documents. In the creation of the Pythagoras static HTML pages, as, for example, the theory of statistical mathematics, the FML publication tool developed in the Hypermedia Laboratory was used (Nykänen 1999). Some of the HTML documents in Pythagoras are dynamically created. Dynamic refers here to the fact that the content and/or the external appearance of a HTML document varies, e.g., depending on the input obtained from the user. In the realisation of Pythagoras Java Servlets were used almost exclusively in the creation of dynamic HTML pages. Servlets enable efficient and scaled server programmes operating through CGI interface and can be produced with an object-based language (Articles of Servlets).

Another prime element in the realisation of Pythagoras is the independent programmes created as Java applets that are executed in the client computer. The major advantage in using applets is getting away from the rigid page concept of WWW. In Pythagoras applets were used especially to create interactive elements. Applets were used in such a way that, e.g., instead of one large applet several smaller general-purpose applets were used on the HTML pages. Using several applets on the same page may from time to time cause technical browser problems. Some of these problems have already been solved through new browser versions, but in practice problems may still arise as there continue to be old browser programmes in general use.

Pythagoras is a distributed application. The applets store the information in the server computer, for which Remote Method Invocation (RMI) technique was mostly used. RMI is a feature included in Java language, which makes it possible to call up Java programme methods via the Internet (Articles of Remote Method Invocation). Certain problems exist in the use of RMI, especially with support from certain browser programmes and client-side firewalls. The problem concerning firewalls can be solved using Servlets (McPherson 1999). A separate RMI server is initiated for each teaching group. The advantage of this is significant scalability - Pythagoras functions without changes with both large and small user numbers.

Functionality of Pythagoras learning environment

In the planning of any net pages whatsoever one of the foremost considerations is navigation, i.e. the logic by which a user progresses from page to page. In Pythagoras an effort was made to ensure that navigation is optimally simple, and, above all, uniform. At the top of each page in Pythagoras there is a menubar for access to the four central elements of Pythagoras. These are learning material, workshop, teachers' lounge and exhibition. In addition to these four areas mention should also be made of the front page, see [Figure 1], which contains some important features.

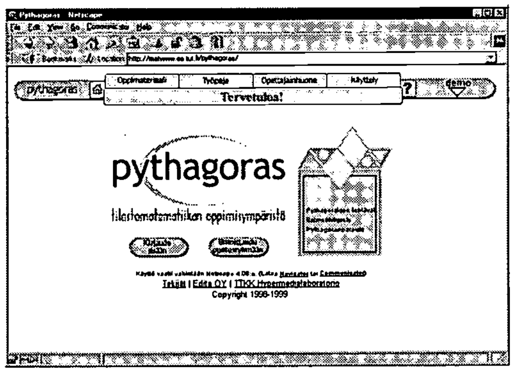


Figure 1: Front page of the Pythagoras Learning Environment

The function of the front page of Pythagoras is to serve as the starting page of the learning environment. There is a tool for students to enrol in their teaching group. From the front page a user can log in to Pythagoras. Loging in is optional, but is makes it easier for the user to use other elements of Pythagoras later.

The learning material in Pythagoras contains elements pertaining to conventional learning: theory and practical exercises. The learning material includes examples and directions for carrying out statistical research. One of the most interesting features of Pythagoras is the interactive exercises. There are seven of these, and most offer alternatives of different degrees of difficulty. The exercises address various aspects of the theory and there are links to the appropriate theoretical sections. The individual exercise page is realised with general task elements. Some of these elements are used to present the initial information and some for the input of the solution. Every exercise page has an instruction panel on which the instructions vary according to what part of the exercise the student is currently undertaking. When the student has completed the exercise Pythagoras checks the answer. If there is something wrong in the answer Pythagoras indicates the location of the mistake and provides further prompts for the solution of the task. Each checking as well as the correct answer is registered in the database for achievements. The student can monitor his/her own achievements.

The Pythagoras workshop contains those essential features that distinguish the learning material of the learning environment. The tools to access groupwork and research are located in the workshop. Through the discussion and chat tools the Pythagoras offers its users the opportunity to communicate. The survey tool in the workshop enables Gallup-type surveys. There is also a WWW editor for students to write their research reports for the net. [Figure 2] shows an example of a research report completed through a project among students. The survey page allows students to carry our questionnaire surveys to which other students may respond. The questionnaires may consist either of multiple choice or preference questions. The material obtained from the responses can be examined and stored for later use and may be used as a baseline for several Pythagoras exercises. On the basis of the data obtained from the survey the students may write a research report. For making reports there is the WWW editor developed in co-operation with the KUOMA Pilot of the ETÄKAMU Project (Leinonen 1998, Piiksi 1999). Using the WWW editor the students can write a research report, append to this the stored diagrammatic pictures and save the document in HTML format. Thc teacher may as his/her discretion publish the best reports in the exhibition space.

The Pythagoras teachers' lounge is an area intended for teachers only. It contains discussion and chat tools comparable to those in the workshop. There is also a tool for monitoring and managing students' achievements.

Teaching experiment

General

The first Pythagoras teaching experiment under the OLE Project was carried out in spring 1999. The purpose of the experiment was to investigate how users reacted to the new user interface and to the numerous new features. The teaching experiment was carried out in the Hypermedia Laboratory's own computer classroom that enabled us to collect data with various technical tools. Those participating in the experiment were students from the ninth class of the Teisko Secondary School.

Research methods

Data on the Pythagoras teaching experiment were collected by questionnaire, by video and by participative observation. Students' background information and opinions and experiences were ascertained by the questionnaire. The questions on the questionnaire were formulated on the basis of the various elements used in the experiment. The questions were in the form of positive or negative statements to which the students responded on a scale of 1 to 5, where 5 corresponded to 'agree entirely' while 1 corresponded to 'disagree entirely'. A total of 15 students responded. One computer screen was taken on video using a direct connection to the display driver card. Using the video data an attempt was made primarily to ascertain the usability of Pythagoras. A great deal of data was also obtained by interviewing course instructor Pauli Koivula.

Results of the experiment

A questionnaire was used to gather background information on the students participating in the Pythagoras teaching experiment. Most of the respondents were fairly neutral regarding the study of mathematics, but most of them considered mathematics important as a subject of study. Most of the respondents reported that they found mathematics difficult. More than half the respondents used the computer regularly and almost half made abundant use of the Internet. Most of those taking part in the experiment stated that they were glad to be involved. The usefulness of Pythagoras in the study of statistical mathematics was elicited in two questions formulated in rather different ways. The students reported that Pythagoras helped in the study of statistical mathematics compared to conventional methods. Almost all respondents reported that Pythagoras was easy to use. The most important feature to be investigated in the questionnaire was the survey tool and the production of the research report with the help of the WWW editor. The students reported that responding to questions was both easy and pleasant. While many did not consider making one's own survey difficult and found using the WWW editor easy, several needed guidance in using these features. The respondents reported that it was pleasant to make one's own questionnaire. Students' opinions on the interesting nature of the Pythagoras exercises were neutral. On the average the exercises were considered difficult.

The video material gathered in the teaching experiment was of use particularly in improving the usability of Pythagoras. Examination of the recorded data revealed several different problems with the user interface. One salient feature here was that the students needed some considerable time to realise which of the tasks was baseline information and which required input on their part.

Certain technical problems emerged in the experiment; they were connected to the fact that the Netscape's Java virtual machine appeared to periodically forget the 'garbage collection', thereby causing superfluous information to accumulate in memory, culminating in the collapse of the browser. This was not a major problem as it occurred on one computer at most a couple of times in the course of the experiment.

Commercialization of Pythagoras

General

The Pythagoras pilot ended at the end of January 2000. It has been installed to the server of Edita Ltd, where it is to be marketed to various educational institutions as an educational product. In the course of the research during 1999 Pythagoras was modified to meet the needs of commercialization. We now consider commercialization from the perspective of education and software technology.

Technical considerations

The commercialization of a learning environment does not significantly differ from the commercialization of any other net environment as far as the technology is concerned. Commercialization should be taken into consideration already at the point at which the definition of the software is made. Due to the nature of the software development work, however, this is not always possible. Certain factors should nevertheless be born in mind in the planning of any software at all. The most important of these are probably the definition of user identification and use session concepts at an early stage. It is frequently problematic and time-consuming to insert user identification into an existing environment. These concepts are the basis in planning the remunerations system.

It was decided to create the remuneration system of Pythagoras in such a way that users can purchase user rights for a specified duration. The system does not require the measurement of actual time of usage, thus there was no need for a particularly complex use session system. It was decided to base user rights on teaching groups, which is most convenient for the action model of a normal school.

It was felt desirable to create an automatic ordering system for Pythagoras to be connected to the Edita Netmarket already in use. The function of the ordering system will be to receive orders and also to create user identities, teaching groups and other technical settings for each order. In practice the system was realised in such a way that the customer completes a form in Netmarket. Netmarket sends information on this to Pythagoras, which accepts the order. Next the customer can register his/her order and select user identities and passwords in Pythagoras. This way the customer gets the identities s/he wants, which is a major aid to their memorability. The registration of the order is accomplished in such a way that it reminds several Windows users of the familiar programme installation wizard.

Pedagogical considerations

Commercialization also entails attention to pedagogical considerations. There is frequently far too few instructions in surprisingly many net environments. At the development stage instructions are frequently felt to be superfluous as using one's own product generally seems fairly straightforward. At the commercialization stage the need for instructions becomes more pronounced, as the users usually lack that internalised model of the use of computer systems which is characteristic of professionals. The interface of a new system must be designed according to some familiar model, or then a new and possibly better model must be learnt. Learning the new model is best achieved through detailed instructions for use. A learning environment product also needs a teacher's guide. A net product is something of an innovation for teachers and they need instructions as to what can be done in the learning environment and how to time the course using the learning environment. A teacher's guide has been compiled for Pythagoras by a group of teachers (Päivi Portaankorva-Koivisto, Riikka Uotila, Pauli Koivula).

Conclusions

Application of WWW technologies to the construction of teaching tools

The construction of an interactive learning environment for the net is still a fairly technically demanding task. The cornerstone on which the technical realisation of Pythagoras principally rests is Java language, which nowadays offers all the necessary tools to produce WWW systems. The latest additions to Java, RMI and Servlets provide the more manageble technology as regards software technology for the realisation of WWW systems than systems realised with the traditionally variable script languages. The greatest stumbling block with Java technology is the browser programmes' virtual machines' poor accomplishment of the Java applets.

Using the net as a teaching tool

It can be stated on the basis of the results of the Pythagoras teaching experiment that using the net as a tool for study has considerable advantages over conventional study. Although several experiments with the net for teaching purposes have been fairly biased towards learning materials, it is clear that using the net is beneficial, for example, in doing groupwork. The greatest advantages of groupwork over the net are that those participating need not be in the same place, or even work at the same time. In Pythagoras the question tool is a good example, which would be difficult to arrange without the use of the net.

ADP and using the net also makes it possible for students to study with materials they themselves have produced. For example, the responses to the Pythagoras questions can be used both for research reports and as starting values for exercises.

Distance learning creates new prospects for study. It is no longer important where the studying is done; the main question is rather how to study in a manner convenient to oneself. However, although distance learning makes individual study possible, it should be born in mind that students need interaction with the teacher and other students.

References

Articles of Remote Method Invocation. (online) http://developer.java.sun.com/developer/technicalArticles/RMI/index.html

Articles of Servlets. (online). http://developer.java.sun.com/developer/technicalArticles/Servlets/index.html

Leinonen, T. (1998). KUOMA - Learning Environment - An Implementation of Collaborative Project Learning in the World Wide Web. January 1998. *Netpaper Ideas Culture Technologie*, Ministry of Public Education, Department of Studies, Italy.

Matrix Calculus 1. Introduction part of Matrix Calculus 1 course presented in A&O Learning Environment (online). http://matriisi.ee.tut.fi/matriisilaskenta

McPherson, S. (1999). Java Servlets and Serialization with RMI. *JDC Newsletter* Oct. 19, 1999 (online). http://developer.java.sun.com/developer/technicalArticles/RMI/rmi/

Nykänen, O. (1999). Producing Structured WWW Hypermedia with Standard Text Editors: Functional Mark-up Language Toolkit. *Intelligent Computer and Communications Technology. Teaching & Learning for the 21st Century. PEG99.* Ninth International PEG Conference 10-12 July 1999. Conference Proceedings. 248-261.

Open Learning Environment project (OLE), Introduction. (online) http://matriisi.ee.tut.fi/ao/intro.html

Piiksi, K. (1999). The Environment Net – Environmental Education in the Open Learning Environment. *Intelligent Computer and Communications Technology. Teaching & Learning for the 21st Century. PEG99.* Ninth International PEG Conference 10-12 July 1999. Conference Proceedings. 262-270.

Pohjolainen, S., Ruokamo, H., Nykänen, O. (1999). A&O Open Learning Enviroment. *Intelligent Computer and Communications Technology. Teaching & Learning for the 21st Century. PEG99.* Ninth International PEG Conference 10-12 July 1999. Conference Proceedings. 23-34.

Pohjolainen, S., Ruokamo, H. (1999) Distance Learning In Multimedia Networks Project - Experiences and Results. In B. Collis & R. Olivier (Eds.) *ED-MEDIA 1999. World Conference on Educational Multimedia, Hypermedia & Telecommunications.* Proceedings of ED-MEDIA 99. World Conference on Educational Multimedia, Hypermedia & Telecommunications. Seattle, Washington, USA; June 19-24, 1999. 922-927.

Pythagoras Learning Environment. (online). http://matriisi.ee.tut.fi/pythagoras

Ruokamo, H., Pohjolainen, S. (1999) Distance Learning In Multimedia Networks Project: Main Results. *Intelligent Computer and Communications Technology. Teaching & Learning for the 21st Century. PEG99.* Ninth International PEG Conference 10-12 July 1999. Conference Proceedings. 153-162.

Towards a Design Methodology for Distributed Virtual Laboratories

Charles Levert and Samuel Pierre
Mobile Computing and Networking Research Laboratory (LARIM)
Department of Electrical and Computer Engineering
Ecole Polytechnique C.P. 6079, Succ. Centre-ville
Montreal, Quebec, CANADA H3C 3A7
Email: <charles@comm.polymtl.ca>, <Samuel.Pierre@larim.polymtl.ca>

Abstract: In this paper, we lay down the foundations to produce a framework for the design of distributed collaborative environments, such as virtual laboratories. We first propose a design methodology based on a generic model of virtual laboratory and a telecommunications platform. This methodology integrates six steps corresponding to the same number of models to be generated. The generic model is founded on a hierarchy of concepts for which the terminal nodes collectively and formally define the notion of virtual laboratory. The telecommunications platform supports a series of specific virtual laboratories and provides users with transparent access to the entire environment, in spite of possible heterogeneity of the access networks. It accounts for such issues as security, interoperability, and quality of service.

Introduction

For several years, education levels have been increasing in our society. A higher proportion of the population also reaches the level of post-secondary education. There is also an increase in the demand for on-going training, caused in part by the many technological breakthroughs of recent years. However, these same technologies, those related to computing and telecommunications in particular, lower some training related constraints such as physical presence, fixed schedule, etc. (Collis 1999) Fully virtual learning institutions are starting to appear. (Finley 1999)

Problem Definition and Basic Concepts

Instructional content delivery in electronic format (Azuma 1999) as well as distant courses (Harris 1999, Takefuji et al. 1999) are applications of these technologies that are increasingly common. They are already subject to systematization effort. Design and implementation of on-line laboratory activities, however, are only starting to benefit from such an effort which involves information technologies. Such an enterprise requires a high knowledge level in these technologies as well as in cognitive sciences. As such, it is only pursued by a few privileged people, more as a craft than a science. Thus, there is a very present need for a well defined methodological approach to the design of distributed learning environment geared toward performing laboratory activities. These activities are a necessary ingredient in the pursuit of knowledge. We label as distributed virtual laboratories the subset of learning environments that enables such activities.

Several factors contribute to the use of virtual laboratories: lack of physical space, cost of real equipment, distance in terms of cost and time of travel, synchronous availability of learners and teachers, dangerous situations, etc. These factors are an incentive to share or simulate real laboratories and their resources (equipment, space, etc.).

Distributed virtual laboratories design constitutes a multidisciplinary problcm which involves computer and information science, telecommunications, and cognitive sciences including instructional design. Indeed, an engineer, even with a solid knowledge base in computers and telecommunications, can not tackle this problem by himself/herself since he/she does not necessarily possess the cognitive sciences aptitudes needed for the instructional design of these learning environments. On the other hand, a simple pedagogy expert is not necessarily able to fully appreciate what is possible from a technological standpoint. This is exacerbated by the rapid advancement of the state of the art in computer science and telecommunications. Nor is he/she able to develop by himself/herself the computing environment under which the experiments and evaluations of his/her interest can be performed.

A similar line of thought can be applied to the specialists of a given discipline which is targeted by a specific laboratory, and to the designers of an environment enabling the creation of such a laboratory. Our role is that of the telecommunications and computer engineer. As such, we are primarily interested in the computer network distribution of the objects that constitute these environments, and not as much by the instructional aspects of the design of these environments. We tackle such problems as distance measurements and heterogeneous networks adaptation, in order to give other specialists access to a methodology, models, and computing tools. These enable the creation, exploitation, and evaluation of distributed virtual laboratories in a given respective disciplinary field.

State of the Art

At this point in time, we can already witness a proliferation of virtual laboratories, at least from what can be seen on the accessible part of the Internet. The real count of such laboratories must be even higher since it includes companies and militaries.

Some of these laboratories include Java applets aiming to reproduce phenomena that are of interest to students of the targeted discipline. Others aim to reproduce the very sensation of physical presence in an equivalent and real environment. Others are implemented with 3D rendering technologies such as the Virtual Reality Modeling Language (VRML, which is open) and Shockwave (which is proprietary). Others still enable distant access to real physical instruments.

The LVEST project, to which we have contributed, uses an approach which separates these concepts: the generic laboratory and the telecommunications platform. Each laboratory that uses this approach includes a specific part and a generic part. Access to the telecommunications functionalities is provided through the telecommunications platform (Kassouf et al. 1999, Pierre & Kassouf 2000), which is composed of three layers:

- the tools and functionalities adaptation layer;
- the base tools and functionalities layer;
- the network adaptation layer.

One of the objectives of this platform is to abstract the distribution and telecommunications aspects related to implementation details. This is done in order to simplify the development task for a virtual laboratory from the point of view of anyone that is not a specialist. The project itself involves a number of specialists from a host of disciplines.

Development of the generic laboratory and telecommunications platform models in done using an inductive process. This means that the initial content of these models reflects the needs of this two first laboratories to have been implemented using this process (in Physics and Electrical Engineering). Each new laboratory both inherits from these models and contributes to their enrichment.

With only two laboratories, the effective definitions of "generic" and "specific" were rather trivial. They basically amounted to the idea of commonality. However, now that this project includes a third laboratory in computer engineering and that many others are planned in several domains of several disciplines, care must be taken to properly generalize these notions. If this was not done, the development of a new laboratory from a generic model would demand more effort rather than reduce it. This would be attributable to the necessary evaluation of how appropriate the use of each offered generic functionality would be. Conversely, a most restrictive definition of the word "generic", aiming to reduce the generic functionalities count, would exclude to many functionalities that are common to only a few laboratories. Such a generalization has not been tackled before.

Design Methodology

The basic principle of the design methodology consists of defining a set of attributes, tools, and functionalities shared by a variety of virtual laboratories dedicated to a variety of science and engineering disciplines. The distributed processing and access aspects of implementing the telecommunications platform imply a number of challenges related to security, interoperability, and quality of service. We now expose them.

Security

Indeed, in an open environment, users should not only benefit from the possibility to exchange information between one another, but also have the possibility to transfer and download content which is subject to a controlled usage. In such a context, securing those transfers is of a primordial importance and this should be reflected in the very process used to design virtual laboratories.

Interoperability

Likewise, there is a matter of interoperability between heterogeneous networks and communication supports that can be used to access the laboratory environment. It must be taken into account as well in the virtual laboratories design process and methodology. In our prototypes, we have investigated the use of CORBA and the capacity to support interoperability between Internet protocols and xDSL technology. We conclude that, in order to address this specific problem, a proposed design methodology must include one step dedicated to networks and supports adaptation at the level of the telecommunications platform.

Quality of Service

As for quality of service, the main concern is the delay to access, transmit, and display the (possibly multimedia) information that is exchanged in this type of environment (Campbell et al. 1994, Ren et al. 1999, Schwartz & Beaumont 1994). This aspect deserves particular attention in the context of virtual laboratories where interactive simulation, telemesure, and tele-experimentation are among the considered approaches and methods.

The three challenges we just exposed are accounted for in a distribution model. Its implementation constitutes one of the later steps in a design methodology for distributed virtual laboratories. This methodology, as well as its associated models, must be supported by software tools which reduce the design and implementation effort asked of the discipline or domain specialists. Some of these tools have already been developed as part of the LVEST project (Télé-université 1999). Other such tools are now in development and will contribute to further enrich our telecommunications platform.

Generic Model

A generic virtual laboratory model should be general enough to cover any virtual laboratory.

The set of all sciences and engineering disciplines can be considered finite. It forms a partition. A single discipline is composed of several domains, each of which is characterized by an experimentation environment that includes tools and functionalities used to define and implement laboratory sessions.

Some of these tools and functionalities are domain-specific, while others can be used universally, i.e., in several domains, even disciplines. The latters are called basic tools and functionalities.

Each domain enables experiments of various types to be performed. For a given domain, the set of experiments that can be performed can be considered finite. The set of all experiments that can be performed for a given discipline forms a partition.

Each laboratory experiment enables the practice of one or more theory elements from a given domain. These theory elements are prerequisite to performing the laboratory session. Therefore, a laboratory session can be defined as a set of experiments of various types, performed in a given environment, linked to a specific domain of a specific discipline, and forming a coherent ensemble.

For a given discipline, a virtual laboratory is defined as a distributed learning environment which enables laboratory experiments to be performed. Those experiments can eventually be grouped to form a session. They can be related to one or more domains of the discipline. In fact, we can define a laboratory as a triplet consisting of

1. the discipline specification,
2. the set of all experiments that can be performed for this discipline, and
3. a family of transformations related to the domains of the given discipline.

This family of transformations can be seen as a didactic engineering process which transforms knowledge elements of a given domain into a series of experiments.

To recapitulate, the generic model is founded on a hierarchy of concepts which terminal node is the notion of virtual laboratory. The basic concepts included in this hierarchy are: the discipline, the domain, the environment, the laboratory session, the type of experiment, the experiment, and the virtual laboratory.

Design Methodology Elements and their Respective Models

It follows that, in order to design a virtual laboratory in any sciences or engineering discipline, each of the basic concepts of the generic model must itself be modeled (Levert & Pierre 2000). They include the discipline, the domain, the environment, the laboratory session, the experiment, to which we add the concept of distribution (access, interaction, interface, interoperability, and security).

Discipline

Disciplines are located at the top of our basic concepts hierarchy since we do not intend to reassess the different discipline constellations (called knowledge fields by specialists) in use. Examples of these knowledge fields include those formed by an university's faculties, the many contests of a grant body, etc.

The discipline modeling should produce a list of domains that is specific to it. In practice, the discipline's evolution makes this list variable in time and possibly according to the place where it is considered. Thus, we have to explore how it will be possible to evolve this list as time passes, either by simple insertion and deletion, or by repartitioning the discipline.

Computer engineering is an example of discipline. It includes, among others, the following domains: algorithmic complexity, design and analysis of algorithms, database management, knowledge management, networking, infography, multimedia, and software engineering (NSERC 1998, NSERC 1997). We can readily see that this list is not exhaustive; this shows the difficulty of producing such an exhaustive list, but it also shows the possibility of working with an incomplete list if it suffices to fill all the needs.

Domain

The domain modeling mainly includes a knowledge representation (Paquette et al. 1996). In addition to the possibility of laying them out on a learning curriculum, these elements can be classified using, for example, the cognitive levels of the Bloom taxonomy (Michalski & Stepp 1983).

The elements from this possibly structured knowledge set should lend themselves to a mapping with laboratory experiments. It does not necessarily follow that the most appropriate classification and structure for these knowledge elements will correspond to that used for the laboratory experiments (whether it is based on a laboratory session grouping or a laboratory type grouping). However, there can be a gain to forcing such a mapping. This is an open question. Computer networking is an example of domain, in the context of the computer engineering discipline.

Environment

The environment model should account for all elements that can constitute an environment, and also for all relations that exist between those elements. This includes material resources (computers, networks, etc.), the place where they are located, as well as the human beings involved in the learning process (learners and teachers). The possible relations between humans are represented by the availability of communication and collaboration tools, as well as by the formation of teams and the learners/teachers ratio. All others ratios between humans and material resources should be modeled. Five spaces can be defined and all elements should fall in exactly one of them: production, help, collaboration, information, and navigation spaces.

The environment is the concept which holds the tools and functionalities. Thus, it is at this conceptual level that the generalization of the genericity and specificity should be applied. This should result in a hierarchical classification of these tools and functionalities. Whether all others elements and relations found in an environment should be included in this framework is an open question. This would allow an advantageous simplification of the environment model.

Laboratory Sessions

A laboratory session is composed of a subset of experiments from the target domain. The laboratory session modeling describes the learning scenarios which are used, categorizes and plans didactical instruments and identifies where an analysis of interactions could take place (Paquette 1998).

Experiments

The experience model should specify the type of experimentation which is performed. Each experiment corresponds to some knowledge and aptitudes which should be transmitted, as described in domain modeling. An experiment takes place in a learning curriculum.

It can sometimes be advantageous to be able to record or reproduce the progress of an experiment, whether for learning evaluation or other purposes. The model must account for this since it will translate in resources needed to its implementation. The nature, moment, and requirements (e.g., temporal requirements) of the various data processing stages must be taken into account for has a strong influence on the computing distribution model which is used.

Distribution

The distribution model should first represent the different computing and networking components which are available. In particular, all aspects having to do with security, interoperability, and quality of service must be represented.

These components can be used in different possible configurations. From this information, an algorithm is devised to produce an optimal scenario for the distribution and interconnection of objects.

The very ideal of optimization implies modeling the various costs involved by the operations performed in a given configuration. They include: the cost of processing power the cost of code transmission (throughput), the cost of data copying, the cost of data transmission (throughput), the cost of configuration computation, the cost of dynamic configuration changes, the cost of data marshalling and other transformations (such as those involving security), the cost of data storage.

In practice, identifying generic characteristics among several laboratories should help reduce the complexity of the mathematical and algorithmic problems created by this modeling.

Concluding Remarks

In order to produce tools that can help develop distributed learning environments, we must first be able to determine the main axes along which their variants can be distinguished. More precisely, we must identify those characteristics that are pertinent to that goal and drop those that are not. Putting this in practice, however, is not obvious. Virtual laboratories and other learning environments developed so far form a rather disparate set from which it would be difficult to extract the principal characteristics. Rather than designing an unflexible and definite characterization from the get go for everything that has been or will be developed, we plan to apply the conceptual clustering technique (Michalski & Stepp 1983) to existing environments and to those whose existence can be predicted.

This clustering technique can be applied to all levels (or elements) of the design methodology: from domain to individual experiments. It is used to determine if it is cost effective to make a tool generic or keep it specific. To use this technique, we must identify quality criteria for the clusters. These are used to discriminate against several possible clusters. The actual concepts that are used by one clustering reveal themselves as the technique is applied. The concepts and tools described so far are applied as they are developed to a virtual laboratory prototype in the computer engineering discipline.

References

Azuma, J. (1999). Creating educational web sites. *IEEE Communications Magazine*, 37(3):109–113.

Campbell, A., Coulson, G., & Hutchison, D. (1994). A quality of service architecture. *Computer Communication Review*, 24(2):6–27.

Collis, B. (1999). Applications of computer communications in education: An overview. *IEEE Communications Magazine*, 37(3):82–86.

Finley, Jr., M. R. (1999). Tele-learning: The "killer app"? *IEEE Communications Magazine*, 37(3):80–81.

Harris, D. A. (1999). Online distance education in the united states. *IEEE Communications Magazine*, 37(3):87–91.

Kassouf, M., Pierre, S., Levert, C., & Conan, J. (1999). Modeling a telecommunication platform for remote access to virtual laboratories. In *Proceedings of the 1999 IEEE Canadian Conference on Electrical and Computer Engineering (CCECE'99)*, pages 127–132, Edmonton (Alberta) Canada. IEEE.

Levert, C. & Pierre, S. (2000). Quality of service, interoperability, and security issues in a design methodology for virtual laboratories. *Computer Communications*. Submitted.

Michalski, R. S. & Stepp, R. E. (1983). *Machine Learning: An Artificial Intelligence Approach*, volume 1, chapter 11, pages 331–364. Morgan Kaufmann Publishers.

NSERC (1997). Reallocation report for computing and information sciences. `http://www.nserc.ca/programs/realloc/pdf/sub07.pdf`.

NSERC (1998). Reallocation submission: Electrical and computer engineering. `http://www.nserc.ca/programs/realloc/pdf/sub334335.pdf`.

Paquette, G. (1998). Engineering interactions in a teleleaming system. In *Proceedings of TeleTeaching '98, IFIP World Conference*, Vienna-Budapest.

Paquette, G., coise Crevier, F., Aubin, C., & Bleicher, E. (1996). AGD: Knowledge modeling in an instructional design support system. In *ED-Media International Conference*, Boston, USA.

Pierre, S. & Kassouf, M. (2000). Toward a telecommunications platform for supporting distributed virtual laboratories. *International Journal of Educational Telecommunications*. Submitted.

Ren, N. N., Boutaba, R., Rasheed, Y., & Leon-Garcia, A. (1999). Distributed video production: Tasks, architecture and qos provisionning. In *Proc. of Multimedia Modeling, MMM99*, pages 299–321, Ottawa (On) Canada.

Schwartz, M. & Beaumont, D. (1994). Quality of service requirements for audio-visual multimedia services. ATM Forum Contribution 94-0640.

Takefuji, Y., Takahashi, N., & Neff, R. (1999). ATM and wireless experiments for remote lectures. *IEEE Communications Magazine*, 37(3):98–101.

Télé-université (1999). Laboratoires virtuels pour l'éducation en sciences et en technologie (LVEST). `http://www.licef.teluq.uquebec.ca/lvest/`.

Acknowledgements

This work was supported in part by the TeleLearning Network of Centres of Excellence (TL-NCE) and CANARIE.

A Meta-analysis of Computer Programming on Cognitive Outcomes: An Updated Synthesis

Yuen-kuang Cliff Liao
Department of Elementary Education, National Hsinchu Teachers College
521 Nan-Dah Road
Hsinchu City, Taiwan, R. O. C
yliao@mail.nhctc.edu.tw

Abstract: The improvement of higher order thinking skills continues to be an important issue in education, Over the past 10 years, two meta-analyses on the issue of computer programming and problem solving ability have been done. yet, there is no meta-analysis conducted to clarify the issue of programming and problem-solving abilities since 1989. The purpose of this study is to continually investigate the issue of programming and problem solving ability. More specifically, this meta-analysis attempted to update the research findings from 1989 to 1999 in the area of computer programming and problem solving. The results from this study suggest that the outcomes of learning a computer language extend beyond the content of that specific computer language. Students are able to acquire some cognitive skills such as reasoning skills, logical thinking and planning skills, and general problem solving skills through computer programming activities.

Theoretical framework and purpose of study

For well over a quarter of a century there have been urgent calls for improved instruction in problem solving. There is ample evidence that the problem-solving skills of the nation's children need significant strengthening, yet existing approaches to develop and improve these skills do not seems to have worked (Casey, 1997). The link between the learning of programming language and the development of problem solving skills has been one of the most intensely argued topics in educational computing (Reed & Burton, 1988). The research findings, however, are conflicting. Some studies report significant gains in various aspects of cognitive abilities following programming experiences (Choi & Repman, 1993; Liu, 1997; Reeder, 1994). Other studies have indicated that there is little, if any, transfer of learning from the programming situation to similar non-programming tasks (Lai, 1993; Palumbo, 1993)

Over the past 10 years, two meta-analyses on the issue of computer programming and problem solving ability have been done. Liao and Bright (1991) conducted a meta-analysis on the effects of computer programming on cognitive outcomes. Their analysis covered the research published between 1969 and 1989. Sixty-five studies were included in their analysis, and the results indicated that the percentiles on students' cognitive performance were 66 for the programming group and 50 for the non-programming group; computer programming has slightly positive effects on student cognitive outcomes. Another meta-analysis conducted by Lee (1990) investigated the effectiveness of computer-assisted instruction and computer programming in the area of problem solving skills, math, and attitudes toward mathematics instruction. Seventy-two studies were included in his analysis, and the results showed that Logo was found to be more effective than BASIC in developing problem solving skills.

The improvement of higher order thinking skills continues to be an important issue in education, yet, there is no meta-analysis conducted to clarify the issue of programming and problem-solving abilities since then.

The purpose of this study is to continually investigate the issue of programming and problem solving ability. More specifically, this meta-analysis attempted to update the research findings from 1989 to 1999 in the area of computer programming and problem solving. The results from this meta-analysis will help provide clearer conclusions.

Procedures

The research method used in this study is the meta-analytic approach which was similar to that described by Glass, McGaw, & Smith (1981). Their approach requires a reviewer to (a) locate studies through objective and replicable searches; (b) code the studies for salient features; (c) describe outcomes on a common scale; and (d) use statistical methods to relate study features to outcomes (Kulik, Kulik, & Bangert-Drowns, 1985).

The purpose of this study was to synthesize and analyze the research on effects of two instructional approaches. It is important to define these approaches to provide for proper selection of appropriate studies.

computer programming instruction -- classes using computer languages, such as Logo, BASIC, Pascal as an instructional tool to teach students.

non-computer-programming instruction -- classes not using any computer programming as an instructional tool to teach students.

Data Sources

The studies considered for use in this meta-analysis came from three major sources and published between 1989 and 1999. One large group of studies came from computer searches of Education Resources Information Center (ERIC). A second group of studies came from Comprehensive Dissertation Abstracts. A third group of studies was retrieved by branching from bibliographies in the documents located through review and computer searches. Twenty-two studies were located through these search procedures; 3 studies came from ERIC, and 19 studies were retrieved from published journals.

Several criteria were established for inclusion of studies in the present analysis.

1. Studies had to assess the relationship between computer programming and cognitive skills such as planning skills, thinking skills, reasoning skills, and metacognitive skills.
2. Studies had to take place in actual classrooms. These was no restriction on grade level.
3. Studies had to provide quantitative results from both computer-programming and non-computer-programming classes.
4. Studies had to be retrievable from university or college libraries by interlibrary loan or from ERIC, Dissertation Abstracts International, or University Microfiche International.

There were also several criteria for eliminating studies or reports cited by other reviews: (a) studies did not report sufficient quantitative data in order to estimate Effect Sizes; (b) studies reported only correlation coefficients -- r value or Chi-square value; (c) studies could not be obtained through interlibrary loans or from standard clearinghouses.

Outcome Measures

The instructional outcome measured most often in the 22 studies was student learning, as indicated on standard cognitive-skill tests at the end of the program of instruction. For statistical analysis, outcomes from a variety of different studies with a variety of different instruments had to be expressed on a common scale. The transformation used for this purpose was the one recommended by Glass et al. (1981); each outcome is coded as an Effect Size (ES), defined as the difference between the mean scores of two groups divided by the standard deviation of the control group. For those studies that did not report means and standard deviations, F values, t values, or proportion values were used to estimate the ES.

In most cases, the application of the formula given by Glass and his colleagues was quite straightforward. But in some cases, when more than one value was available for use in the formula of ES, the value, which measured outcomes most correctly, was selected.

In addition, when studies used more than one type of control group (e.g., programming vs. CAI and programming vs. non-programming), only the comparison of programming and non-programming was retained. Also, when studies contained reports of experiments where treatments were compared with each other and no non-computer control group was involved (e.g., programming vs. CAI), Glass et al. (1981. p.124) proposed a process to split the ES into two components to estimate comparisons of each treatment to a hypothetical control group (e.g., programming vs. non-programming and CAI vs. non-CAI). In other cases, several subscales and subgroups were used in measuring a single outcome (e.g., those that reported separate data by language or grade). In such cases, each comparison was weighted in inverse proportion to the number of comparisons within the study (i.e., 1/n, where n = number of comparisons in the study) so that the overweighting of ES of a study could be avoided (see, for example, Waxman, Wang, Anderson, & Walberg, 1985, p. 230).

Variables Studied

Seventeen variables (i.e., sample size, type of publication, year of publication, grade level, instrumentation, instructor bias, reliability of measure, selection bias, statistical power, statistic, type of research design, language studied, instructional approach, duration of treatment, type of instructional for treatment, implementation of innovation, and type of outcome) were selected for coding each study in the present synthesis. Each variable was employed as a factor in an analysis of variance (ANOVA) to investigate whether there are significant differences within each variable on the effect size.

Results

The number of comparisons, target population, and the study-weighted ESs are reported in Table 1. Of the 22 studies included in the present synthesis, all of the study-weighted effect sizes were positive and favored the programming group. The range of the study-weighted effect sizes was from 0.04 to 3.7. The overall grand mean for all 22 study-weighted ESs was 0.76. When this mean ES was converted to percentiles, the percentiles on students' cognitive performance were 66 for the programming group and 50 for the non-programming group. The standard deviation of 0.78 reflects the great variability of effect sizes across studies.

Author(s)	Year	No of Comparisons	*ES*
Bernardo	1994	6	0.288
Choi	1993	2	0.374
Clements	1990	8	0.457
Dalton	1991	2	0.539
Jang	1992	1	0.651
Lai	1993	1	0.329
Leher	1989	3	1.265
Liu, M[a]	1997	3	0.747
Liu, M	1997	1	0.423
Mundy-	1989	16	0.204
Nastasi	1990	1	1.382
Norris	1992	2	0.38
Palumbo	1993	2	1.156
Palumbo	1991	3	1.203
Reed	1992	2	0.35
Reeder, L	1994	1	0.877
Rucinski	1991	1	0.055
Swan	1993	10	0.04
Swan	1991	10	0.081
Vasu, E	1997	2	1.169
Verzoni	1995	3	3.699
Wilson	1991	1	1.035
Overall grand mean	0.759		
Overall grand median		0.498	
Overall grand SD		0.781	

Note. Total N of studies = 22. Total N of comparisons = 86

[a]Two Separated studies reported in one article.

Table 1Number of Comparisons and Study-weighted Effect Sizes

Among the 86 effect sizes included in the present synthesis, 74 or 86% were positive and favored the programming group, while 12 or 14% were negative and favored the non-programming group. The range of the effect sizes was from -0.17 to 1.45

Table 2 lists the *F* values for the 17 variables for all study-weighted ESs in the study. For ANOVAs, two variables showed statistically significant impact. For each of these variables, a post hoc (Fisher□ Protected LSD) test was performed. Descriptive statistics for these variables are presented in Table 3.

Table 4

Variables	*df*	*F*	*p*

Study Characteristics			
Type of Publication	1, 20	4.294	0.051
Year of Publication	3, 18	1.727	0.197
Grade Level	4, 18	0.974	0.446
Methodology Characteristics			
Instructor Bias	2, 19	0.444	0.648
Instrumentation	1, 22	0.187	0.67
Pretest Equivalency	4, 17	0.038	0.997
Reliability of Measure	2, 19	0.798	0.465
Sample Size	2, 19	1.263	0.306
Selection Bias	2, 19	0.9	0.914
Statistical Power	1, 20	0.03	0.986
Statistics	1, 20	0.032	0.861
Type of Research Design	3, 18	3.393	0.041*
Program Characteristics			
Language studied	4, 21	0.722	0.587
Instructional Approach	2, 20	0.924	0.413
Length of Experiment	5, 19	2.288	0.087
Type of Instruction for Treatment	3, 18	1.923	0.162
Duration of Treatment	3, 18	1.905	0.165
Outcome Characteristics			
Type of outcome	5, 20	5.574	0.002*

* $p<.05$

Table 2. Results of ANOVAs for Coded Variables

Variables	**N**	**%**	**ES**	**SD**
Study Characteristics				
Type of Publication				
Journal article	19	86.4	0.632	0.452
ERIC	3	13.6	1.567	1.853
Year of Publication				
1989 - 1991	9	40.9	0.691	0.534
1992 - 1993	7	31.8	0.469	0.351
1994 - 1995	3	13.6	1.621	1.823
1996 - 1997	3	13.6	0.780	0.374
Grade Level[a]				
K - 3th	2	8.7	0.667	0.297
4th - 6th	8	34.8	0.819	0.542
7th – 8th	3	13.0	1.436	1.962
High school	3	13.0	0.510	0.613
College	7	30.4	0.426	0.224

Table 3 Cont.

Variables	**N**	**%**	**ES**	**SD**
Methodological Characteristics				

Sample Size				
10 - 40	9	40.9	0.822	0.476
40 - 80	6	27.3	1.076	1.322
Over 80	7	31.8	0.408	0.355
Instructor Bias				
Same	12	55.5	0.901	0.973
Different	7	31.8	0.633	0.418
Unspecified	3	12.7	0.487	0.624
Instrumentation[a]				
Local	11	45.8	0.778	1.071
Standard	13	54.2	0.638	0.428
Reliability of Measure				
Actual reliability figure	10	45.5	0.729	0.367
Adequate indication	5	22.7	0.447	0.545
Unspecified or inadequate	7	31.8	1.025	1.253
Selection Bias				
Adequate indication	12	54.5	0.738	0.463
Probably threat	7	31.8	0.853	1.272
Unspecified or inadequate	3	13.6	0.625	0.557
Statistical Power				
Adequately minimized	19	86.4	0.758	0.832
Probably threat	3	13.6	0.767	0.427
Statistics				
Mean & Standard deviation	18	81.8	0.774	0.857
F - value	4	18.2	0.695	0.320
Type of Research Design				
One group repeated measure	5	22.7	0.446	0.172
Pretest-posttest control group	6	27.3	0.870	0.509
Nonequivalent control group	9	40.9	0.558	0.472
Posttest-only control group	2	9.1	2.119	2.234
Program Characteristics				
Language Studied[a]				
Logo	13	50.0	0.898	0.985
Basic	6	23.1	0.439	0.394
Pascal	3	11.5	0.330	0.278
Fortran	1	3.8	0.188	0.000
HyperCard	3	11.5	0.405	0.351
Instructional Approach[a]				
Focusing on cognitive skills	11	47.8	0.899	1.027
Not focusing on cognitive Skills	9	39.1	0.686	0.457
Unspecified	3	13.1	0.213	0.163

Table 3 Cont.

Variables	**N**	**%**	**ES**	**SD**
Type of Instruction for Treatment[a]				
Large group	10	45.5	0.431	0.325

Small group (less than 5 persons in a group)	6	27.3	1.311	1.223
Mixed2	9.1	1.016	0.517	
Unspecified	4	18.2	0.624	0.579
Duration of Treatment				
0 - 3 months	6	27.3	1.353	1.244
4 - 6 months	5	22.7	0.689	0.429
7 - 12 months	3	13.6	0.515	0.203
Unspecified	8	36.4	0.450	0.409
Outcome Characteristics				
Type of Outcome[a]				
Conceptual transfer	2		2.482	1.721
Critical thinking	2		0.478	0.458
Metacognitive skills	2		0.393	0.091
Problem solving skills	17		0.582	0.415
Spatial skills	1		0.367	0.000
Creative thinking	2		-0.133	0.099

Note. [a] Some sudies reported more than one comparison groups.

Table 3. Means and Standard Deviations of Study-weighted ESs for Coded Variables

For type of research design, $(F(3,18) = 3.393, p<.05)$ the post hoc test showed that the mean for studies employed posttest control group design was significantly higher than the mean for studies used one-group repeated measure, pretest-posttest control group, or nonequivalent control group designs.

In addition, the post hoc test for type of outcome, $(F(5,20) = 5.574, p<.01)$ showed that the mean of studies in which the outcome measured was conceptual transfer was significantly higher than studies measured critical thinking, metacognition, problem solving abilities, spatial thinking, or creative thinking. There were no significant differences among the other five groups.

One variable, type of publication, $(F(1,20) = 4.294, p<.06)$, was approaching significance. The result showed that the mean for studies coded as ERIC document was greater than the mean for studies coded as published paper.

Discussion

The results of this meta-analysis indicate that computer programming has moderate-to-high positive effects on student cognitive outcomes; an effect is said to be small when ES = 0.2, medium when ES = 0.5 and large when ES = 0.8 (Cohen, 1977). One hundred percent of positive study-weighted ES values and 88% of positive ESs overall confirm the effectiveness of computer-programming instruction. The overall mean ES of 0.76 was much higher than Liao and Brights' (1991) meta-analysis, in which the overall mean ES was 0.41. The great differences of ES between these two meta-analyses possibly because new programming languages such as HyperCard are easier to learn, or perhaps teachers have found more effective approaches using computer programming to enhance students' cognitive abilities.

For the analysis of coded variables, the greater ES associated with the posttest control group design was interesting. However, there were only 2 studies coded as this design, this result may be somewhat unstable.

For type of outcome, the larger ES was connected with conceptual transfer, possibly because there are some differences between conceptual transfer and other types of cognitive outcomes such as critical thinking and problem solving abilities. Yet, there were only two studies measured conceptual transfer, the result may be considered tentative.

Conclusions

The results from this study suggest that the outcomes of learning a computer language extend beyond the content of that specific computer language. Students are able to acquire some cognitive skills such as reasoning skills, logical thinking and planning skills, and general problem solving skills through computer programming activities. Since fostering students' cognitive abilities is usually part of our educational goal, the results provide to teachers a mildly effective approach for teaching students cognitive skills in the classroom setting. Left unanswered is the question of whether computer programming is as efficient, or any more efficient, at developing these cognitive abilities than other possible instructional approaches that teachers might use. Studies of this question will require further clarification of the exact nature of the cognitive abilities most likely to be developed through programming. This meta-analysis points out only that improvements in cognitive outcomes are possible. That information by itself is useful.

A Meta-analysis of Gender Differences on Attitudes toward Computers for Studies Using Loyd and Gressards' CAS

Yuen-kuang Cliff Liao
Department of Elementary Education, National Hsinchu Teachers College
521 Nan-Dah Road
Hsinchu City, Taiwan R. O. C
yliao@mail.nhctc.edu.tw

Abstract: A meta-analysis was performed to synthesize gender differences on attitudes toward computers for studies using Loyd and Gressards' CAS. Twenty-eight studies were located from three sources, and their quantitative data were transformed into Effect Size (ES). The overall grand mean of the study-weighted ES for all 28 studies was 0.273. The results suggest that gender differences on attitudes toward computers exist, however, the differences are small. Left unanswered is the question of what factors truly contribute to the differences. Studies of this question will require further clarification of the exact characteristics of each type of computer attitude (i.e., anxiety, confidence, liking and usefulness) and their relationships with gender. This meta-analysis points out only that gender differences on attitudes toward computers exist. That information by itself is useful.

Theoretical framework and Purpose of Study

Computer use and skills has been portrayed in our society as more appropriate to men and boys than women and girls (Whitley, 1997). Computer games and educational software have been designed to appeal more to boys than girls (Kiesler, Sproull, & Eccles, 1985). Computer use in schools has also been linked to traditionally 'masculine' subjects such as science and mathematics but not to traditionally 'feminine' subjects such as art and literature (Hawkins, 1985). In fact, research has shown that males use computers more often (Chen, 1986; Cole, 1997; Shashaani, 1994; Sutton, 1991; Urban, 1986), in more places (Chen, 1986; Culley, 1988; Sanders, 1985; Shashaani, 1994), and for more purposes (Chen, 1986; Martinez, 1988; Riggs, 1994) than do females. Furthermore, many studies also reported that males take more classes in school in which computers are used than do their female counterparts (Chen, 1987; Cole, 1997; Shashaani, 1994; Sutton, 1991; Urban, 1986); males use computers more frequently in their recreational time (e.g., after school clubs, summer camps, and at-home use), and stay on computers for a longer time than females (Joiner, 1996; Shashaani, 1994). These gender differences in socialization and computer-related behaviors have led to the hypothesis that women and girls are more likely to hold more negative attitudes toward computers.

Although many studies have been conducted to examine the hypothesis of gender differences on computer attitudes (Campbell, 1988; 1989; Chen, 1986; Koohang, 1989; Loyd & Gressard, 1986; Meier, 1988; Wallace & Sinclair, 1995; Woodrow, 1994), the results of existing studies have reported a confusing picture. For example, Campbell (1990), Chen (1986), Colley, Gale, & Harris (1994), Jacobson (1991), Loyd & Gressard (1986), Wallace & Sinclair (1995), Whitley (1996a;1996b), and Woodrow (1994) all reported significantly higher positive computer attitudes for males than females, while Campbell (1986;1989), Cantrell (1995), Chu & Spires (1991), Francis (1994), Koohang (1987;1989), Loyd & Gressard (1985), Loyd, Loyd, & Gressard (1987), Mertens & Wong (1988), Pope-Davis & Twing, and Robertson, Calder, & Jones (1995) have indicated that there is little, if any, differences of computer attitudes between males and females. In addition, Kay (1992) based upon a meta-analysis described the results of this research as "conflicting and confusing."(p.227) Rosen and Maguire (1990) concluded on the basis of a meta-analysis that gender differences on computer attitudes were real, but small. A more recent meta-analysis on this issue conducted by Whitley (1997) also reported that the overall effects were "nonsignificant or small." (p.11)

Whitley (1997) proposed a possible explanation for the confusing picture in the computer attitude literature. He argued that many researchers treat attitudes toward computers as a unitary construct rather than multifaceted construct. The variety of computer attitudes scales that have been developed and their differing content suggest that computer-related attitudes are indeed multifaceted, including components such as anxiety about using computers, self-confidence in dealing with computers, and the positive and negative beliefs about computers and their effects on society (Whitley, 1997). Gender differences exist on one component in one computer scale may vary in another computer scale, depends on what questions are asked. Therefore, a meta-analysis synthesizes gender differences for results from studies using varied computer-related scales may not only obtain confusing picture, but also produce unexpected confounding conclusion. To avoid this, the purpose of the present meta-analysis was to synthesize the results of existing studies on gender differences toward computer attitudes using Loyd and Gressards' Computer Attitude Scale (CAS). The results of this meta-analysis may provide clearer conclusion on this issue.

Procedures

The research method used in this study is the meta-analytic approach which was similar to that suggested by Kulik, Kulik, & Bangert-Drowns (1985). Their approach requires a reviewer to (a) locate studies through objective and replicable searches; (b) code the studies for salient features; (c) describe outcomes on a common scale; and (d) use statistical methods to relate study features to outcomes (Kulik, Kulik, & Bangert-Drowns, 1985).

Data Sources

The studies considered for use in this meta-analysis came from three major sources and were published from 1986 to 1998. One large group of studies came from computer searches of Education Resources Information Center (ERIC). A second group of studies came from Comprehensive Dissertation Abstracts. A third group of studies was retrieved by branching from bibliographies in the documents located through review and computer searches.

Twenty-eight studies were located through these search procedures; 8 studies came from ERIC, 16 studies were retrieved from published journals, and 4 studies were from Comprehensive Dissertation Abstracts.

Several criteria were established for inclusion of studies in the present analysis.

1. Studies had to compare the differences between males and females on attitudes toward computer.
2. Studies had to use Loyd and Gressard's Computer Attitude Scale (CAS) as instrument.
3. Studies had to provide quantitative results from both male and female subjects.
4. Studies had to be retrievable from university or college libraries by interlibrary loan or from ERIC, Dissertation Abstracts International, or University Microfiche International.

Outcome Measures

The outcome measured most often in the 28 studies was survey data from participants, as indicated in CAS for examining participants' attitudes toward computers. For statistical analysis, outcomes from a variety of different studies had to be expressed on a common scale. The transformation used for this purpose was the one recommended by Glass et al. (1981) and modified by others (e.g., Hunter, Schmidt, and Jackson, 1982). To reduce measurements to a common scale, each outcome was coded as an Effect Size (ES), defined as the difference between the mean scores of males and females divided by the pooled standard deviation of two groups. For those studies that did not report means and standard deviations, F values, or t values were used to estimate the ES.

Variables Studied

Nine variables were selected for coding each study in the present synthesis. These variables were nation of subject, target population, type of publication, year of publication, sample size, reliability of measure, statistical power, statistics, and type of attitude. Each variable was employed as a factor in an analysis of variance (ANOVA) to investigate whether there were significant differences within each variable on the effect size.

Results

The number of comparisons, target population, and the study-weighted ESs are reported in Table 1. Of the 28 studies included in the present synthesis, 24or 86% of the study-weighted ESs were positive and favored the male subjects, while 4 or 14% of them were negative and favored the female subjects, indicating that males had more positive attitudes toward computers than females. The range of the study-weighted ESs was from -0.407 to 0.772. The overall grand mean for all 28 study-weighted ESs was 0.273. When this mean ES was converted to percentiles, the percentiles on computer attitudes were 61 for the male subjects and 50 for the female subjects. The standard deviation of 0.284 reflects the small variability of ESs across studies.

Author(s)	Year of Publication	Target Population	N of Comparison	ES
Abler & Sedlacek	1987	College	15	0.4355
Busch	1995	College	7	0.5199
Cantrell	1995	Teacher	4	0.5494
Colley et al.	1994	College	3	0.4748
Dyck, & Smither	1996	Adult	3	0.7339
Francis	1994	College	3	0.0364
Hwang	1991	Elementary	1	0.2006
Kluever et al.	1995	Teacher	4	0.0236
Koohang	1986	College	3	0.2538
Koohang	1986	High School	1	0.7238
Koohang	1987	College	3	0.1501
Koohang	1989	College	4	0.3307
Latham	1991	College	4	0.7723
Liao	1993	College	3	-0.0019
Liao	1994	College	3	0.2817
Liao, & Shih	1994	College	3	0.2858
Liao	1995	College	6	-0.0833
Loyd, & Gressard	1984	Mixed	3	0.1028
Loyd, & Gressard	1986	Teacher	4	0.3771
Loyd et al.	1987	Junior High	12	-0.1254
Mertens, & Wang	1988	College	3	-0.4071
Moon et al.	1994	College	3	0.3277
Nash, & Moroz	1997	Teacher	1	0.1107
Pope-Davis, & Twing	1991	College	4	0.1353
Sacks etal.	1993	High School	2	0.0980
Shawareb	1993	College	1	0.2750
Wallace, & Sinclair	1995	College	3	0.7390
Woodrow	1994	Junior High	6	0.3638
Overall grand mean				0.273
Overall grand median				0.278
Overall grand SD				0.284
Total N of study				28
Total N of comparison				112

Table 1: Number of Comparisons and Study-weighted Effect Sizes

Table 2 lists the *F* values for the 9 variables for all study-weighted ESs in the study. The positive means indicate more positive attitudes toward computers favor male subjects. For ANOVA, 2 variables, sample size and type of attitude, showed statistically significant impact. Descriptive statistics for these variables are presented in Table 3.

For sample size, ($F(3, 24) = 3.075$, $p<.05$), the post hoc test showed that the mean comparison of studies with

101 – 200 participants was significantly higher than studies with 201 – 300, or over 300 participants.

The post hoc test for type of attitude, ($F(4, 76) = 4.864$, $P<.01$), showed that the mean comparison of studies that measured anxiety was significantly higher than studies that measured liking. In addition, the mean comparison of studies that measured mixed attitudes was significantly higher than studies that measured other types of attitudes.

Variables	*df*	*F*	*p*
Nation of Subject	1, 26	0.457	0.505
Target Population	3, 24	0.267	0.849
Sample Size	3, 24	3.075	0.047*
Type of Publication	2, 25	1.121	0.342
Year of Publication	3, 24	0.393	0.759
Reliability of Measure	1, 26	2.996	0.095
Statistical Power	1, 26	0.040	0.842
Statistics	2, 25	0.231	0.796
Type of Attitude[a]	4, 76	4.864	0.002**

*p<.05 **p<.01

Note. [a] Some studies reported more than one comparison groups.

Table 2: Results of ANOVAs for Coded Variables

Variables	N	%	ES	SD
Sample Size				
Less than 100	9	33	0.326	0.379
101 – 200	6	21	0.498	0.145
201 – 300	7	25	0.170	0.153
Over 300	6	21	0.090	0.187
Type of Attitude[a]				
Anxiety	24	30	0.134	0.173
Usefulness	5	6	0.023	0.055
Confidence	24	30	0.081	0.109
Liking	24	30	0.043	0.097
Mixed	4	4	0.340	0.296

Note. [a] Some studies reported more than one comparison groups.

Table 3: Means and Standard Deviations of Study-weighted ESs for Coded Variables

Discussion

The results of this meta-analysis indicate that gender differences on computer attitudes exist, males have slightly positive attitudes toward computers than females; however the differences are small. An effect is said to be small when ES = 0.2, medium when ES = 0.5, and large when ES = 0.8 (Cohen, 1977). Eighty-six percent of positive study-weighted ES values and 78% of positive ESs overall also confirm the males' positive attitudes over females. The slightness of the differences must keep in mind, however; the overall study-weighted mean ES of 0.273 only indicates 11 percentile scores higher than the female subjects. The percentile scores for the overall grand mean and median were identical, possibly attributed to the small overall grand standard deviation (0.284).

The analysis of studied variables suggests some interesting trends in the accumulated research base and is discussed in the following sections.

A comparative study of subjects from different cultures can supply valuable information, not only about the specific groups selected whose reactions toward computers, but also examine and compare the presence of computer in the context of two different cultures (Collis & Williams, 1987). The results of this synthesis indicate that studies using subjects from other countries had slightly higher ES than subjects from US. There may be some cultural bias, or difference in computer accessibility between US and other countries. The differences, however, were trivial; more cross-cultural studies need to be conducted to clarify this variable.

For the target population variable, there was no significant difference of mean ES. The fact that about 2/3 of studies conducted for college students seems to suggest that most researchers assumed that Loyd and Gressards' CAS was more appropriate for this population. In addition, the mean ES slightly increased from K –12 to teacher/adult is not surprising. Studies have shown that, with age, males are increasingly more confident in their abilities to use computers and more positive in their attitudes toward computers than are females (Ayersman, 1996; Bunderson, 1995; Chen, 1986; Fetler, 1985; Hattie, 1987; Sackrowitz, 1995; Shashaani, 1994). The results of this meta-analysis were consistent with their findings.

Source of studies in a meta-analysis is always an important factor to be examined. The fact that more than half of studies were located from journal articles indicates that the majority of studies included in the synthesis have been critically reviewed by journal reviewers. The larger ES associated with Dissertation/thesis is atypical, however; usually the larger ES associated with published articles is typical in meta-analysis (Glass, et al., 1981, p. 227).

The year-of-publication variable in the meta-analysis allows an assessment of the effect of hypermedia over time. Although no significant difference of mean ES was found, the larger ES associated with studies published between 1995 – 1997 seems to suggest that gender differences on attitudes toward computers have become more observable recently.

The sample size for a study may significantly affect the statistical power of the study; in general, the larger the sample size, the better the statistical power. The sample sizes for about 54% of studies included in the synthesis were less than 200, and the higher mean ES was associated with these studies. For studies in which the sample size went beyond 200, the mean ES dramatically dropped to less than 0.2. This seems to suggest that the gender differences on computer attitudes may only be observed in small to medium sample size. Why the differences diminish in a larger sample size will be a critical question for researchers.

For reliability of measure, statistical power, and statistics, there was no significant difference of mean ES among them. This suggests that mean ES did not affected by the differences of characteristics of research methodology.

Gender differences in computer attitudes clearly varied as a function of type of attitude. The positive mean ESs indicate males had lower anxiety, and higher confidence, liking, and usefulness attitudes toward computers than females.

The mean ES for each subscale showed that gender differences on anxiety was higher than on liking, confidence, and usefulness, suggesting, males and females had small differences on anxiety, and trivial differences on computer liking, confidence, and usefulness. In addition, 4 studies did not report data for subscales and were coded as mixed. These studies showed highest mean ES (ES = 3.4). As a whole, he results somehow indicate that males hold more positive attitudes toward computers than females.

Conclusions

The present meta-analysis synthesized gender differences on attitudes toward computers for studies using Loyd and Gressards' CAS so that confounding results could be avoided as stated earlier. The unique feature differs this meta-analysis from other meta-anlyses on this issue. Although the results showed that the overall ES was small, the fact that the differences between males and females exist was obvious. This finding is consistent with earlier studies conducted by Rosen and Maguire (1990), and Whitley (1997). Left unanswered is the question of what factors truly contribute to the differences. Studies of this question will require further clarification of the exact characteristics of each type of computer attitude (i.e., anxiety, confidence, liking and usefulness) and their relationships with gender. This meta-analysis points out only that gender differences on attitudes toward computers exist. That information by itself is useful.

Selected References

*Abler, R. M., & Sedlacek, W. E. (1987). Computer Orientation by Holland type and sex. *The Career Development Quarterly*, *36*(2), 163 – 169.

*Busch, T. (1995). Gender differences in self-efficacy and attitudes toward computers. *Journal of Educational Computing Research*, *12*(2), 147 – 158.

*Cantrell, R. T. (1995). Attitudes of secondary marketing education instructors in Georgia toward computers. (Doctoral Dissertation, The University of Georgia , 1994). *Dissertation Abstracts International*, *56*, 437A.

*Colley, A. M., Gale, M. T., & Harris, T. A. (1994). Effects of gender role identity and experience on computer attitude components. *Journal of Educational Computing Research*, *10*, 129 – 137.

*Dyck, J. L., & Smither, J. A. (1994). Old adults' acquisition of word processing: The contribution of cognitive abilities and computer anxiety. *Computers in Human Behavior*, *12*(1), 107 –119.

*Francis, L. J. (1994). The relationship between computer related attitudes and gender stereotyping of computer use. *Computers Education*, *22*(4), 283 – 289.

*Hwang, S. C. (1991). A comparison of the effects on students' attitudes toward computers of a computer programming course verse a computer programming and awareness. (Doctoral Dissertation, Florida Institute of Technology, 1990). *Dissertation Abstracts International*, *51*, 2697A.

*Kluever, R. C., Lam, T. C., Hoffman, E. R., Green, K. E., & Swearingen, D. L. (1995). *Journal of Educational Computing Research*, *11*(3), 251 – 261.

*Koohang, A. A. (1986). Computerphobia: An empirical study. (ERIC Document Reproduction Service No. ED 306 948).

*Koohang, A. A (1986). Effects of age, gender, college status, and computer experience on attitudes toward library computer systems (LCS). *Library and Information Science Research*, *8*, 349 –355.

*Koohang, A. A. (1987). A study of attitudes of pre-service teachers toward the use of computers. *Educational Communications and Technology Journal*, *35*, 145 – 149.

*Koohang, A. A. (1989). A study of attitudes toward computers: Anxiety, confidence, liking, and perceptions of usefulness. *Journal of Research on Computing in Education*, *21*, 137 – 150.

*Latham, C. V. (1991). The effect of a color in computer assisted instruction on vocabulary retention rates and computer attitudes of science upward bound students. (Doctoral Dissertation, University of North Texas, 1990). *Dissertation Abstracts International*, *51*, 3393A.

*Liao, Y. C. (1993). Effects of computer experience on computer attitudes among preservice, inservice, and postulant teachers. In D. Carey, R. Carey, D. A. Willis, & J. Willis (Eds.), *Technology and Teacher Education Annual 1993* (pp. 498-505). Charlottesville, VA: Association for the Advancement of Computing in Education.

*Liao, Y. C. (1994). Will different types of computers affect inservice teachers' learning of computers? In D. Carey, R. Carey, D. A. Willis, & J. Willis (Eds.), *Technology and Teacher Education Annual 1994* (pp.163-270). Charlottesville, VA: Association for the Advancement of Computing in Education.

*Liao, Y. C. & Shih, S. (1994). Effects of college, gender, and prior computer experience on attitudes toward computers among college students in Taiwan. In D. Carey, R. Carey, D. A. Willis, & J. Willis (Eds.), *Technology and Teacher Education Annual 1994* (pp.19-24). Charlottesville, VA: Association for the Advancement of Computing in Education.

*Liao, y. C. (1995). A cross-cultural comparison of computer attitudes among preservice teachers. In D. A. Willis, B. Robin, & J. Willis (Eds.), *Technology and Teacher Education Annual 1995* (pp. 61-65). Charlottesville, VA: Association for the Advancement of Computing in Education.

*Loyd, B. H., & Gressard, C. (1984). The effects of sex, age, and computer experience on computer attitudes, *AEDS Journal*, *18*, 67-77.

*Loyd, B. H., & Gressard, C. P. (1986). Gender and amount of computer expedience of teachers in staff development programs: Effects on computer attitudes and perceptions of the usefulness of computers. *AEDS Journal*, *19*, 302 – 311.

*Loyd, B. H., Loyd, D. E., & Gressard, C. P. (1987). Gender and computer experience as factors in the computer attitudes of middle school students. *Journal of Early Adolescence*, *7*, 13 – 19.

*Mertens, D. M., & Wang, Z. (1988, March). Attitudes toward computers of preservice teachers of hearing-impaired students. *American Annals of the Deaf*, 40 – 42.

*Moon, S. B. (1994). The relationships among gender, computer experience, and attitudes toward computers. Paper presented at the annual meeting of the Mid-South Educational research Association, Nashville, TN. (ERIC Document Reproduction Service No. ED 381 142).

*Nash, J., & Moroz, P. (1997). Computer attitudes among professional educators: The role of gender and experience. Paper presented at the Southwest Educational Research Association, Austin, Texas. (ERIC Document Reproduction Service No. ED 408 242).

*Pope-Davis, D. B., & Twing, J. S. (1991). The effects of age, gender, and experience on measures of attitudes regarding computers. *Computers in Human Behavior, 7,* 333 – 339.

*Sacks, C. H., Bellisimo, Y., & Mergendoller, J. (1993). Attitudes toward computers and computer use: The issue of gender. *Journal of Research on Computing in Education, 26*(2), 256 – 269.

*Shawareb, M. S. (1993). A study of the attitudes of college freshman English students and their teachers about computer use as viewed through social learning theory. (Unpublished Doctoral Dissertation, University of Houston , 1993).

*Wallace, A. R., & Sinclair, K. E. (1995). *Affective responses and cognitive models of the computing environment.* (ERIC Document Reproduction Service No. ED 389 279).

*Woodrow, J. J. (1994). The development of computer-related attitudes of secondary students. *Journal of Educational Computing Research, 11*(4), 307 – 338.

e.learning@mq Staff Development to Integrate Online Media into Learning and Teaching at Macquarie University.

Andrew Litchfield
Centre for Professional Development
Macquarie University, Australia
andrew.litchfield@mq.edu.au

Abstract: This paper considers the impact of diverse staff development activities designed to assist faculty to integrate online media into the curriculum. An overview is given of the aims, objectives, activities and evaluation of the 1998-99 *e.learning@mq* project at Macquarie University. Influenced by diffusion theory and the characteristics of the early and late-majority's uptake of innovations, the author designed various activities for both local-area and university-wide settings. The patterns of participation reveal the varied activities attracted different groupings and numbers of faculty and administrative staff. At the completion of the project 91 participants self-assessed the project's impact on their understanding of the issues involved in using online media in learning and teaching. In nine specified areas of understanding 81% of the project participants have self-evaluated slight, moderate or significant improvement in awareness, knowledge and skills in using information technology and online media in their educational programs.

Introduction

Educational practices are intrinsically embedded into the prevailing dominant technologies of communication, knowledge creation and information dissemination. These tools, practices and processes are rapidly changing due to the rise of digital online media. Evermore publicity is appearing from global 'borderless' providers offering privatised and accredited educational services 'anytime anywhere'. Using 'online learning' and 'flexible delivery' these services are now available 'just-in-time' and tailored to meet your individual needs. The rhetoric exhorts that to remain relevant in an increasingly networked economy and society, education providers need to integrate online communication, activities and resources into their offerings.

To support these changes an important organisational strategy is effective staff development. This paper presents an overview of *e.learning@mq,* a 1998-99 project at Macquarie University that aimed to develop capacity to integrate information technology (IT) into learning and teaching. The project focused on the development of faculty, though activities were open to all Macquarie staff and interested visitors.

Influenced by diffusion theory and the characteristics of the majority's uptake of innovations, the author designed and implemented diverse activities and initiatives for local-area and university-wide settings. Diffusion theory argues that adoption of new technology and innovation starts with enthusiastic innovators and early-adopters and then moves to use by the early and late-majority when the innovation is better supported and more reliable. The characteristics of the majority to consider in the design of 'diffused' staff development include that they look to local and discipline-based ideas and practice, favour incremental change, are pragmatic and risk averse, want proven applications, and may need significant support (Rogers 1995, Geoghegan 1994).

e.learning@mq activities were designed to address these characteristics and provided staff with multifarious entry-points to engage with the issues of integrating online media into their educational programs. It was hoped the varied activities would attract different individuals and groupings of staff.

Project Aims and Objectives

Macquarie's IT Strategic Plan. states that "successful integration of IT into a university environment requires radical shifts in thinking about all aspects of [its] educational vision". To support such integration the Center for Professional Development (CPD) successfully applied for an Australian Government 1998-99 CUTSD staff development grant.

The proposed project aimed to support the development and implementation of a coherent program of staff development to improve the capacity of faculty and units at the University to explore and introduce IT effectively into their educational programs. The successfully proposed objectives of the project were to;

1. raise the awareness of staff at all levels to;
   - the potential of IT to enhance and deliver educational programs across the disciplines,
   - the issues associated with the design and development of IT based curricula,
   - the issues associated with managing the development and integration of IT into the curriculum,
2. assist staff to strategically plan and set specific goals in relation to the introduction of IT,
3. assist staff to develop coordinated strategies for realising these goals,
4. assist staff to develop the knowledge and skills required to use IT in the curriculum.

Project Activities

The author's collaborative project management involved all the providers of IT support and facilities at Macquarie, together with many faculty early-adopters and invited quests, to convene and facilitate *e.learning* activities. In early 1998 as reference group was established with members from the CPD, the Centre for Flexible Learning (CFL) and the Macquarie Library's IT Training Unit (ITTU) to assist the development of a more cohesive approach to the project's activities.

Three co-ordinated programs of *e.learning* were implemented during each of the teaching semesters from August 1998 to December 1999 and included local-area and university-wide activities and initiatives. The project website at *<www.cpd.mq.edu.au/e.learning>* facilitated online bookings, discussion and feedback. The site includes full descriptions of all the project activities with some handouts and transcriptions from events. The site was designed to model a simple yet functional and effective online media resource.

Local-area Peer Development Projects

The successful *e.learning@mq* grant application proposed to establish IT peer development groups in local areas to develop discipline-specific approaches to their educational programs and to foster continuing exploration and debate. The author designed a competitive grant scheme for teams to research localized IT issues. To receive funds the team-leaders had to establish a local-area team and propose a plan to research an appropriate IT issue and then convene appropriate peer development activities for their colleagues. To provide an incentive for team-members to become involved funding was available for time-relief and other minor expenses.

In late 1998, three workshops supported the development of project proposals to include a concept, rationale, objectives, timeline and budget. A selection committee decided that nine from a total of 15 submitted proposals could be funded from the *e.learning@mq* grant. These nine local-area projects were implemented during 1999 and early 2000;

- *'How to use computer-mediated-communication in european languages'* in the School of European Languages,
- *'Getting with IT! A structured IT core competencies program for staff'* within the Macquarie Library,
- *'Using IT strategies for communication between on-campus lecturers and mentors of students'* within Warawara, Macquarie's Aboriginal and Torres Straight Islander (ATSI) Centre,
- *'IT supported unit delivery facilitation'* in the Institute of Early Childhood,
- *'Individualised IT support and training'* in the School of Biological Sciences,
- *'How to use WebCT for creating online english language learning modules'* in the National Centre for English Language Training and Research,
- *'Moving beyond the still frame -multiskill with multimedia'* within the Macquarie Library,
- *'IT training for flexible courses'* in the School of Asian Languages,
- *'Teacher Education website project'* in the School of Education.

University-wide activities

The *e.learning@mq* application proposed to improve awareness, knowledge and skills about integrating IT into the curriculum with "one-off" and "short-term" activities. This prescription required considerable elaboration and the author planned five types of university-wide activities, which were then collaboratively designed and facilitated by staff from all levels across the university;

- *Speakers* addressed the theme 'You, Macquarie & information technology' with time for questions and answers in a one-hour lunchtime format,
- *Workshops* with the theme 'Integrating *e.learning* into the Curriculum' with theoretical discussion and practice activities in two-hour lunchtime and some early-evening sessions,
- *Showcases* of *e.learning* case-studies from different disciplines and software demonstrations in a one-hour lunchtime format,
- *Short courses* requiring a time commitment to a series of activities over two to six weeks,
- *Information sessions* about IT support services and facilities at Macquarie in a one-hour lunchtime format.

Through three semester-long programs these activities were collaboratively designed, convened and facilitated together with many Macquarie staff from all levels. Descriptors of all the events and activities are found at *<www.cpd.mq.edu.au/e.learning>*.

Adjunct Activities

In collaboration with *e.learning@mq*, two adjunct initiatives received organisational support;

- Macquarie has established the *e.studio* in the Library. The facility is an independent staff and postgraduate research student IT learning facility with hardware and software often not available in local areas. Launched early in 1999, the *e.studio* is supported by equipment and software demonstrations by staff from ITTU and CFL and promoted in CPD's publicity. Interesting work is emerging from this facility that would not of otherwise occurred due to a lack of local-area equipment and support.
- The CPD funded a global survey to identify and determine the quality and scope of accessible, online resources specifically designed to support the development of english language higher-education staff. A total of 385 university websites were surveyed in detail and the *pdonline* website at *<www.cpd.mq.edu.au/pdonline>* has links to the 'best-of' online resources found (Litchfield & Spear 1999).

Patterns of Staff Participation

> *Although I take advantage of much of what CPD offers it can be seen as something 'out there'. I think this project is the best marrying of CPD and the academic staff at the university that I have been involved in.*
>
> Comment of a local-area team member.

In Australian higher-education, staff are industrially categorised either as 'academic and research' or 'administrative and specialist support' - a 'divide' commonly described as academic and general. An emerging feature of integrating online media into learning and teaching is the blurring of these traditional categories. University work is being actively re-defined with position descriptions and selection criteria increasingly influenced by the skills, roles and team-structures needed by networked education. Concurrently many traditional academic and general staff positions are becoming redundant, and many of the *e.learning@mq* participants were understandably motivated and stressed by this phenomena.

Local-area Peer Development Projects

In late 1998, 44 staff attended three workshops convened to support the development of proposals for the *e.learning* local-area grants. All the ultimately successful project team-leaders attended the workshops and have stated the high-value of this support in the development of sound proposals with clear aims and objectives, time-lines and budgets. The nine funded project teams comprised 38 members (68% academic and 32% administrative staff) who worked together, and then received payment for their time, throughout 1999 and early 2000. Many of the team-leaders were in this role for the first-time and developed substantial project, team and financial management knowledge and skills.

At mini-conferences held in February, July and December 1999 the teams reported on progress and discussed issues. The mini-conferences had 72 attendances indicating a high-level of team-member participation in these support activities. The final reports from the team-leaders indicate the local-area and discipline-based objectives were all realised often with unforeseen advances, and the peer development activities achieved very high-levels of participation. This high-level of peer involvement confirms diffusion theory's premise that the majority favour incremental change and look to local and discipline-based settings for new ideas and innovative practice.

As the main cost-item of the *e.learning@mq* budget, the author considers the local-area team and peer development scheme as the most effective and substantial of all the project's activities. Requiring the least amount of CPD support, significant peer development has occurred in self-selected local issues of integrating IT into educational programs.

University-wide Activities

65 *e.learning* university-wide activities were convened and the records indicate a total of 997 attendances from 385 individuals. The 6 speakers attracted 226 attendances, the 30 workshops 357, the 15 showcases 194 participants, the 9 short courses 170 participants and 5 IT support information sessions 50 participants. The level of participation was well-spread with only one activity needing to be cancelled due to lack of interest.

Figure One compares the staff-category of participants in each of the five university-wide activities. The attendance patterns indicate the project successfully focused on involving academic staff, who were the majority in all activity-types, particularly in the short courses, workshops, and showcases. Only slightly higher numbers of academic than general staff attended the speakers and IT support information sessions. Across all five activities an average 59% of participants were academic staff, 31% general staff, and 10% were of unknown category including the participants external to Macquarie.

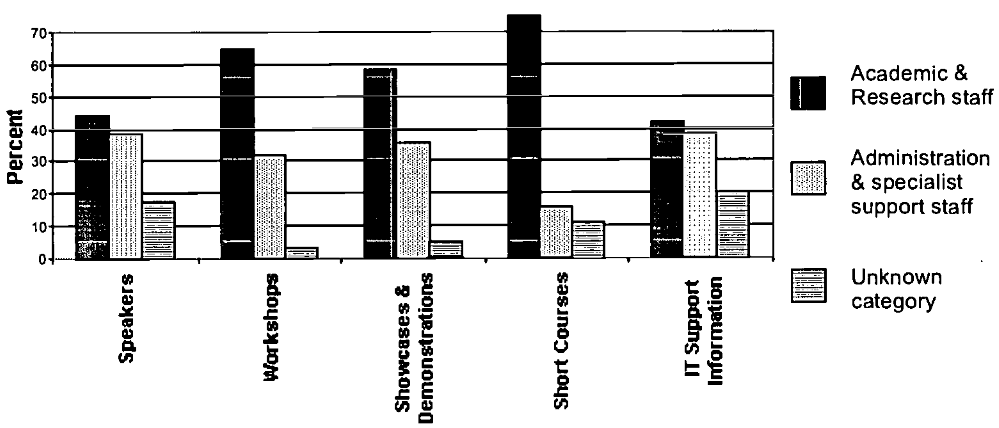


Figure One: Staff category of participants in the five *e.learning* university-wide activities.

University-staff in Australia are over-worked, time is valuable and clearly participants were selective about what interested them enough to attend. The author's diverse and multi-entry 'scatter-gun' strategy certainly worked as each participant averaged only 2.6 attendances. Though face-to-face 'one-off' workshops are the traditional and most-popular method of higher-education staff development, it is important to note the clear potential of short courses to attract and involve academic staff.

Activities which did not succeed included open calls to apply for funds to support relevant local-area activities. Some of the speaker's attracted low attendances, and a web-conference established to facilitate ongoing discussion of events, debates and issues received minimal staff contributions. The online feedback has not worked and even feedback sheets handed out at the conclusion of activities are difficult to garner.

Participants' Self-Assessment of the Impact of the Project

A total of 409 individuals participated in the local-area and university-wide *e.learning* activities. In December 1999 after the completion of all scheduled activities, these individuals were sent an email questionnaire asking for their assessment of the impact of their participation in understanding the issues involved in integrating IT and online media into the curriculum. A follow-up paper-version of the questionnaire to facilitate anonymity was then sent to all the participants who had not responded to the email. A total of 91 valid responses were received of which a high 55 were anonymous.

In nine key areas the questionnaire asked the participants to self-assess the level of impact of their *e.learning@mq* involvement as significant, moderate, slight or not-at-all. The questions asked whether their participation had increased their (1) awareness, or their knowledge or skills in (2) planning, (3) strategic program planning, (4) managing, (5) designing, (6) developing, (7) implementing, (8) evaluating, or assisted them to develop (9) coordinated strategies for the use of IT in the curriculum. Figure Two compares the impact of the project in these nine key areas of understanding.

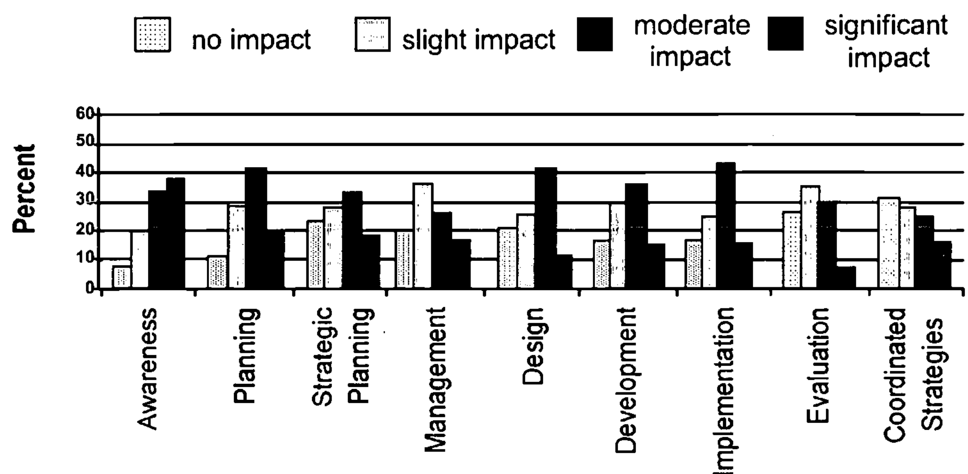


Figure Two: Participant's self-evaluation of the impact of *e.learning@mq* in nine key areas.

On average across the nine specified areas of understanding a total 81% of the participants assessed that the project had a positive impact. An average 18% of participants assessed the project had a significant impact, 35% a moderate impact, 28% a slight impact, and 19% assessed the project had no impact at all. These findings indicate the project has achieved its aim to raise staff's awareness and improve their knowledge and skills in the issues.

In each of the nine areas there are interesting variations in the degree of impact of the project. The strongest impact was in increased awareness of the issues, and in the knowledge and skills involved in planning, designing and implementing the use of IT in the curriculum. The project's weakest impact was in evaluating and developing coordinated strategies. The activities focusing on these issues were poorly attended and reflect the difficulties of developing coordinated strategies at the individual level, noting that in 1998 Macquarie underwent a major organisational restructure.

Conclusion

In an important strategic direction for Macquarie University, the 1998-99 *e.learning@mq* staff development project fulfilled its aim to increase the organization's capacity to integrate IT and online media into the curriculum. The project outcomes clearly indicate that well-funded and managed professional development activities can increase *individual* awareness, knowledge and skills about integrating online media into higher-education learning and teaching. The project's diverse activities, in both local-area and university-wide settings, attracted different groupings and numbers of staff, justifying the author's pluralistic approach informed by diffusion theory and the characteristics of the majority in the uptake of innovations. The different activities did appeal to different people.

Participating *individual* staff have self-assessed improvements in awareness of the issues involved in integrating online media into the curriculum. On average, across nine key areas of understanding, 81% of participants have self-evaluated slight, moderate or significant improvement in awareness, knowledge and skills.

However it is important to note that Macquarie has a total permanent staff of some 1500 and only 409 individuals participated in the project. Overall 19% of these participants considered no change at all had occurred through the project. So a complex and ongoing issue is how to increase involvement from staff who have yet to show interest in using online media. There is a need for innovative and imaginative strategies to address this issue including improved incentives and rewards. In particular there is a clear need for strategies to maximise the number of staff getting their 'hands-on the tools' in a supportive, localised context.

The project's external funding was for 1998-99 and the project has now ceased. Macquarie has not funded an ongoing project as apparently the aims have been met and are now "embeddded into the infrastructure". Better ongoing cohesion and collaboration between Macquarie's IT support structures and staff was facilitated by the project and some activities continue in different ways.

The development required to improve the *organisational* capacity to integrate new media into the curriculum continues to require substantial innovative, collaborative and well-designed policy, processes and activities. Issues such as improved supports for staff and students, policy developments with rigorous course review and accreditation processes, and better teaching load recognition for online development, and other incentives and rewards, are crucial initiatives that remain to be achieved.

As a local-area *e.learning* participant noted "it is only the tip of the iceberg - unless we can get the value of this type of skill development recognised at university level, that is with ongoing provisions for staff relief for such projects the impact will be limited".

The author hopes the activities and outcomes of the 1998-99 *e.learning@mq* project can assist staff developers involved in similar work. Regardless of our respective roles, with issues of IT and change we constantly need to be learning and supporting each other. Indeed facilitating professional development in using online media is emerging as a generic skill required by us all.

References

Coaldrake, P. & Stedman, L. (1998). *On the Brink: Australian universities confronting their future.* Brisbane: Queensland University Press.

Geoghegan, W. (1994). What Ever Happened To Instructional Technology?. *22nd Annual Conference of the International Business Schools Computing Association,* Baltimore, Maryland, July 17-20, 1994.

Information Technology Strategic Plan 1996. Internal Document. Macquarie University.

Litchfield, A. and Spear, P. (1999). Online Professional Development: the 1999 status of online resources to support the development of higher-education staff. *Cornerstones of Higher Education Conference, 1994,* Annual conference of the Higher Education Research and Development Society of Australasia, Melbourne, July.

Philip, R. & Litchfield, A. (1999). Learning and Teaching Online: a short course for higher education staff. *Diversity Conference, 1999*, Annual conference of the Australasian Society for Computers in Learning in Tertiary Education, Brisbane, Australia, December.

Rogers, E. (1995). *Diffusion of Innovations.* (4th Edition). New York: Free Press.

Acknowledgements

The author thanks all the many participants, convenors, and facilitators of the project's activities. Especially thanked for their contributions are Mark Gregory for his website support, Patricia Gustafson for her wide project support, and Hamid Khezrnejat for his evaluation analysis. The project only happened due to funding from the Australian Government CUTSD Committee with the success of a grant application co-authored by Maree Gosper and Stephen Marshall.

Exploring the Use of Virtual Multimedia Examinations in Teaching and Learning: Results from the Fielding Testing

Min Liu
University of Texas at Austin
Department of Curriculum & Instruction
Austin, TX 78712
(512) - 471-5211
MLiu@mail.utexas.edu

Erini Papathanasiou
Cyprus

Winnie Hao
University of Texas at Austin
Department of Curriculum & Instruction
hao@mail.utexas.edu

&

John Kappelman
University of Texas at Austin
Department of Anthropology
jkappelman@mail.utexas.edu

Abstract: This paper discusses a National Science Foundation sponsored project for developing virtual multimedia examination formats for use in sciences. It describes the project and multimedia exam templates, and the results of field-testing of their uses in the classrooms.

Theoretical Framework

The prevalence of technology is experienced in every aspect of our lives. Being able to understand technology and using technological tools have become important expectations of today's and tomorrow's workforce. The Clinton Administration has identified four areas that need to be addressed to meet the challenge of preparing technology literate workforces: (1) making modern computers accessible to all students, (2) making classrooms connected around the world, (3) integrating interactive educational software into the curriculum, and (4) making sure that teachers are capable of teaching with technology (U.S. Department of Education, 1998).

Integrating interactive software into the curriculum calls for the use of innovative software in teaching and learning. Research shows that technology has the potential to facilitate learners' understanding and increase their problem-solving skills if the software is well-designed (Liu & Reed, 1995; O'Callaghan, 1995; Pedersen, Williams, & Liu, 1999; Smith, 1994). However, the use of innovative software as part of teaching is not always accompanied by innovative uses of assessment tools. In most cases, traditional testing using paper-and-pencil is still a norm even for assessing the effectiveness of technology on learning. Although computerized testing and computer adaptive testing have been used more than a decade, in the past two years, there is a much more stronger interest in using online multimedia testing as an alternative assessment to the traditional paper and pencil tests.

This interest is partly sparkled by the fact that the explosive uses of internet technology in recent years has made it possible to deliver instruction over a distance and to a wide audience. The number of online courses has exponentiated. The more extensive uses of technology in instruction have prompted educators to reexamine the assessment tools.

Advantages and Limitations of Computerized Testing

Supporters of computerized testing maintain that testing on the computers can minimize the error involved in administration of the test by standardizing the testing environment, and therefore increasing the reliability of the test (Eaves, 1985; Wise & Plake, 1990; Zandvliet & Farragher, 1997). It also provides immediate computerized scoring, which facilitates and expedites decisions that might need to be taken based upon the results of the scores. Moreover, computerized testing can provide the examinees with feedback on the correctness of the answer. Additionally, information is provided regarding test-taking behavior. For instance, the examiner can collect data such as how many items have been reviewed by the examinee, or how much time is spent on each item (Wise & Plake, 1990). Computerized assessment facilitates evaluation of test items, including group analysis of the test and item bias, as well as analysis of items' reliability and difficulty (Eaves, 1985). In contrast to paper based testing, computerized based testing gives the examiner the capability to enrich the display of information by integrating multimedia elements. Finally, computerized tests may become individualized and proceed in different ways based upon examinee's responses.

However, using computerized testing has limitations. Will testing on the computers cause anxiety – test anxiety as well computer anxiety—to learners? Is it fair to use computerized testing on everyone, especially those who do not have frequent access to computers? Is it worth the money and effort to put a test on the computer when it is more efficient to use a equivalent paper-and-pencil version? Is it realistic to use computerized testing in the classrooms? Is it realistic to expect instructors to develop computerized tests in addition to their regular duties? Even though the benefits of computerized testing are evident as discussed above, these limitations prevent the wide use of computerized testing in the classrooms until recently when the ease of incorporating multimedia and internet technologies into instruction becomes a possibility for the majority. The following section looks at the use of computerized testing in the recent years.

Research Findings

Zandvliet and Farragher (1997) in their study investigate the equivalence of a computer-administered test (CAT) with a written format of the test. Analysis of the test scores indicated that there were no significant differences attributable to the test format. Although the CAT required more time than the written test, authors attributed this difference to the fact that the students were unfamiliar with the computer format. They also conducted a survey to identify students' attitudes towards computerized testing. The results showed that the students clearly preferred the computer-administered test.

Isham (1997) conducted a study to investigate whether an interactive computerized visualization assessment would help interior design students improve their visualization skills. A paper assessment was first developed to validate assessment problems for the computerized version. The computerized assessment was based on the paper assessment and was similar in content and sequence. It included, however, animations. The results of the study indicated that the average score of students who took the computerized version of the test was higher than the score of those students who took the paper version. The author concluded that the inclusion of animations in the assessment seemed to enhance students' visualization skills.

In another study conducted by Soo and Ngeow (1998), students using a multimedia self-assessment English proficiency course were compared with students in a conventional teacher-taught proficiency class. Factors such as gender, race and learning style (visual, auditory and kinesthetic) were also included in the collection and analysis of data. The results showed that students who used the self-paced multimedia program achieved significantly higher scores as measured by the TOEFL, and in less time than the students who were taught in a traditional course. Multimedia instruction was effective across all genders, races and learning styles. As the authors concluded, "convenience, flexibility, and simulation of interactive multimedia allows learners to learn better and faster compared to learning with human teachers in language proficiency learning" (p.87).

However, incorporating various media into computerized testing and making it interactive is still new. Much research is needed to understand how to make the testing not only an evaluation tool but also a learning tool. Because the making and using of computerized testing requires the knowledge of advanced computer knowledge. The challenge is how to make it possible for any instructors, who are interested, to use such tests in their teaching.

Purpose of the Project

The purpose of the project is (1) to develop virtual multimedia examination formats for use in sciences and other disciplines; and (2) to evaluate the use of such formats in classrooms, especially examining students' attitude towards being evaluated by such multimedia exams, and instructors' attitude for using it.

This presentation will describe the project, but will focus on the field-testing of the use of such multimedia exam formats in actual courses.

Project Description

Given the challenges of developing interactive evaluation tools to better assess learning and improve teaching, and to make such tools available to instructors in sciences to use in their courses, a group of faculty and students at the University of Texas – Austin, led by the fourth author of this presentation started to develop multimedia examination templates for use in sciences. This is a National Science Foundation sponsored project. It is currently in its second year of implementation. The project is to use recent advances in digital technology to utilize the full range of color imagery, video, two- and three-dimensional animations, and sound so as to produce rich and interactive evaluations. Because the undergraduate teaching in various sciences often shares the use of similar types of student performance assessments (e.g. laboratory assignments, quizzes, mid-term and final exams), it is possible to produce a series of multimedia exam templates that can be customized for use across disciplines. Instructors using these templates can "copy, cut, and paste" their questions into the formats, add multimedia materials, and utilize the interactive question formats to make their own exams.

The Virtual Multimedia Exam Templates

The virtual exam templates (VExam) consists of three programs: (1) Exam Builder, (2) Exam Giver; and (3) Exam Reviewer. Exam Builder allows instructors, regardless of their computer experiences, to build their customized exams. It guides the user through exam construction in a step by step manner. Exam Giver allows students to take the computerized exam his or her instructor has created. Exam Reviewer helps students review what he or she has missed in the exams and provides study suggestions.

The exams created with the Exam Builder shares similar characteristics to a traditional paper-pencil exam in that it can contain the same content and sequence as a paper exam, and use the same common testing formats such as multiple choice, true/false and matching items. However, these new exam formats have some innovative features that will be hard to implement in the paper exams. First, the presentation of questions is greatly enhanced through the use of images, video, animation and sound. The use of multimedia is particularly attractive to visual learners who need assistance to understand abstract concepts. The multimedia elements, directly related to the content of the questions, can aid the learner in understanding the questions, and enhance learners' ability to recall the information necessary to answer the questions. The multiple representations of each question, through verbal and non-verbal stimuli, can accommodate learners with different learning styles. This is strongly supported by the dual code theory, which suggests that the retrieval of information is facilitated through multiple stimuli that can cue the right information (Ormrod, 1995).

Another important feature of this new exam format is that it allows a more dynamic and interactive type of questioning. The questions can present real world situations, where the student is asked to make observations and measurements, collect data, form hypothesis and, solve a problem. Students are evaluated both on the end product, as well as on the procedure that the student has followed. The goal of these questions is, therefore, not only for the student to reach a solution, but also to learn from the whole problem-solving process.

In addition, Exam builder allows instructors to generate random questions, alternative forms of the same exam to ensure security and fairness of the exams for all students. Once a test is over, scores are calculated and displayed immediately for the students. Correct answers are explained. Though students cannot retake the same exam after viewing the answers, they can review the content, exam formats and get ready for the next exam. In short, such exams are developed not just to evaluate students' performance, but more importantly, assist students' learning as the ultimate goal.

Field-Testing

Research Questions

After several circles of the formative evaluation, the VExam is being used in several courses at the University of Texas-Austin. Evaluating the efficacy of using these exams as a primary assessment tool focuses on the following research questions:

(1) Are these multimedia exams equivalent to the paper and pencil exams in terms of the content?
(2) What are students' as well as instructors' attitudes toward using them?
(3) Does students' computer experience affect their use of the exams?
(4) In what way does the use of such exams influence learning and teaching?

Method

The field-testing reported here consists of two phases: (1) using it in two different science courses where instructors implemented the exam templates in a bit different way; and (2) using it as the assessment for an online self-paced science course. The evaluation examined students' as well as instructors' perspectives. Questionnaires and interviews are the two primary data sources. The actual exams, their content and formats, were also studied.

Phase I. The templates were used in two different undergraduate science courses from fall 98 to spring 99. One instructor is relatively new to the multimedia technology and had used graphics in the teaching. Another instructor is an experienced multimedia user, who has used all media formats in the teaching including video, graphics, animation and sound. Approximately 120 participants returned the questionnaire, who represented several science disciplines and from freshmen to seniors.

A questionnaire was devised to examine students' anxiety and attitudes toward being "tested" using the multimedia exams. It consists of 25 items on a 5-point Likert-scale with 1 being "I strongly disagree" and 5 being "I strongly agree". These 25 items address three issues related with multimedia exams: anxiety towards multimedia exams (9 items), attitudes towards taking multimedia exams (8 items) and attitudes towards multimedia and learning. The items regarding anxiety towards multimedia exams were based upon a modified version of Spielberger's self-evaluation anxiety scale (Reed & Palumbo, 1987). The attitude items were based upon Richards, Johnson, and Johnson's computer attitude scale (1986). Examples include "I feel upset when I take a multimedia exam", "I had difficulties completing the exam because it was a multimedia exam", and "Multimedia exam will enhance my performance." The questionnaire was examined by three experts in instructional technology for content validity and pilot-tested by a group of five students. Comments and suggestions were incorporated. Six open-ended questions were used to ask the participants to express their likes or dislikes of multimedia exams, and to compare the multimedia exams with the traditional paper-pencil exams. Sample questions were "How do you like or dislike taking a multimedia exam", or "Which part of the multimedia did you like the most? Why?" Students' computer prior experience was also surveyed and grouped into novice, intermediate and expert users according to their experiences.

Interviews were conducted with a randomly selected group of students about their opinions of the multimedia exams. Three questions were used to start the interviews, but the researchers made an effort to keep the interview process open, allowing students expressing their opinions freely. Follow-up questions were used if further explanations were needed. An extensive interview was conducted with the instructors using 10 questions.

Phase II. In the fall 99 and spring 00, the multimedia exam templates are being used to create virtual exams for an online self-paced course (http://www.dla.utexas.edu/depts/anthro/courses/99fall/SP301/). This self-paced course uses the instructor created multimedia CD-ROM as an important source for instructional materials. Students study the materials in their own time, and get evaluated about their knowledge through quizzes and exams created using VExam programs at a time that is convenient to them. Review sessions and Q&A sessions are provided on a regular basis throughout the semester. Because of the self-paced nature of the course and the use of the multimedia CD-ROM as a primary teaching tool, the use of multimedia exams in this case reflects more closely what is being taught. The questionnaire has been revised based upon the results from Phase I and is being incorporated into an online form. Interviews will be conducted with the instructor and the students. In addition, observations of the review sessions and the testing sessions will be made. At present, data for Phase II are being collected and analyzed.

Results and Discussion

Descriptive analyses were conducted for the questionnaire. The interview data were analyzed following the framework by Miles and Huberman (1994). Results from Phase I are reported here.

Table 1. Mean scores for students' anxiety and attitudes towards the multimedia exam format

Computer Expertise		**Anxiety** (1 to 5)**	**Gender**	**Attitude* (1 to 5)**	**Anxiety** (1 to 5)**
Novices	3.32	2.87	Male	3.65	2.31
Intermediate	3.58	2.51	Female	3.48	2.68
Experts	3.83	2.46			

(* = The higher the number, the better the attitude
** = The lower the number, the lower the anxiety)

Table 2. Multimedia Exam Vs Paper Exam Preference

	Prefer Multimedia	**Prefer Paper**	**Either**	**No Opinion**
Novices	41.17%	29.41%	29.41%	0%
Intermediate	43.58%	30.76%	20.51%	5.1%
Experts	66.66%	33.33%	0%	0%
Male	42.10%	26.31%	26.31%	5.26%
Female	45%	33.33%	18.33%	3.33%

Typical students' comments from the interviews on their attitudes and anxiety toward the multimedia exams included:

- I like multimedia exam better, because it offers the chance to get instant feedback on the test results.
- Pictures and animations can give you clues when you are trying to remember something.
- Multimedia exam appeals to me visually and therefore, seems easier, although the material may not be. It's more accessible.
- I prefer multimedia exam. It seems to be easier and more interesting to use.
- I like it, because it makes test taking and grading quicker and easier.

- I like the multimedia environment, it's less stressful and that helps resolve test anxiety.

The following are typical students' comments on the interactive elements built in the exams:

- Being able to manipulate things, take measurements and things like that where you wouldn't be able to do on a piece of paper.
- [I liked] The interactive part as opposed to the Multiple choice part. I liked the fact that I was able to take measurements, rotate things and see them from different angles. I also liked plotting a graph, because you were able to change your answers, see the different possibilities and estimate which one is the correct.
- [Do you like the multimedia exam?] Yes, because like in the lab and in the class we use these materials and we have these 3D models. And then the professor uses the same things in the exam. And it's like another way to help you remember.
- I like the interactive part, where there was this whole case that you had to work on and do different stuff, collect and analyze data... And each part builds on the previous one. And the good thing is let's say you missed one question and then you move to the next part and you have to use the results of that questions, it will give you the correct one to move from there. I think that's good, because you actually learn something from the test. You do something wrong, but then you realize why it's wrong.
- Yes, because I spent less [time] remembering how something exactly looks like and I was focus [ing] more what its feature[s] mean so that when it comes to application I can use that instead of spending ten minutes trying to remember what it looks like.

The interviews with the instructors revealed that though the instructors recognized that the templates could provide the same content and sequence as the paper exams, they chose to take advantage of the multimedia and interactive features made possible by the new formats. The multimedia exams were enhanced versions of the paper exams according to the instructors. Though the multimedia templates have made it very easy for instructors to use, regardless of their computer experience, it still takes quite a bit of time to assemble and create all media elements. This reinforces the concept that technology has provided enormous new possibilities, but it does not necessarily has made our life easier.

The quantitative and qualitative data suggested the following:

1. The overall attitudes toward the use of the multimedia exams as the primary evaluation method have been positive. Students' computer anxiety, regardless of their prior computer experiences, has been relatively low.
2. Students with more computer experience have a greater preference toward using the multimedia exams.
3. Gender does not seem to be a factor in differentiating the opinions.
4. The use of multimedia elements, especially 3D modeling and animation, and immediate scoring are important reasons for students to like multimedia exams.
5. The interactive nature of certain questions, allowing students to manipulate and analyze the data, focus on solving problems rather than recalling facts, is especially well-liked by the students.

However, some students expressed negative attitudes towards multimedia exams and showed preference towards the paper-pencil exams. There were three main reasons for this negative attitude:

(1) valuable time being lost to scan the test. It was more difficult and time-consuming to go back and forth on the computer to get an idea of the whole test and review their answers. One student said, "With the multimedia exam you can see one question at a time, whereas with a paper exam you can scan over all questions and get a feel for the test."
(2) the possibility that everyone could look on the screen while taking the test, and see the score at the end. Some students indicated it was stressful and tiring to read the computer screens.
(3) the dislike of computer. Though most of the participating college students like and use computers as part of their college life, some do not, as one said, "I don't like computers. I'm not into technology at all. I still

use a typewriter for my papers." Some students mentioned that they were more used to, therefore more comfortable to, paper-and-pencil exams.

Such negative feelings about the multimedia exams indicated the following:

- Using multimedia exams is a relatively new way of assessment. Though colleges and universities are the best places to implement them, sample tests and practices of using the new formats should be made available for students to get familiar with. Students should make an effort to practice using the new format.
- The multimedia templates being developed can be improved and enhanced to incorporate students' suggestions.
- The actual administration of the tests can be further examined to ensure testing security and fairness.
- The effective use of such new assessment depends partly on instructors' willingness to try new things and their experience in using technology in instruction.

The advances in technologies and possibilities made available through internet and multimedia force us to reexamine the ways we teach, we learn, and we evaluate. With more and more courses being offered online, computerized testing is a logical way for evaluation. Examining how to make testing as a part of the learning is an important challenge. After all, the goal of evaluation is not to merely test students, but to help them learn as well.

Page limit of the conference proposals prevents elaborate presentation and discussion of the results, which will be shared more in detail at the presentation. The VExam will also be demonstrated to the audience.

References

Eaves, C. (1985). Educational assessment in the United States. In Sandals, L. (1992). An overview of the uses of computer-based assessment and diagnosis. Canadian Journal of Educational Communication, 21(1), 67-78.

Isham, D. (1997). Developing a computerized interactive visualization assessment.
The Journal of Computer-Aided Environmental Design and Education 3(1). Online. Scholarly Communications Project, University Libraries, Virginia Tech. Internet. 21 Jan.1999. Available: http://scholar.lib.vt.edu/ejournals/JCAEDE/v3n1

Liu, M. & Reed, W. M. (1995). The effect of Hypermedia-assisted-instruction on second language learning. *Journal of Educational Computing Research. 12*(2), 159-175.

O'Callaghan, B.R. (1995). The effects of computer-intensive algebra on students' understanding of the function concept (Doctoral Dissertation, The Louisiana State University and Agricultural and Mechanical College, 1994). Dissertation Abstracts International, 55(11), 3440A.

Ormrod, J. E. (1995). Human Learning. New Jersey: Prentice-Hall, Inc.

Miles, M. B, & Huberman, A. M. (1994). Qualitative *Data Analysis* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Pedersen, S., Williams, D., & Liu, M. (1999). *The Effect of Hypermedia Delivered Modeling on Learners' Self-Directed Study During Problem-Based Learning.* In B. Collis & R. Oliver (Eds.) *Educational Multimedia and Hypermedia 1999.* Proceedings of the World Conference on Educational Multimedia & Hypermedia (pp.1212-1213).

Reed, M.W. & Palumbo, D. (1987). Computer anxiety: Its relationship with computer
experience and locus of control. Paper presented at the Annual Conference of the Eastern Educational Research Association. Boston, Massachusetts.

Richards, P. S., Johnson, D. W., & Johnson, R. T. (1986). A scale for assessing student attitudes toward computers: Preliminary Findings. *Computers in the Schools*, *3*(2), 31-38.

Smith, K.B. (1994). Studying different methods of technology integration for teaching problem solving with systems of equations and inequalities in linear programming. Journal of Computers in Mathematics and Science Teaching, 13(4), 465–479.

Soo, K. & Ngeow, Y. (1998). Effective English as a second language (ESL) instruction with interactive multimedia: The MCALL project. Journal of Educational Multimedia and Hypermedia, 7(1), 71-89.

U.S. Department of Education. (1998, July 6). Education technology headlines... [Announcement]. Washington, DC: the World Wide Web: http://www.ed.gov/Technology.

Wise, S. & Plake, B. (1990). Computer-based testing in higher education. Measurement and Evaluation in Counseling and Development, 23(1), 3-10.

Zandvliet, D. & Farragher, P. (1997). A comparison of computer-administered and written tests. Journal of Research on Computing in Education, 29(4), 423-438.

Learner as designer-producer: Physical and health education students experience Web-based learning resource development.

Lori Lockyer
Faculty of Education
University of Wollongong
Wollongong, NSW, Australia
Lori_Lockyer@uow.edu.au

Yvonne Kerr
Faculty of Education
University of Wollongong
Wollongong, NSW, Australia
Yvonne_Kerr@uow.edu.au

Abstract: It has been demonstrated that an effective strategy for constructing meaning and knowledge about a particular subject area is in the design and production of subject-specific educational resources - particularly computer-based resources (Jonassen and Reeves, 1996). In a continuing effort to explore the effective use of computer-based technologies in the teaching and learning experience, the Faculty of Education at the University of Wollongong implemented a 'learner as designer-producer' model in a senior year physical and health education course. A number of factors -- limited experience using computers, restricted time available to access production equipment and competing priorities related to the final year of study -- provided a challenge to the pedagogical re-conceptualisation of the course to include such a model. However, preliminary analysis of the outcomes of the implementation proved encouraging and has informed further developments.

Background

It has been demonstrated that an effective strategy for constructing meaning and knowledge about a particular subject area is in the design of subject-specific educational resources - particularly computer-based resources (Jonassen and Reeves, 1996). In this concept of 'learner as designer', the learner is engaged in a meaningful task where important aspects of the knowledge construction process such as analysis and reflection are facilitated. Hedberg, Brown and Arrighi (1997) have further explored the impact of such pedagogical strategies in the concept of 'learner as producer'. When the learner is involved in the production of interactive hypermedia-based educational resources they are focused on learning about such production as a body of knowledge with an accompanying set of skills. It follows then that when the learner is involved in both design and production aspects of hypermedia-based educational resource development they actively explore concepts related to the subject matter, hypermedia production and the related skill set.

In a continuing effort to explore the effective use of computer-based technologies in the teaching and learning experience, the Faculty of Education at the University of Wollongong (in New South Wales, Australia) has implemented a 'learner as designer-producer' model in its senior year *Advanced Teaching and Learning Studies*. The goal of this subject is to foster the importance of professional development for teacher trainees in their final year of study in a four-year Bachelor of Education (Physical and Health Education) degree. The emphasis is on the need to react to change, to continually expand their repertoire of teaching skills and to develop a personal teaching philosophy. Among the specific objectives for the subject are the analysis of senior secondary physical and health education related syllabuses and the ability to translate the policies into teaching and learning environments and the critical examination of the use of technology in the physical and health education classroom.

The delivery of this subject for the 1999 academic year coincided with the New South Wales Board of Studies circulation of a proposed senior secondary school syllabus, which was scheduled to be released for use in next school year. Thus, students enrolled in this subject would likely be securing teaching positions within which they would be required to have in-depth knowledge of and ability to implement the contents of this draft syllabus. At the same time curriculum was being re-examined, employers were increasingly expecting teachers to be skilled in both the administrative and pedagogical use of computer-based technologies (Ministerial Advisory Council on the Quality of Teaching, 1998).

Thus, it was timely to implement an educational innovation within *Advanced Teaching and Learning Studies* with the investigation of the impact of learner as designer-producer model. The focus of this innovation was an assessment task which involved the design and production of a Web site with embedded learning activities which related to the proposed syllabus. For this task, students worked in collaborative teams.

The literature regarding collaborative approaches to learning was convincing. Henri (1996) explained that group learning qualifies as cooperative or collaborative when the process is structured to include: interdependent learner interaction; commitment to the learning of each member of group; commitment to fulfill assigned group functions; use of the appropriate social and interpersonal skills to stimulate cooperation; and, continual revising of the group functioning process. Metheny and Metheny (1997) found that such learning approaches help students overcome their fear of technical courses while helping them prepare for today's collaborative workplace. In reviewing the research, Slavin (1989) found cooperative learning to be statistically significant in facilitating academic achievement in 57% of more than 70 studies. 34 of 41 studies that involved a Student Team Learning approach found significantly positive achievement results (Slavin, 1989). Cinelli et al (1994) argued that the application of cooperative learning was especially important for the school health educator who, in the context of a comprehensive school health program, should employ a range of classroom activities to maintain, reinforce, and enhance the health attitudes, practices, and skills of children and youth.

Implementation

In this investigation, students formed teams of three members and choose from among list of topics covered in the proposed syllabus for the focus of their Web site. Assessment of the Web sites was based on:

- Content (e.g., relevant to the syllabus topic, current and accurate, at the appropriate depth for the proposed students).
- Learner engagement (e.g., the site included learning activities, the activities related directly to the syllabus topic, the activities stimulated the learner to think critically, and a feedback mechanism for learners was evident).
- Design and functionality (e.g., easy to use and well organized, users able to easily navigate site, the site was aesthetically pleasing and professionally presented, the reading level and choice of graphics was appropriate for senior secondary students and, all links work as intended).

Intensive hands-on workshops were held to introduce students to the range of skills necessary for Web site development. An authoring tool, Claris Home Page, was used in the workshops for Web site construction. Workshops covered the following:

1. Site map development, file management, Web page creation, navigation systems, and inserting an image.
2. Creating internal and external site links, page backgrounds, and using tables.
3. Creating and editing images and forms of interaction.

Due to the technical resources available (i.e., software and hardware limitations) an alternating peer-tutoring model was implemented. Each week, one member of the team attended the skill development workshop. A paper-based resource was distributed to each workshop participant that related to the skills covered. This resource was also available on the subject Web site. Immediately following the workshop, the team representative peer-tutored the rest of their team members on the skills they had just acquired.

Jacques (1991) has suggested that peer tutoring allows students to be active learners, feel integrated into the delivery of the subject and increases cooperation, motivation and self-esteem. Peer tutoring is a strategy that is often employed in school physical and health education classes. Thus, this investigation allowed for the modeling of multiple strategies that the teacher trainees could implement in their future classroom practices.

Methodology

A mixed-mode methodology was utilised to evaluate the effectiveness of the learning experience for students from both a quantitative and qualitative perspective. The data collection strategies were varied and included:

- Pre- and post-implementation surveys of student skills and comfort level associated with using computers.
- Student journals and self-analysis of the experience.
- Post-implementation interviews with representatives of the student teams.

Outcomes

Overcoming the barriers of limited experience using computers, restricted time available to access production equipment and competing priorities related to the final year of study, the students rose to this new learning challenge.

Of the 70 students enrolled in the subject, the vast majority self-reported having little or no experience using computers prior to engaging in this learning activity (only 9% reported having "a lot of experience with computers"). For most students, their computer skills were limited to the components of the integrated software package (ClairsWorks) for which they engaged in skill development during their first year of study (e.g., word processing, spreadsheets, databases, draw).

Students reported limited experience using the Internet (only 6% reported having "a lot of experience with the Internet"). In the main, they considered their Internet-related skills in terms of sending and receiving e-mail and searching for and/or accessing information on the World Wide Web. Only two students reported that they had been involved in producing a Web site prior to engaging in this learning activity.

The final Web sites submitted by the learning teams demonstrated that students grasped the basic skills of Web site construction (see Figure 1). All Web sites were functional and with a range of aesthetic designs. Most importantly, all sites included learning activities that were designed to facilitate critical thinking -- an objective inherent in the proposed syllabus.

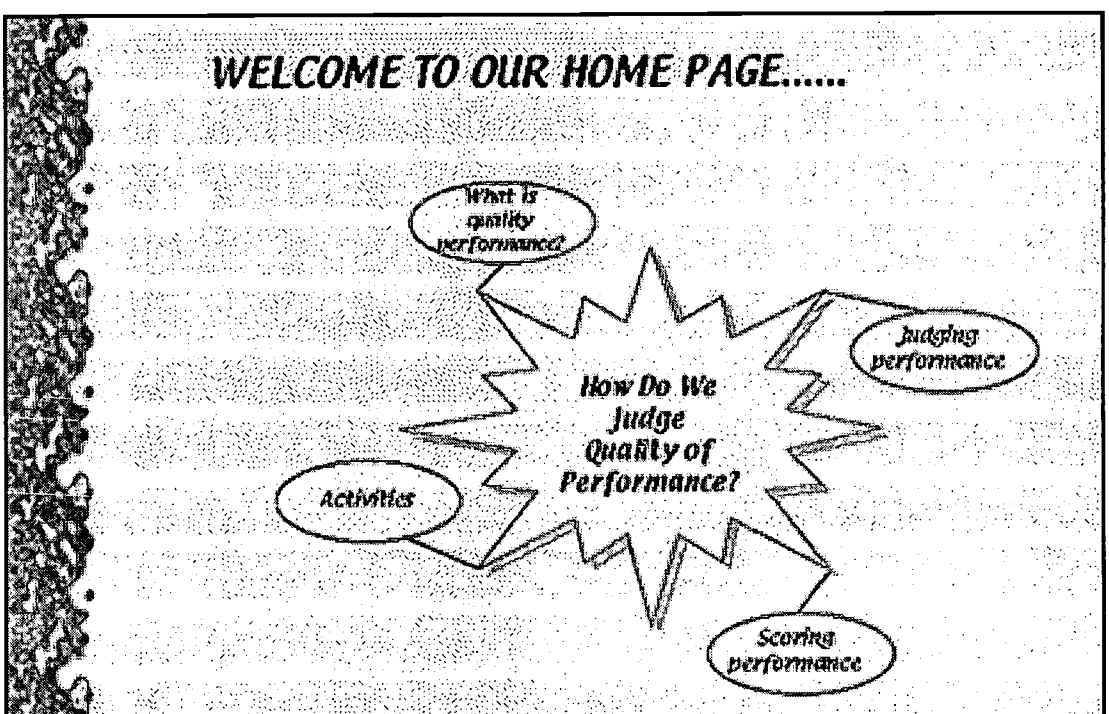


Figure 1: Example of student team developed Web site.

Prior to engaging in the learning experience students were somewhat split in their comfort level in terms of using computers. However, data collected post-implementation demonstrated that students had moved along the continuum with 85% reporting that they felt "comfortable about using computers." Importantly, after the learning experience, 75% of the students reported that they felt "comfortable about using computers in the teaching environment."

Students were also asked to respond to a number of statements about the activity and related assessment task. Table 1 provides an overview of the findings:

Table 1: Student post-implementation perceptions regarding learning activity and assessment task.

Statement	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**	**No Response**
The workshops and the assessment task were helpful in increasing my understanding of how technologies, specifically Web-based technology, can be used for Personal Development, Health and Physical Education teaching and learning	18%	73%	9%	--	--
The assessment task was helpful in facilitating my skills in developing educational Web sites.	34%	60%	4%	--	2%
The assessment task was helpful in increasing my understanding and facilitating my analysis of the draft senior syllabus.	6%	56%	37%	--	1%
The peer teaching model was an effective strategy for facilitating my understanding of Web site construction.	27%	47%	25%	--	1%

This survey data, open-ended comments on the survey and the post-implementation interviews found that students perceived value in the learning activity. One student commented that the task required them to

> *...critically think and develop a practical instrument that could be used for our teaching. This was much better than a more theoretical based approach that only looked at potential uses of technology in teaching senior classes OR playing around with existing sites or CD Roms. It makes it much more relevant and gave us good practice of working with and seeing what computers can do.*

This was further supported by another student who commented,

> *I guess I really have never thought of using computer technology in the PDHPE* [Personal Development, Health, and Physical Education*] classroom. The use of computers for use other than writing up assignments is new to me. The web-based learning activity broadened my thinking in terms of learning strategies.*

Some students felt the task was time-consuming and some did report frustrations with using the technology. Students reported both positive and negative attitudes toward the experiential learning of group work and peer tutoring. One student cxplained, "I thought this was very good, it placed some responsibility and sense of ownership with the peer group/tutor. However, it would have been good if this process continued for a longer period." Some expressed their lack of comfort in playing the role of the tutor. For example, one student noted, "... but I wasn't confident in teaching my group in case I made a mistake and didn't know what to do then I would let the rest of the group down because then we all wouldn't have an idea of those skills. However, others held more positive perceptions about the strategy, for example, "I thought this was a really good idea. It made me really pay attention and not rely on someone else to listen. I liked this strategy and it worked well and I know I'll use it in my teaching."

Students felt it important that they were aware of the difficulties of team management processes that their future students might encounter when such strategies were employed. Students appreciated the issues that came from sharing the experience of learning a skill (i.e., Web site construction) that was completely new to them.

Concluding Remarks

The encouraging preliminary results from this first implementation of the learner as designer-producer model has provided scope for refining future implementations within the course. Additionally, it has provided a basis on which to re-conceptualise the pedagogical strategies that might effectively integrate information and communications technologies in physical and health education.

References

Cinelli, B., Woldford Symons, C., Bechtel, L., & Rose-Colley, M. (1994). Applying cooperative learning in health education practice. *Journal of School Health, 64*(3), 99-102.

Hedberg, J., Brown, C., & Arrighi, M. (1997). Interactive multimedia and Web-based learning: Similarities and differences. In B. H. Khan (Ed.), *Web-based Instruction* (pp. 47-58). Englewood Cliffs, New Jersey: Educational Technology Publications.

Jaques, D. (1991). *Learning In Groups* (2nd ed.). London: Kogan Page.

Jonassen, D. H., & Reeves, T. C. (1996). Learning with technology: Using computers as cognitive tools. In D. H. Jonassen (Ed.), *Handbook of Research for Educational Communications and Technology* (pp. 693-719). New York: Macmillan LIBRARY Reference USA.

Lockyer, L., Patterson, J. and Harper. B. (1999). Measuring effectiveness of health education in a Web-based learning environment: A preliminary report. *Higher Education Research & Development, Special Issue: Learning-Centred Evaluation of Innovation in Higher Education*, 18(2), 233-246.

Metheny, D., & Metheny, W. (1997). Enriching technical courses with learning teams. *College Teaching, 45*(1), 32-35.

Ministerial Advisory Council on the Quality of Teaching. (1998). *Towards Greater Professionalism: Teacher Educators, Teaching and the Curriculum*. Sydney: Department of Education and Training New South Wales.

Slavin, R. E. (1989). Research on cooperative learning: An international perspective. *Scandinavian Journal of Educational Research, 33*, 231-243.

The Development of an On-line Learning Community of Physical and Health Education Professionals.

Lori Lockyer
Faculty of Education
University of Wollongong
Wollongong, NSW, Australia
Lori_Lockyer@uow.edu.au

Gregg Rowland
Faculty of Education
University of Wollongong
Wollongong, NSW, Australia
Gregg_Rowland@uow.edu.au

John Patterson
Faculty of Education
University of Wollongong
Wollongong, NSW, Australia
John_Patterson@uow.edu.au

Abstract: While ad hoc, course-specific projects have allowed early adopters to explore possible innovations in the use of information and communication technologies in facilitating flexible learning situations, educational institutions are now exploring more integrated strategies to such developments. This paper describes the development of one such strategy that attempts to foster a community-wide approach for a group of professionals coming to terms with the most effective way to utilise technologies -- physical and health educators. The Faculty of Education at University of Wollongong is developing an on-line learning community to facilitate the pre-service education and continuing professional development of students, faculty and practicing teachers.

Introduction

Institutions of higher education in Australia are involved in the international trend to consolidate networked information and communication technologies (ICT), particularly the World Wide Web, into their teaching, research and community outreach endeavours. Web-based environments can create meaningful experiences where learning is fostered and supported (Khan, 1997).

In the main, these Web-based activities are particular to individual courses or specific research projects and only infrequently involve an organised change process which incorporates multiple activities and various stakeholders (i.e., members of the community) with a common interest.

The challenge

Within the physical and health education profession, the important members of the community include teacher educators, practicing teachers, pre-services teachers (i.e., students), the professional associations and employers of teachers. An existing example of partnership amongst the members of this community is the model for teacher education which utilised links between schools and universities to promote the communication of professional understanding through practicum experience (Goodlad, 1994). However, the effectiveness of the implementation of this partnership model has been the discussion of recent debate and calls for reform (Ministerial Advisory Council on the Quality of Teaching 1998).

While universities are encouraging the implementation of Web-based technologies into teaching and learning practices, employers of teachers (in this context specifically, the Department of Education and Training New South Wales) are expecting their teachers to have the skills to incorporate educational technologies (including Web-based technologies) within their teaching practices.

Pre-service educators within the Physical and Health Education program in the Faculty of Education at the University of Wollongong recognise the importance of exploring the use of Web-based technologies in their teaching. Recent experiences have proven effective (Lockyer, Harper, and Patterson, 1999; Lockyer, Patterson, and Harper, 1999; Lockyer and Kerr, In Press). However, such initiatives have been implemented on an ad hoc basis. As the Faculty of Education at the University of Wollongong evaluated their experiences, it became clear that a conceptually and practically organised implementation plan which included specific contact with the broader profession and its activities was necessary,

It has been noted that the key features of reciprocal partnerships include:

- a recognition of the interdependence and the unique contribution of the various parties;
- constructive and imaginative problem solving; a will to work to change and improve;
- a working relationship which permits risk taking; a tolerance for ambiguity, uncertainty and dilemmas;
- joint responsibility for the planning, implementation and evaluation outcomes;
- joint, commensurable benefits;
- organisational structures which will facilitate the enactment of decisions;
- appropriate resourcing; intercultural understandings

(Groundwater-Smith, Parker, and Arthur, 1994).

Thus, the concept of an on-line learning community for physical and health education and which comprised these key features was born. Schwier (1999) explained the power of learning communities "resides in their ability to take advantage of, and in some cases invent a process for exchanging ideas and learning collectively" (p. 282). While the community of physical and health education professionals have traditionally fostered successful processes for the exchange of ideas and mentoring newcomers into the community of practice, change fiscal and social influences require new approaches to be investigated. The use of technologies in sustaining and invigorating the community is timely.

There now exists an abundance of literature to inform us of the nature of virtual communities. Fernback and Thompson help us to understand the value of the community that exists in cyberspace (i.e., using Internet technologies).

> *Ideologically, community within cyberspace appears to emphasise a shared belief in the principles of free speech, individualism, equality, and open access... Experientially, community within cyberspace emphasises a community of interests, usually bounded by the topic under discussion, that can lead to a communal spirit and apparent social bonding... they may promote action that is, virtual communities may manifest themselves in real political action, such as educational reform ...* (Fernbank and Thompson, quoted from hypertext document)

The Concept

An on-line learning community for physical and health education has been conceptualised to incorporate these key features of a partnership.

This community will be facilitated by a Web-based environment that encompasses:

- on-line access to the Physical and Health Education program at the University of Wollongong;
- physical and health education teaching resources;
- facilitation of professional development activities; and,
- access to physical and health information sources.

This is a collaborative initiative involving lecturers, students and practicing teachers (Figure 1). The development of the on-line community is dependent on a student-centred learning model. Students propose learning contracts which involve collaborative projects that will add to the resource base of the community. It is envisioned that active participation by students in the development of the on-line community will facilitate a smoother transition into their chosen profession -- the community of practice of teaching. As Bruffee (1993) argues, collaborative learning in the university setting provides students with the opportunity to speak the language of their profession and, "speaking the language fluently defines membership in the community" (p. 130).

Figure 1: Key participants of the Physical and Health Education On-line Learning Community

Through their participation in the development of the virtual community, physical and health education lecturers will enhance their understanding of the use of Web-based technology for teaching and learning within the discipline. This translates into the integration of such concepts into the curriculum of the program. As Sherry and Wilson (1997) suggest "roles and concepts of teaching and learning [should] be restructured" as the Web extends the walls of the traditional classroom (p.67).

Practicing teachers are in integral component of the project. Physical and health education teacher will develop skills to implement Web-based technologies into their classroom and participate in the collegial exchange of ideas and applications of the innovations.

Phase I - On-line Practicum Support

The initial phase of the project has focused on discussion with stakeholder representatives; the design of the Web-based environment which will support the community; the prioritisation for implementation of components, activities or features; and the confirmation of learning contracts with students who will contribute to the development of the community.

Building on the existing collaboration between participants in the form of school-based mentoring and practice teaching for pre-service teachers, a first activity to be explored within the virtual community is an on-line practicum.

The Bachelor of Education (Physical and Health Education specialisation) at the University is conducted over a four-year program. In each year of the program, students engage in practice teaching experiences which involve local schools, supervising teachers and University-based faculty. Anecdotal information gathered from practicum participants (faculty, pre-service and supervising teachers) has called for greater and more consistent communication among participants; access to a variety of information (related to the program specifically and to the teaching profession generally) and access to resources and tools (such as lesson ideas).

The initiative of an on-line practicum provides a model for successive implementations within the community -- the first iteration explored through pilot study with a sub-set of students in the fourth (i.e., final) year of their pre-service teaching studies.

Building on the initial anecdotal feedback regarding the practicum experience, a formalised analysis is being undertaken to clearly identify the needs of the participants. Data collected during the needs analysis will assist in identifying the resources necessary to include in the Web-based environment and, most importantly, the structure that the on-line practicum will take. As suggested by Brehm (1999) it is critical that structure and expectations of involvement of all participants are effectively designed and clearly communicated.

Data collected during the pilot study (in the form of journals, logs of on-line discussions, and post-implementation surveys and interviews) will provide some evaluative indicators and a basis for consideration of extending an on-line practicum component throughout each of the four years of the program.

Concluding Remarks

It is envisioned that this on-line community will evolve to encompass increasing avenues for collaboration among the participants. The community is structured to provide an exciting action research environment for innovations in both initial teacher training and ongoing professional development in the area of physical and health education which can then be communicated to inform similar groups initiatives.

References

Brehm, Barbara. (1999). Factors for successful telementoring of preservice teachers. Proceedings of ED-MEDIA99 World Conference on Educational Multimedia, Hypermedia and Telecommunications. (vol. 2, pp 1300-1301). Charlottesville, VA: Association for the Advancement of Computing in Education.

Bruffee, K. A. (1993). Collaborative learning: Higher education, interdependence, and the authority of knowledge. Baltimore: The Johns Hopkins University Press.

Fernback, Jan and Thompson, Brad. Virtual communities: Abort, retry, failure? Originally presented as "Computer-Mediated Communication and the American Collectivity: The Dimensions of Community Within Cyberspace," at the annual convention of the International Communication Association, Albuquerque, New Mexico, May 1995. [Online] http://www.well.com/user/hlr/texts/VCcivil.html

Goodlad, J.I. (1994) *Educational Renewal: Better Teachers, Better Schools.* San Francisco: Jossey Bass.

Groundwater-Smith, S., Parker, J., and Arthur, M. (1994) Partnerships: Beyond consultation. *Australian Journal of Teacher Education.* 19(1), pp. 9-14.

Khan, B. (1997). Web-Based Instruction (WBI): What Is It and Why Is It? In B. Khan (Eds.), Web-Based Instruction (pp. 5-18). Englewood Cliffs, New Jersey: Educational Technology Publications, Inc.

Lockyer, L., Harper, B. & Patterson, J. (1999). Health Education in a Web-based Learning Environment: Learners' Perceptions. Proceedings of ED-MEDIA99 World Conference on Educational Multimedia, Hypermedia and Telecommunications. (vol. 1, pp 56-61). Charlottesville, VA: Association for the Advancement of Computing in Education.

Lockyer, L., & Kerr, Y. (In Press). Learner as designer-producer: Physical and health education students experience Web-based learning resource development. In *Proceedings of ED-MEDIA2000 World Conference on Educational Multimedia, Hypermedia and Telecommunications.* Charlottesville, VA: Association for the Advancement of Computing in Education.

Lockyer, L., Patterson, J. and Harper. B. (1999). Measuring effectiveness of health education in a Web-based learning environment: A preliminary report. Higher Education Research & Development, Special Issue: Learning-Centred Evaluation of Innovation in Higher Education, 18(2), 233-246.

Ministerial Advisory Council on the Quality of Teaching. (1998) *Towards Greater Professionalism: Teacher Educators, Teaching and the Curriculum.* Sydney: Department of Education and Training New South Wales.

Schwier, Richard A. (1999). Turning learning environments into learning communities: Expanding the notion of interaction in multimedia. Proceedings of ED-MEDIA99 World Conference on Educational Multimedia, Hypermedia and Telecommunications. (vol. 1, pp 282-286). Charlottesville, VA: Association for the Advancement of Computing in Education.

Acknowledgements

The initial development of this on-line learning community is supported by the Faculty of Education and the Educational Strategic Development Fund of the University of Wollongong.

Interactive Video Conferencing for the Small College: Pitfalls and Possibilities

Kate MacDonald, Project Leader, Director of Instructional Resource, Division of Instructional Resources, Massachusetts College of Pharmacy and Health Sciences, Boston, MA, USA, kmacdonald @mcp.edu

Michelle Chapman, Pharm.D., Assistant Professor, School of Pharmacy, Massachusetts College of Pharmacy and Health Sciences, Boston, MA, USA, mchapman @mcp.edu

James Moy, Senior Technician, Division of Information Technology, Massachusetts College of Pharmacy and Health Sciences, Boston, MA, USA, jmoy @mcp.edu

Francis Rogers, Director of Media Services, Division of Instructional Resources, Massachusetts College of Pharmacy and Health Sciences, Boston, MA, USA, frogers @mcp.edu

Lynne Sylvia, Pharm.D., Associate Professor, School of Pharmacy, Massachusetts College of Pharmacy and Health Sciences, Boston, MA, USA, lsylvia @mcp.edu

Abstract. This paper reviews a distance learning project implemented at Massachusetts College of Pharmacy and Health Sciences, a small private college, to deliver a nontraditional, part-time Doctor of Pharmacy program using interactive video conferencing for students located at two sites. Although it was not a complete match to our needs, this technology was chosen in response to a mandate to replace videotape because of consistently negative feedback related to lack of real-time participation. There was both significant potential and considerable risk in our decision. From the start we had difficulties with the system configuration, lack of knowledgeable technical support from the vendor, training issues, networking/connectivity difficulties, and overwhelming environmental problems with our broadcasting space. What we learned during a very difficult implementation of new technology is worth sharing with others who may be considering a synchronous distance learning solution.

Introduction

Many small colleges face stress and frustration in attempting to implement distance learning because some or all of the prerequisites for success are missing or incomplete. These prerequisites include comprehensive analysis and planning, adequate funding, staffing, technical support, and training. Often it is difficult to secure crucial *top-down* administrative commitment for a quality distance learning program, and/or to convince administrators to invest the time and money necessary to do the proper amount of research and preparation *before* a program is put in place (see Robbins 1997 & Wagschal 1998). Studies show that venturing into distance learning without establishing these key elements is a risky endeavor, as outcomes can seriously impact the reputation of the institution (see Carr 2000 & Schneider 1999 & Weiss 1999).

Massachusetts College of Pharmacy and Health Sciences (MCPHS) has been in exactly this situation for the past 16 months. In 1996 MCPHS initiated a non-traditional Doctor of Pharmacy program geared for practicing pharmacists who could not commit to a full-time program. This three-year, part-time program is currently offered at two sites, the Boston MCPHS campus and an affiliated institution, Western New England College located in Springfield, Massachusetts. This program was developed in response to the demands of alumni throughout New England and it was initiated without full administrative support for distance learning. For the first two years of the program, courses were delivered *live* at the Boston campus and these lectures were videotaped. Videotapes were sent to the Springfield students, who also met periodically with their peers for interactive, small group discussions. This method of course delivery was optimal for the Boston-based students, but it was not well-received at the distant site. In mid-1998, the director of the program received administrative support and funding to establish video conferencing between the two sites, and the technology was implemented in January 1999. Despite many obstacles and substantial frustration, this interactive video conferencing program is functioning and improving. We have learned a great deal about *doing it right* and what to avoid.

We were challenged on all fronts, including:

- locating various funding resources.
- finding a high-quality, *reliable* video conferencing system for *reasonable* cost.
- clearly understanding the roles of the ISDN provider and the system vendor.
- existing essentially as an *unsolicited* beta site, since it was later discovered that the system configuration within our type of environment was the first for our vendor.
- computer networking/connectivity problems.
- lack of appropriately-designed broadcasting space.
- lack of experienced support staff (see Boaz et al. 1999 & SURA Video Development Initiative 1999).
- Scarcity (and expense) of quality training in course preparation (for interactive, student-centered distance learning), and on-camera presentation skills designed for college faculty, *not for corporate trainers* (see Boaz et al. 1999 & Parker 1999).

Obstacles were encountered from the start of installation, through system testing and throughout implementation of the first broadcast courses. Some of these issues have been resolved or mitigated, while other solutions for improvement are still in progress.

Program Implementation

Technical Problems

In the beginning we encountered many transmission problems because of:

- our technician's lack of experience with this type of equipment.
- phone company linemen's lack of ISDN experience.
- Intel technician's inexperience supporting a system that was not tested in a real-life environment.
- limited, expensive options for transmitting full-motion video (30 fps) (see Graves 1996).

Because of this unfortunate deficiency in expertise from all of these critical sources of support, those involved with the program at MCPHS during the early stages became discouraged with the technology (see Boaz et al. 1999). A major reason for some of the obstacles we faced was that the system was still in the beta development stage, a fact that was undisclosed to us during purchase negotiations. Technicians at Intel were often unable to help us because this was their first encounter with many of the problems we confronted.

Our first major (and easily avoidable) problem occurred two weeks into the program when we experienced transmission problems. Our system is designed to be portable and originally was located on a rolling cart with the ISDN boxes lying loosely beside the other system components on the cart. We worked tirelessly trying to pinpoint the failure before we realized that the problem was due to the placement of the ISDN boxes. Because the boxes were not in a consistently fixed position, any movement of the wires and boxes affected the transmission signals. Mounting the ISDN boxes on a stable platform inside a closet where the lines run in from the street alleviated this problem. This process took over two months to resolve because the vendor's technical support didn't know what to do. Since that time, we have had only one incidence in which we lost video during a transmission. That problem was rectified with a simple re-boot of the system.

Technical Specifications

The reasons for choosing the Intel TeamStation for video conferencing included:

- Cost.
- Functionality.
- Ease of use.
- Interfacing capabilities with the Microsoft NT network and other Microsoft applications (Word, Excel, PowerPoint).

The current cost of the system, which ships with a Pentium III 500 MHZ processor running Microsoft's Workstation operating system and Intel's proprietary video conferencing software, is between $12,000 to $16,000 per unit, and two units are necessary. Two years ago this system running on a Pentium II 233MHZ processor cost $35,000. As a result of a 1999 agreement between Intel and PictureTel, PictureTel is now the vendor for the TeamStation product line.

Operating and routine maintenance of the system requires minimal technical knowledge. The system is equipped with a Sony video camera with auto-focus and built-in auto-tracking and motion detection, which allows the camera to follow the speaker as she moves about the room. The audio system is hands-free and full duplex, which allows simultaneous speech from both ends. This audio system is optimally designed for an 8 to 10 foot radius. A third-party sound system can substantially improve the audio range of the system.

An Intel technician installed the software and upgraded the system with an aggregator board to allow it to transmit at 384 Kbps, which was the vendor's performance claim. The system was originally designed to transmit at 128 Kbps, which was adequate, but not considered full-motion video. The system may be run in the 128K mode to reduce the ISDN costs. Bell Atlantic charges 75 cents per minute per line, which amounts to a weekly charge to the program of about $675, since actual broadcast time for course activity is five hours once a week. It was discovered that transmitting at this rate can provide adequate video and sound with minimal loss of quality if the presenter significantly limits her movements. With advances planned for Internet II, we may have more options for better broadcast quality in the future (see Graves 1996).

Environmental and A/V Media Issues

As the system problems were resolved or mitigated, a larger deficiency began to emerge as our main obstacle to good video conferencing: a poorly designed broadcasting room at both sites. This is a critical operational component for video conferencing (see SURA Video Development Initiative 1999). The factors that detracted from effective transmission were:

- shape and size of room including ceiling height.
- color of walls and furniture.
- lighting systems and room-darkening devices.
- audio amplification and interference.
- placement of system components.
- conformation/location of instructor platform and general access to instructional devices/student view.

A consultant was hired to conduct a full analysis of the environmental problems and a complete, prioritized report was submitted. Some recommendations have been implemented and the whole program is currently in review.

Installation of a third-party sound system improved audio range at both sites. Indirect and diffuse lighting adaptations were also made. Another major improvement was accomplished by arranging the video devices so that the instructor is looking at both audiences at the same time, while allowing both audiences a direct view of the instructor. This requires that the camera be placed directly in front of the instructor's designated space (suspended in some way from the ceiling, or mounted within the local audience). Two video displays are required: one behind the instructor large enough for the local audience to see (we use a large projection screen) and a second video monitor placed in front of the instructor and behind or above the local audience.

Limiting the instructor's movement to a specific zone allows for much more reliable audio and camera tracking. The system components were relocated within the broadcast area so that the instructor had easy access to peripheral devices, such as the document camera, to effectively shift the teaching format while maintaining direct contact with the audience (see Zielinski 1998 & Parker 1999).

We learned that effective communication between all support staff and faculty is a vital requirement in planning and developing a successful program (see Boaz et al. 1999 & Hardwick 1997). For example, it is very important that the staff involved with environmental and audio-visual media work closely with the computer and networking technicians. The placement of ISDN lines may limit the placement of the video conferencing equipment and peripheral devices within the broadcasting space. It is essential that those people designing and locating the A/V and instructional support devices work closely with the networking technicians who will locate the ISDN lines, in order to ensure that the full system is appropriately situated in the space for optimum teaching activity.

Faculty Training Issues

Time became a major issue in the proper implementation of the video conferencing system. Students were so displeased with the existing format of videotapes that directors of the program mandated that the first instructional broadcast would occur in less than five months after the equipment was chosen and purchased. This proved to be a woefully inadequate preparation period given the situation at MCPHS. In August of 1998 *none* of the following pre-requisites for interactive video conferencing existed:

- A specially designed or appropriately adapted room for broadcasting at both sites.
- Adequate number of support staff trained in this technology.
- Training in place for faculty (focusing on customizing courses for this format, practicing specific teaching/presentation skills for on-camera delivery, coaching on the use of the electronic components, and managing the new instructional environment).
- A vendor with past experience supporting this system configuration in this particular environment.

A one-day training session for faculty was not customized to the needs of higher education and was of little value in preparing to teach using the technology. Faculty faced the camera in January 1999 with little formal preparation on the *best practices* of successful video conferencing. In the meantime, a grant was funded for a 3-day, customized, formal training seminar. This program took place in April 1999 and was a success — exactly what was needed. The only obstacle was that faculty schedules were so fixed and heavy that only a small number could attend. Nonetheless, as a result of the training, several faculty and support staff are in place to coach those faculty who either couldn't attend the training or who later transitioned into video conferencing. It was obvious that customized, quality training is a lynchpin in any video conferencing program (see Boaz et al. 1999 & Bray 1999 & Weiss 1999).

The main issues in providing this type of training are (see Parker 1999 & Robbins 1997):

- Factor into the distance learning budget adequate funding for a quality training program, or secure funds from an external source.
- Work within the timeline and milestones of the overall project to ensure that faculty are comprehensively trained *before* the first time they have to teach via video conferencing.
- Announce the training event well in advance to allow faculty to work it into their calendar.
- If possible, have a plan for release time for some faculty who may need to have classes covered.
- Do a thorough needs-assessment of your faculty and accept only customized training.
- Expect that a good agency/consultant will conduct their own needs-assessment with you.
- Demand to talk with other higher education institutions that have utilized this training agency/consultant for the same kind of training.

The three-day seminar that was chosen by MCPHS focused on (see Pike & Arch 1999):

- An experienced consultant who modeled best practices.
- Innovative course design for video conferencing.
- Interactive, student-centered approach.
- Preparation of visuals for broadcast format.
- On-camera presentation/audience engagement skills.
- Assessment strategies for distance education.
- Many real-life, relevant examples.
- Opportunity to practice using the system.

The consultant provided participants with handouts, a practical workbook of activities, and a handbook of useful techniques and references. All participants delivered 10 minutes of instruction under live broadcast conditions. Each received individualized feedback and a videotape of their performance for self evaluation (see Hardwick 1997 & Robbins 1997 & Zielinski 1998).

As a result of the seminar, participants generated several sets of guidelines, including *When the Technology Fails: Guidelines for Creating Plan B*, *Basic Protocol and Etiquette for Video Conferencing Discussion*, *Guidelines for Conducting a Distance Learning Orientation Event for Students*, and *Guidelines for Guest Lecturers*. These documents have helped significantly in preparing faculty and also in focusing course coordinators and administrators on the special needs of teaching via video conferencing.

Teaching Experiences and Outcomes

Using video conferencing, five courses have been delivered to the adult learners in this program. Four of the five courses were team-taught and one was taught exclusively by an individual instructor. All courses in the program are structured to include didactic lecture sessions, interactive faculty-led sessions and student-based case discussions. The lectures and interactive sessions are delivered on Saturdays in the morning and early afternoon. For these sessions, the on-site and remote sites are connected via interactive technology. The case discussions, conducted using small groups of students in the late afternoon, do not require the use of video conferencing. The variety of delivery methods used in these courses, and the day-long duration of each course, requires much faculty planning for versatility in the classroom, and adaptation to new, interactive technology (see Hardwick 1997 & Pike & Arch 1999).

When the first team-taught course was offered in January 1999, the course coordinator was not teaching and was available to handle the technical complications that arose. Faculty members using this technology needed to adjust to a number of changes in lecture delivery including time delays, development of an on-camera persona, and adaptation of lecture material to distance learning (see Parker 1999 & Zielinski 1998). Faculty had to learn to deal with a five to ten second delay in transmission of her words to the remote site. This was difficult, even for faculty members who were accustomed to pausing between concepts to allow for students' questions. It seemed an unnatural amount of time for both the faculty member and the students on site. Furthermore, if students at the remote site had a question, it took the same amount of time for their question to be transmitted. The dialogue became cumbersome. Therefore, most faculty members built small group exercises into their lectures so that students could discuss issues among themselves and try to help each other in answering questions about the lecture material.

Faculty have tested the compatibility of a variety of audiovisual aids with this technology. We have found that PowerPoint presentations project well at both sites and allow students at the remote site to focus on visual representations of the lecture material and not solely on the instructor. We have also found it crucial to provide the students with very structured and detailed handouts (see Pike & Arch, 1999). If the visual projection is ever lost, students are still able to follow the lecture using their handout. Although many of us traditionally use overhead projectors to facilitate interactive sessions in large classroom settings, these projections are not successful using interactive technology. Instead, specialized equipment, such as a document camera, facilitates interactive learning. A limitation of the document camera is that the instructor is no longer visible to the students at the remote site. Because of this limitation and the fact that we have only one camera, it is essential to provide students with a structured handout which includes all graphics and interactive diagrams so that they can easily keep pace with the instructor.

Feedback

Initial comments about the technology from students at both sites were predominately negative. They felt that *videoconferencing was disruptive* and *adversely impacted on discussion during lecture*. Students at the Boston campus were frustrated with the *intrusion of videoconferencing* and students at the remote site were more passive in their participation. Students identified sound and video problems which needed to be resolved by an expert rather than by the work-study students who werc assigned to assist broadcasts. Although the work-study students were very reliable, they did not have the level of training to address the inadequacies of the system (see Boaz et al. 1999 & Carr 2000).

As of fall 2000, student feedback has much improved with only a few comments on course evaluations regarding the technology. Faculty have had mixed reactions to video conferencing. Some have adapted better than others to the technology and to the necessary changes they have had to make to their teaching style (see Kirchdorfer 1997).

Conclusions

Program Status

Overall, it has taken almost three semesters for the majority of faculty and students to become comfortable with the process. However, the system still is still not completely reliable and faculty must always have a backup plan in case of technology failure. To further maximize the process, all parties involved, particularly the faculty and technology support personnel, need to work closely together. Faculty need to keep informed of changes in the technology, the availability of new training sessions, and changes in personnel. In addition, the technology personnel need to be well informed of the faculty member's course planning and design requirements (see Boaz et al. & Hardwick 1997 & Robbins 1997).

Faculty Training

Faculty need training in interactive, student-centered course design and on-camera techniques for video conferencing (including hands-on practice) *before* they use the technology to teach. Adequate funding for customized, quality training must be factored into the overall project budget (see Bray 1999 & Parker 1999 & Robbins 1997 & Weiss 1999).

Broadcast Environment

A fully equipped, appropriately designed broadcasting room should be established and tested at each video conferencing site. This information is readily available on the internet (see SURA Video Development Initiative 1999 & Pike & Arch 1999), or from established vendors.

Orientation

Whenever a new group of students begins a program delivered via distance learning, a formal orientation program should be presented, *before* the start of classes (see Pike & Arch 1999). The orientation should take place within the chosen environment for delivering the program (e.g., conduct the orientation session via video conferencing if the instructional program will be video conferenced). This orientation should:

- deliver all necessary information about the structure and schedule of the program.
- describe the key elements of the chosen delivery format that differ from a conventional class.
- demonstrate the operational features of the equipment.
- discuss the roles and expectations of all participants (students, faculty, site facilitators, technicians).
- clarify rules and protocol for questions and discussions, as well as all vehicles of communication such as e-mail, internet, telephone, FAX.

Activities should be planned that help to introduce participants to each other and to the faculty and administrators of the program. *Plan B*, the backup plan that will go into action if a technology failure occurs, should also be presented (see Pike and Arch 1999).

References

Blumenstyk, G. (1999, July 23). Distance Learning in the Open University: the British institution's success has inspired imitators in the United States. *The Chronicle of Higher Education*.

Boaz, M., & Elliott, B., & Foshee, D. R., & Hardy, D., & Jarmon, C., & Olcott, D. Jr. (1999). *Teaching at a Distance: A Handbook for Instructors*. Mission Viejo, CA: League for Innovation in the Community College and Archipelago Productions.

Bray, H. (1999, April 11). Plugging in to the electronic campus. *The Boston Globe Magazine*, 20-30.

Carr, S. (2000, February 11). As Distance Education Comes of Age, the Challenge is Keeping the Students. *Chronicle of Higher Education*, Section: Information Technology, p. A39, http: // chronicle.com/weekly/v46/i23/23a00101.htm.

Graves, W. H. (1996, September/October). Why We Need Internet II. *Educom Review*, 28-31.

Grossman, W. (1999, July). On-Line U. *Scientific American*, Cyber View section, 41.

Hardwick, S. W. (1997, October). Distance Learning Goes Global: A Faculty Perspective. *Distance Education Report: Special Report on Videoconferencing*, 1-4.

Kirchdorfer, U. (1997, September). Teaching College Courses to High School Students Via Compressed Audio and Video. *Distance Education Report*, 1-3.

Parker, A. (1999, Autumn/Winter). Interaction in Distance Education: the Critical Conversation. *Educational Technology Review*, 13-17.

Parks, E. (1999, August). When they say, 'WBT is not for me'. *The Lakewood Report on Technology for Learning*, 5 (8), 4.

Pike, R. & Arch, D. (1999). *Creative Training Techniques for Video Conferencing Workbook*. Minneapolis, MN: Creative Training Techniques Press.

(1998). *Profiles of College and University Distance Learning Programs*. New York, NY: Primary Research Group, Inc.

Robbins, C. (1997, December). Training Faculty to Teach at a Distance. *Distance Education Report*, 1-3

Schneider, A. (1999, June 14). Association Urges Greater Voice for Professors in Distance Education, *Chronicle of Higher Education*: Daily news, http: // chronicle.merit.educ/infotech/.

SURA Video Development Initiative, (1999, September 14). *Video Conferencing Cookbook*, http: // sunsite.utk.edu/video_cookbook/.

Wagschal, P. H. (1998, July). Distance Education Comes to the Academy: But Are We Asking the Right Questions? *Distance Education Report*, 1-3.

Weiss, K. R. (1999, April 8). California Virtual University Has a Collision With Reality. *Los Angeles Times*, Home Edition, ID: 0990031667.

Zielinski, D. (1998, February). Bringing Out the Actor Within. *Presentations*, 42-52.

TRIAD: Tactical Readiness Instruction, Authoring, and Delivery

James E. McCarthy
Sonalysts, Inc.
215 Parkway North
Waterford, CT 06385
mccarthy@sonalysts.com

Michael Hannafin
Learning and Performance Support Laboratory
University of George
611 Aderhold Hall
Athens, GA 30602
hannafin@coe.uga.edu

Terry Stanard
Klein Associates
1750 Commerce Center Blvd. North
Fairborn, OH 45324-3987
terry@klein-inc.com

Paul Radtke
Naval Air Warfare Center, Training Systems Division
12350 Research Parkway
Orlando, FL 32826-3224
radtkeph@navair.navy.mil

Abstract: Decision-makers within the U.S. Navy must command vast quantities of information. The bulk of this knowledge is accumulated through personal study of written documentation including Tactical Memoranda (TACMEMOs). This paper describes the theoretical and technical underpinnings of the Tactical Readiness Instruction, Authoring, and Delivery (TRIAD) project, an effort designed to improve the usability of these documents.

Introduction

Decision-makers within the U.S. Navy are faced with increasingly complicated and stressful tactical environments. These environments are characterized by situational uncertainty, time compression, and capable adversaries. To cope with such environments, today's decision-makers must have absolute command of a vast and varied knowledge base. The decision-maker must be familiar with situational cues, own ship capabilities and limitations, those of potential adversaries, tactics at his or her disposal, and those that potential adversaries might employ.

Some of this knowledge comes from formal training. However, the bulk of it is developed through experience and through personal study of tactical publications (including Tactical Memoranda [TACMEMOs]) and combat system doctrine (Cannon-Bowers, 1995; Cannon-Bowers *et al.*, 1994). In this work, we focus on TACMEMOs.

TACMEMOs are developed to provide Fleet personnel with the information necessary to employ a new tactic or tactical concept. They are often developed by relatively junior officers. These officers (and their support staff) may be knowledgeable in the tactical subject-matter in question. However, they have little or no training in effective technical writing or instructional design. Moreover, the documents that are produced suffer from shortcomings that are common in many technical documents: passivity, linearity, and poorly represented spatiotemporal relationship.

We began the Tactical Readiness Instruction, Authoring, and Delivery (TRIAD) project to develop a set of authoring and delivery tools that will enhance the quality of tactical guidance.

Development Context

TACMEMO development begins with the identification of a tactical deficiency and development of a tactical solution that addresses that deficiency. The resultant tactic is disseminated to Fleet units via a TACMEMO.

TACMEMOs are written by middle grade officers with operational experience relative to the assigned tactical project warfare area. These individuals possess a minimum of a bachelor's degree, and at least some computer skills. They are supported by a staff of senior petty officers, and civilian editors and production specialists. In some cases, tactical project officers may receive analytical support from civilian contractors or government laboratory engineers/representatives.

Project officers are provided with structural guidance[1] (*i.e.*, the sections that a TACMEMO should include, and the order of those sections). However, they are provided with little or no guidance as to how to author a document that efficiently communicates the tactic.

Once written, TACMEMOs are read by personnel ranging from flag-level commanders (*i.e.*, Admirals) down to junior enlisted personnel. At every level, readers must balance the need to read and understand new TACMEMOs against the press of their other responsibilities. Their task is made more difficult by documents whose format is not consistent with the reader's needs. We recently queried a group of readers on their use of TACMEMOs. Within this group, TACMEMOs are used extensively as reference documents and are rarely studied. Only one participant indicated that he often read the body of the TACMEMO. Most indicated that they did so on occasion. The remainder indicated that they did so rarely if ever. By contrast, a large majority of participants indicated that they consulted TACMEMOs during operations.

It is within this context that TRIAD must operate. In designing TRIAD, we must create tools that augment authors' typical communication skills to produce documents that meet the task-demands of readers.

TRIAD Overview

The personal computer (PC)-based TRIAD system is being designed and developed to:

- Provide authors with the capability to create an effective multimedia learning environment to support the transfer of tactical knowledge to readers; and
- Provide readers of tactical documentation with a product that addresses their need for efficient and effective tactical documentation that is easy to use and supports self-training.

In this regard, TRIAD will provide authors with an integrated tool set to enable them to create tactical documentation (*i.e.*, TACMEMOs) using a variety of multimedia presentation techniques, and to create associated interactive multimedia instruction (IMI) to support the documented tactic/doctrine. In turn, readers will receive a multimedia tactical documentation "product set" that supports tactic/doctrine presentation and briefing, instruction, quick reference, and facilitation of electronic feedback regarding tactic/doctrine evaluation.

After a tactic has been defined, but before it has been documented, the author uses TRIAD to create a product set. The process consists of three stages: interview, edit, and review.

During the *interview stage*, the author creates and/or imports media regarding the tactic in response to interview questions. For example, the author might be asked to define the tactic (text), describe the tactic using an illustration (graphics), generate a scenario that supports practice (simulation), and/or import a video that shows tactic evaluation results. As the interview progresses, the TRIAD system adds the information provided by the author to its database.

Using the information gained from the interview, the TRIAD system automatically generates a draft TACMEMO product set consisting of the following components: Base Document (core TACMEMO), Tactic Training Component, Quick Reference Guide (QRG), Feedback, and Brief (PowerPoint® presentation).

Once the interview is complete and the draft product set generated, the *edit stage* commences. Here, the author is presented with the draft product set, and can choose to edit any or all of the product set components. He can add

[1] Often, even this minimal guidance is violated.

new media and edit existing media (text, graphics, animation, simulation, *etc.*). The author can import related media from the local TRIAD database, or from a remote database, into a product template and then edit as desired.

The *review stage* commences after all TACMEMO product set components have been developed. The TRIAD system will integrate the components into a review document with all associated markings. This review version can be distributed via multiple means (paper, local area network (LAN), wide area network (WAN), disk, *etc.*). Reviewers will be able to comment within the document and return these comments to the author. Comments received electronically will be stored in the TRIAD database for use by the TACMEMO author to revise components as required. The capability to merge comments into the document will be provided. Comments received on paper will be utilized by the author to revise components as required. As in the edit stage, the author can create/import new media and edit existing media (text, graphics, animation, simulation, *etc.*) in response to review comments.

This process of assembling the product set components into a review document, distributing the document for review, incorporating review comments, and reassembling the product set can repeat as necessary until a final product set is approved. Upon completion of the review process, the TRIAD system will assemble the TACMEMO product set for final packaging and subsequent distribution to readers (compact disk/digital video disk (CD/DVD) or LAN/WAN). TRIAD will support document version control throughout this process.

A reader will receive the TACMEMO in an appropriate electronic format, and will be able to access the multimedia TACMEMO product set (Base Document, Tactic Training, QRG, Feedback, and Brief).

Authoring Component

Although TRIAD will produce a product set that includes much more than is normally considered "training," we conceptualize it as an instructional design task. As such, TRIAD must automate the instructional design process. As Reigeluth (1993) noted:

> Automating could entail anything from providing a few tools for an instructional designer to use, to entirely replacing the instructional designer. It generally does not refer to replacing the subject-matter expert. The instructional design process could entail anything from the instructional strategy selection process . . . to the entire spectrum of phases . . ..

Theoretical Foundation

Instructional design theories relate instructional conditions (student and subject-matter attributes), instructional methods, and instructional outcomes (Reigeluth, 1983). Our focus is on prescribing instructional methods to produce instructional outcomes (given certain instructional conditions). More generally, this could be rephrased to say that we want to devise communication methods that will produce performance outcomes.

A number of others have investigated the process of automated instructional design and TRIAD can certainly benefit from their work [see, for example, Spector, Polson, & Muraida, (1993)]. In general, two classes of authoring systems have emerged.

The first approach seeks to provide instructional design assistance and coaching during development. Gagné's Guided Approach to Instructional Design Advising (GAIDA) provides one example of this approach (Gagné, 1993). Using information about students, the task, and the environment, GAIDA guides instructional designers through a four-step process of instructional design. Tennyson (1993) offered a similar, albeit more ambitious, approach. He proposed to develop a system that could coach novice users through specific development problems while developing their ISD background. The same system would simply offer advice to more experienced users.

The guidance/assistance/coaching approach is relatively easy to implement and may be applied to a variety of design situations. However, it does require the developer to acquire, interpret, and apply instructional design principles while in the process of development. In the TRIAD context, our authors seldom have the background necessary to use such a tool effectively. Such an approach might impose a significant learning requirement on the authors while not ensuring compliance with instructional design guidance.

An alternative approach is to provide restrictive template structures as the primary mode of development. Merrill's Electronic Trainer provides a good example of this approach. Within Merrill's approach (1993), the author uses a defined grammar to specify the training environment and curriculum. Expert systems are then used to select, sequence, and partially populate the appropriate instructional transactions.

The use of a template structure removes many of the burdens imposed by GAIDA. Instructional design prescriptions are built into the templates. Therefore, authors do not have to mastery this material themselves and compliance is assured. However, such systems can be complex to operate and the selection of appropriate templates is not always obvious.

TRIAD developers have selected a hybrid inquiry-based strategy. Within our approach, the majority of development occurs through the use of implicit templates. That is, the templates are used to guide an interview with the author and to organize the resultant content. This approach has the benefits of Merrill's template approach, while hiding much of the complexity from the author. It ensures a high-level of compliance with theoretically sound instructional design principles without requiring the author to master those principles.

Design Summary

The various theoretical perspectives on decomposing content, establishing learning objectives, and associating learning objectives with communication strategies embodied within TRIAD can be summarized in an overarching design approach. The TRIAD team has organized this approach into three interview-stage phases: Pre-planning, Initial Query, and Elaboration/Augmentation. Each phase satisfies an important goal for the authoring process.

During the *pre-planning phase*, TRIAD guides the author to establish the basic framework of the TACMEMO product set. That is, starting with a metaphorical "blank sheet of paper," TRIAD helps the author to identify the primary content areas which must be explored in the product set. This establishes a framework on which later authoring functions can elaborate.

More specifically, the Pre-Planning phase has two goals associated with it. The first goal is to help the developer begin to mentally frame the content of the TACMEMO to be written. TRIAD should not only solicit information from the developer, but also help the developer organize his/her thoughts about the TACMEMO as it is being developed. This will facilitate an active, rather than passive, participation of the developer within the interview.

After considering a range of pre-planning options (full case-based retrieval, exemplar case-based retrieval, TACMEMO taxonomy, traditional knowledge elicitation probes, and scenario-based development), the development team determined that the development of a TACMEMO taxonomy was most feasible. This method relies on the development of a TACMEMO taxonomy that is used by the developer to classify the TACMEMO to be written. The taxonomy decomposes each classification several layers deep, permitting the developer to select those elements applicable to the TACMEMO to be authored. To succeed, it must be possible to classify existing TACMEMOs into a finite number of categories. For TRIAD, we were able to develop on a three-tier taxonomy: categories, anchors, and sub-anchors.

Next is the *initial query*. The base document represents the primary communication of the tactic and the central product set component. Therefore, step one of the initial query combines sub-anchors into various base document sections and sub-sections. TRIAD will support the author in this process as well as guiding the author to generate a performance goal and associated title for each section[2].

After reviewing the base document structure, the author will be supported through the process of creating base document content. For example, TRIAD will provide guidance based on effective technical writing techniques, appropriate content sequencing and media selection (based on performance goal verbs).

At this point, authoring will transition from the Base Document component to the Tactic Training component. Together, TRIAD and the author will identify Base Document sections that can benefit from associated instruction. These are likely to be sections that are sufficiently complex or that rely on doubtful background knowledge.

[2] It should be noted that this focus of performance goals within the base document is likely to lead authors to create a "leaner" and more usable document than was common in previous, unguided attempts.

In any event, when a section is earmarked for instructional support, TRIAD will guide the author through the process of creating verb-based learning objectives. Next, the author will be guided to create assessment items, instructional material, and practice items in support of each objective. This process will work up from content sections to include both lesson- and module-level instruction.

Similar processes will be applied to derive the quick reference guide, Feedback, and Brief components.

When done with the initial query, the author will have produced a complete, albeit immature product set. The maturation process occurs through elaboration and augmentation.

The *Elaboration/Augmentation* (E/A) process is applied in the final stages of TRIAD document authoring. The process consists of three strategies: confirming, elaborating, and fine-tuning. These strategies are designed to help authors refine and augment content. They are applied iteratively.

Confirmation assists authors in validating content accuracy and completeness as well as confirming TRIAD-generated structures and sequences. Confirmation is critical because it safeguards the accuracy of both the content and structure of TRIAD-generated documents. *Elaboration* helps authors to extend, amplify, and otherwise augment TRIAD documents. Authors elaborate and add detail descriptions and supporting examples, especially those considered critical to the user's knowing and implementing the tactic. *Fine-tuning* enables the author to clarify information, directions, instruction, and presentation. At this step, the author amplifies key information, reducing or eliminating ambiguity and unclear or non-essential information.

The E/A process is grounded in a set of partially overlapping foundations. E/A in the Base Document is grounded in seven foundations: text structure, text design, text augmentation, usability/transferability, technological, cultural, and pragmatic. In the Tactic Training component, E/A is grounded in five foundations: psychological, pedagogical, technical, cultural, and pragmatic. In both cases, these foundations ultimately help authors develop and fine-tune structure and content drafted during the initial query.

The interview process will create a variety of interconnected content. TRIAD needs a robust process for organizing, maintaining, and using that content. To meet this challenge, we have adopted the use of knowledge objects.

One can think of knowledge objects (sometimes referred to as learning objects or sharable courseware objects) as boxes with labels. The label on the outside of the box tells everyone about the contents inside the box. Knowledge object boxes may contain other boxes, or real contents. As such, the knowledge objects provide an elegant way to store and organize the contents of our TRIAD product sets. The labels help in the organization function. The labels also make it possible to look for a box (knowledge object) that contains desired content.

Delivery Component

An elegant authoring process is of little use if the content is delivered to the reader in a form that fails to meet his or her needs. TRIAD will build on Internet technology to create a robust, user-sensitive, and flexible delivery environment. Here, we describe how TRIAD delivery components will rise to meet this challenge.

Enabling Technology

An understanding of how content will be delivered to the user requires an understanding of three component technologies.

As noted abovc, we will be using knowledge objects to organize the output of the authoring stage. In the delivery environment, however, we make use of an Extensible Markup Language (XML) representation of the content. A transformation process will transform knowledge objects into the TRIAD XML representation. XML is a mark-up language that describes the functional/semantic parts of a document (titles, headings, paragraphs, warning, cautions). XML is well suited to the task of representing the structure and interrelationships inherent in a body of content. An XML representation of content is independent of how that content might be rendered to a user.

To render the content, TRIAD will use Dynamic Hypertext Markup Language (DHTML). DHTML is a good tool for rendering content in a browser-based environment and for supporting simple types of interactivity. It is poor at facilitating the storage of content, its content, and its inherent interrelationships. TRIAD needs a mechanism to translate the XML representation of the content to its DHTML representation[3]. The Extensible Style Language (XSL) provides a vehicle for that translation. Stylesheets, written in XSL, describe how different elements of the XML representation are to be rendered. That is, the XSL stylesheet works as a map between XML elements (defined through a document type definition; DTD) and DHTML representations.

Design Summary

Internet browsers are "stateless machines." That is, they can follow links from one place to another, but they are not designed to have memories about users or their actions. Such a memory is critical to several TRIAD functions. For example, the TRIAD "Quick Pick" TACMEMO list, notes, bookmark, and highlight functions are all user-specific and depend on the system's ability to recognize a given user. Similarly, the functioning of the Tactic Training component and the management of administrative privileges all depend on user-specific information.

To provide that functionality, TRIAD has adopted a three-part architecture. The most obvious part of the architecture is the browser itself. TRIAD will delivery product set material to the reader through an Microsoft® Internet Explorer 5.0 browser. Rather than operating in a "stand-alone" fashion, the browser will be hosted within a secondary application, the "Presentation Engine". The Presentation Engine is a piece of "middleware" that serves as a communication bridge between the browser and the third important piece of software, the "Delivery Engine". The Delivery Engine is responsible for the bulk of TRIAD delivery functionality. This includes activities like maintaining user data, managing information access, preparing knowledge objects for delivery, and system administration.

References

Cannon-Bowers, J.A. (1995). Application of Multimedia Technology to Training for Knowledge-Rich Systems. Technical Development Plan. Program Element PE0603733N.

Cannon-Bowers, J.A., Salas, E., Duncan, P., & Halley, E.J. (1994) Application of Multimedia Technology to Training for Knowledge-Rich Systems. Paper Presented with 13th Interservice/Industry Training Systems and Education Conference. Orlando, FL.

Gagné, R.M. (1993). Computer-Based instructional guidance. In J.M. Spector, M.C. Polson, & D.J. Muraida (Eds.), Automating instructional design: Concepts and issues. Englewood Cliffs, NJ: Educational Technology Publications.

Merrill, M.D. (1993). An integrated model for automating instructional design and delivery. In J.M. Spector, M.C. Polson, & D.J. Muraida (Eds.), Automating instructional design: Concepts and issues. Englewood Cliffs, NJ: Educational Technology Publications.

Reigeluth, C.M. (1993). Functions of an automated instructional design system. In J.M. Spector, M.C. Polson, & D. J. Muraida (Eds.), Automating instructional design: Concepts and issues. Englewood Cliffs, NJ: Educational Technology Publications.

Reigeluth, C.M. (1983a). Instructional Design: What is it and Why is it? In R.M. Gagné (Ed.), Instructional Technology: Foundations. Hillsdale, NJ: Lawrence Erlbaum Associates.

Tennyson, R. D. (1993). A framework for automating instructional design. In J.M. Spector, M.C. Polson, & D.J. Muraida (Eds.), Automating instructional design: Concepts and issues. Englewood Cliffs, NJ: Educational Technology Publications.

Acknowledgments

This work was supported under contract N61339-98-C-0058 from the Naval Air Warfare Center, Training Systems Division. The authors wish to thank their colleagues for their contributions to this project.

[3] This notion of separating content from rendition is a powerful one within TRIAD. For example, a given idea could be represented in a single XML representation. However, it could be rendered for the user in a number of formats across TRIAD's product set components.

Evaluating the Influence of Web Based Seminar Preparation for Undergraduate History Students

Pauline McCormack, Teaching and Learning Support Unit, University of Newcastle upon Tyne, UK, pauline.mccormack@ncl.ac.uk

Dr Donald A Spaeth, Modern History, University of Glasgow, UK, d.spaeth@modhist.arts.gla.ac.uk

Abstract
This paper discusses the implementation of web-based primary sources in two undergraduate history modules at the University of Glasgow, Scotland. It outlines the purpose of implementing Information and Communications Technology (ICT) and the different approaches taken by lecturers to the use of computer assisted instruction. The implementation employed a range of evaluation instruments both quantitative and qualitative, before and after the modules were taught. The results of the evaluation and the implications of the findings are debated.

Introduction

The School of History and Archaeology at the University of Glasgow recently injected the use of Information and Communications Technology (ICT) into its Level Two history courses in order to introduce all its history students to the potential of computer networks and access to sources. It is hoped that the exposure to ICT will provide a prelude to specialist honours Historical Computing courses which deal with more advanced methodological applications of computers.

The IT Committee of the School had been working on this implementation since the move from full year courses, to a modular system of ten week courses, in 1996.[1] It had already ensured the introduction of a School policy which stated that the completion of at least one assessed, computer-based unit within a Level Two course will be a prerequisite for entry into honours in a student's third year, and had run a pilot scheme with one lecturer. 1998 though, saw a number of other developments which were to give a boost to this policy:

1. The complete redesign of the Level Two modules with a new aim to increase students' familiarity with primary sources and to give them skills in interpreting such sources critically. This was entirely independent of any development in ICT and indeed some tutors chose to use paper primary sources like examples of palaeography and works of art in local galleries.
2. The completion of twelve multi-media, history tutorials for use in undergraduate teaching, by the national Teaching and Learning Technology Program (TLTP) History Courseware Consortium which provided the project with a rich starting point in terms of available sources.[2]
3. The founding of the successor to the TLTP project, the Courseware for History Implementation Consortium (CHIC)[3], set up to provide funds and pedagogical advice to UK Universities embedding the tutorials into undergraduate history teaching.

A successful grant application to the CHIC project enabled the provision of in depth support for implementing and evaluating a range of resources within the new modules which were: European Society from 1550 to 1700 (Early Modern); and Society, Culture, Politics and Power in North America from First Contact to the Present (America). The Early Modern module would take place during the first semester with around 200 students registered and the American module was to be taught in second semester to circa 220 students.

The main business of the project was to introduce students to the use of on-line sources to prepare seminar topics but other parts of the project set up data analysis exercises, multi media lectures and a computer mediated conferencing system.[4]

One of first issues to deal with was the different approaches between the two courses, and within the Early Modern module, the differing approaches of individual lecturers, regarding the presentation of the sources and the extent of the skills that would be introduced to the students.

Early Modern

Not all the students who enrolled of the Early Modern module used computerised sources. Five tutors took seminar groups and decided their own seminar topics, of these five, only two made the use of web-based sources mandatory. Both of these tutors were highly directive in the instructions they gave to their students. They presented the students with a small number of primary sources per seminar, pre selected from the TLTP tutorials, prefaced with questions that the students should consider for the seminar. Figure 1.shows a section of the instruction for one such seminar question.

> Toulouse is a provincial city located in the south-west of France. For five days in May 1562 the streets of Toulouse were the location of religious violence which led to the deaths of many people. Such violence in Toulouse and other cities demonstrated the explosiveness of the political and religious situation in France. It was the prelude to the outbreak of the French Wars of Religion and a foreshadowing of more famous violence such as the St. Bartholomew's Day Massacre of 1572.
>
> The Reformation was born in Germany in the 1520s. It did not take it long to spread to France, aided by the proximity of the Protestant city of Geneva, home of Jean Calvin. Try each of the following links to find out more. (Remember to use the Back button to get back here.)
>
> The growth of Protestantism can be studied by counting prosecutions for heresy.
>
> • 07.27 Background of accused heretics.
>
> The distribution of Protestantism can be studied through the origins of refugees from France who went to Geneva. (Toulouse is in south-west France.)
>
> • 07.29 The Geographical Spread of Refugees from France to Geneva.

Figure 1: Screen shot from the Early Modern Seminar Preparation page.

One of the tutors conducted some timetabled seminar sessions in the computing labs on the subject of Migration in Early Modern England, where the students were introduced to raw data and to data handling. (The students in these seminar groups explored the sources more deeply and employed higher levels of computing skills than any of the other students.) The second Early Modern tutor requested that his students work through the seminar preparation materials in their own time, with help available from Graduate Teaching Assistants (GTAs) during drop in sessions.

America

The lecturers on the America module co-operated regarding seminars so that all students covered the same seminar subjects and were required to use on-line sources for seminar preparation throughout the module. The TLTP tutorials were only two of a large bibliography of web links. The students on this module were given far less direction than those on the Early Modern module, but rather were presented with the URLs of four or five comprehensive sites, for each seminar. Figure 2 shows the links for one particular seminar.

America as a World Power

- The Great Powers and the Division of Europe (only available locally in the Art
- Albert Beveridge, "The March of the Flag" (1898)
- William Jennings Bryan, "Imperialism" (1900)
- John Dewey, "Imperialism is Easy" (1927)
- Woodrow Wilson, 14 Points (1918)
- Franklin Roosevelt and Winston Churchill, "The Atlantic Charter" (1941)
- Harry Truman, "Address Before Congress" (1947)

Figure 2: Screen shot from the American History Seminar Preparation page.

Like some of their Early Modern peers, the students of American history were provided with drop in lab sessions supervised by a GTA and had to use the web resources in their own time. They were also given access to an on-line conferencing system and attended multi-media lectures.

Before this article proceeds, a quick word about GTAs, on whom tutors relied extensively to support undergraduates during their seminar preparation. The GTAs were all PhD history students and three of the four GTAs held on MPhil qualification in historical computing. In addition to this each GTA was provided with four hours paid training solely on the web-based sources that the undergraduates were using.

Evaluation

A full evaluation was undertaken with students returning questionnaires on their attitudes to computers and computerised sources before and after they studied the modules. Post course qualitative interviews were conducted with a selection of students and with all staff. Observations were undertaken of laboratory based seminars, classroom based seminars, and a classroom based seminar with students who did not use any ICT in seminar preparation.

The purpose of the evaluation was to identify the best methods of embedding computer-based resources into the courses in order to give the students a deeper and richer learning experience. Inevitably, much of the evaluation focused on student reaction to the computer-based resources and how this compared with their reactions to traditional resources and activities such as lectures, seminars, note-taking, and paper-based materials. Gauging student reaction involves determining more than whether students 'liked' the materials, but whether they found the materials were appropriate to their study approach and whether the technology served as an obstacle to learning. Since the aim of teaching is to enhance student learning, another important aspect of student learning is whether students have a sense that they understood the historical content better. A final component of the evaluation was to assess whether the approach to implementation was effective and, where possible to compare approaches.

Pre-Module Results

The first questions in the pre module questionnaire attempted to measure the students' perception of their level of computer skills against a more formal gauge of software competency decided by the questionnaire designer. Students' assessment of their own skills did not match reality, while 75% professed themselves as having moderate or substantial experience, 89% were actually found to be competent or very competent in software use. When asked about how confident they felt using computers, only 60% of all students and only 50% of the Early Modern students professed to be confident or very confident.

One theory is that this is due to modesty, typical of British students. It is perhaps modesty combined with a lack of experience with computers and different ideas about what constitutes competence. The study was measuring whether students possessed the skills which would allow them to take part in this particular project without further training, eg: experience of web use and word processing. Students perhaps recognise that these are not high level computing skills and it's possible that our measure of competence was relatively low.

When it came to student training it was surprising that only 45% had acquired their skills on the freely provided University Basic IT Certificate course. This means that students are coming to University already skilled or are picking up the skills via peers or self study.

When questioned about their attitude to the use of computerised history sources 58% of Early Modern students were found to have a positive attitude, against only 32% of America students. This can be explained by that fact that the Early Modern students were self selecting as they signed up for the seminar of their choice and could have studied a seminar topic which did not involve the use of ICT. It is interesting that the Early Modern group were less confident but more hopeful about the experience and this contrast is illustrated in figure three below. The proportion of America students who expect a negative experience is alarming but also fits with the generally pessimistic attitudes discussed above. To go beyond conjecture on such issues the evaluation needs to be extended to cover pre course qualitative studies.

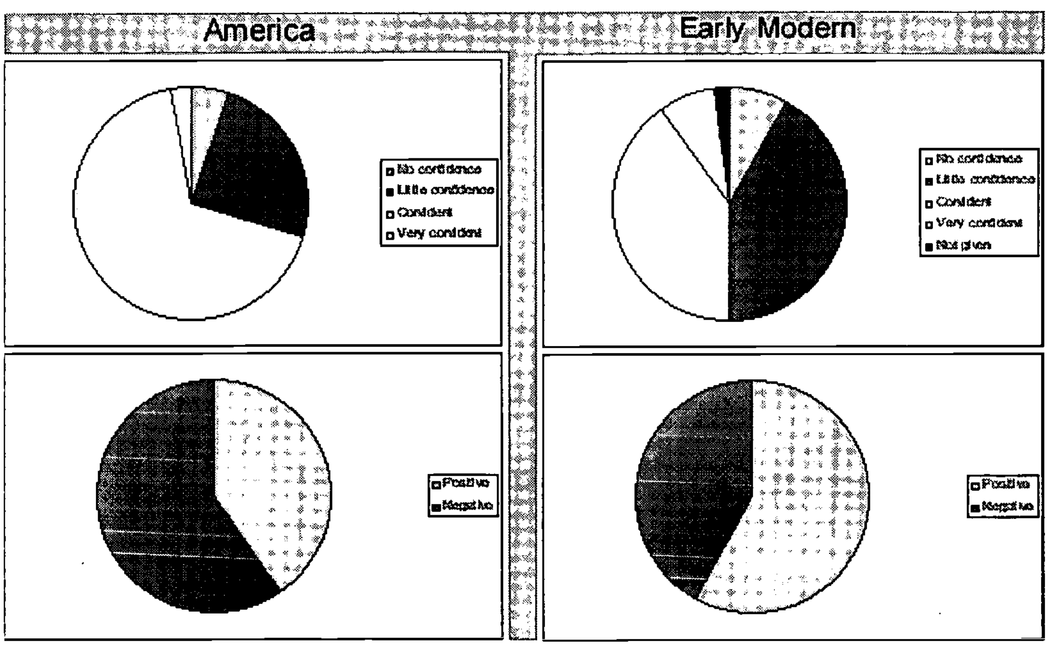


Fig 3: Graphs of Students' Pre-Course Attitudes to Using Computers

In summary, there were two key points from the pre course questionnaire: firstly higher proportions of UK students are coming to University with ICT skills each year, and this trend is expected to continue; secondly, students still lack confidence in using ICT and it is therefore crucial to provide adequate documentation, support and guidance as well as assurance.

Post Module Results

The post module questionnaire provided information about three sets of questions:

- How did students use the materials?
- How easy did students find the computer-based resources? Did the technology come between them and the subject? Did they have any particular difficulties?
- How helpful did students find the materials in learning about the historical subject? How did these materials compare with others they also were using?

While all of the students studying the Early Modern module actually used the on-line sources to prepare for their seminars, 4% of the America students did not use a computer at all. This difference is probably explained by the highly directive nature of the Early Modern resources whereby the questions, issues and sources related to the seminars were contained on the course web page and nowhere else.

Students were asked whether they had sought help or advice from anyone, including from friends, or neighbours in the computing labs. 70% of students sought no advice at all and almost all of these attributed this to the ease of use of the materials.

The requests for assistance were highest among the Early Modern groups which participated in laboratory based seminars where 50% requested help. Not only were these students undertaking more involved skills based tasks but, being in a lesson with their fellow students and with GTAs meant they automatically turned a peer or teaching assistant for help. Observing one of these seminars it was found that the students ask for help with the historical questions and well as with computing problems. The observation also found that, in contrast with classroom based seminars where the majority of the discussion is directed to and mediated by the tutor, in a laboratory situation the students talked constantly to each other about the data they were analysing and their results. Such student to student interaction is encouraging.

Students rated the computer-based resources very highly. Only one student on each module said they would not recommend them to other students. When asked to compare the usefulness of computer-based materials with other types of resources, such as lectures, books, and their own notes, computerised sources received the highest rating in several respects with 99% of respondents rating these resources positively. In sum, students placed a higher value on computer-based resources than on any other, including traditional methods of delivering teaching. It should be noted that the evaluation was likely to be somewhat biased in favour of computer-based resources, in part because the students knew that they were participating in an experiment and in part because students had already received direct feedback from assessed coursework based on these resources, whereas they had yet to sit an exam (which concentrated primarily on lecture topics). Nonetheless, the highly positive reaction to the computer-based materials is a significant finding.

Students were asked which resources they found most and least helpful. The answers to these questions were less insightful than had been hoped because some students regarded the computer or the computer-based tutorial as a single resource. Their answers therefore provide more insight into student views of the computer than about their approaches to learning. Nonetheless, students identified particular features they valued, including personal histories (i.e. autobiographies) and witness reports, and the analytical advantages of graphs and tables. Clearly, students valued the greater understanding they gained through personal evidence that helped bring the past to life, and the summaries provided by descriptive statistics.

Qualitative analysis via focus groups gives more insight into the differences between the two pedagogic approaches. As might be expected, those students who participated in timetabled lab sessions reported higher level learning outcomes than the remaining students. In general, students on the Early Modern module assert as positive aspects such things as, forming one's own interpretation based upon an assessment of the evidence, or as some of the students put it, they felt as though they were 'doing' history. The Early Modern students also felt a sense of ownership and relevance about the computer-based materials and they appreciated the amount of preparation they had been spared by being presented with a set of materials which were put together especially for their seminars[5].

In contrast some of the America students felt the presentation of their materials lacked direction and there were too many resources for them to consider fully. It can of course be argued that the location, selection and assessment of the probity of sources is as much a part of historical methodology as is the analysis and use of a source to answer a historical question. This though must be balanced against the amount of time a student would spend searching for a source in what is essentially an introductory exercise. The most positive aspect of the project for the America students was that the computer-based resources were more widely accessible than library based materials.

Conclusions

The evaluations of both modules have in common four key findings:

- Students appreciated the availability and diversity of the computer-based sources. Not only were the materials more easily available than books from the library, but they provided a stimulating range of sources which would not otherwise be available. Students enjoyed being able to access images, facsimiles and sound as well as texts, and being able to compare contrasting or contradictory evidence.
- Even though some America students felt there were too many resources for them to explore, the majority of students valued the fact that the resources were directly relevant to the seminar subjects.
- It was recognised that the diversity and relevance of the resources offered increased opportunities for deep learning.
- It is crucial that students are provided with adequate training (at least one class hour) and with support in lab sessions throughout the module.

From the post module evaluation then we can see that students' negative expectations of the experience of using ICT in seminar preparation were not borne out the evidence and this is a heartening vindication of the teaching team's belief in being able to deliver a richer learning experience through this project. It would be advantageous to further teaching to undertake qualitative evaluation which attempts to locate the roots of these negative expectations and recommend ways in which the teaching of ICT can be introduced so as best to allay students' fears at the earliest possible opportunity.

Acknowledgement

The work of Ms A Gow is acknowledged.

---

[1] The background to this process is described in McCormack, P, The Pedagogical Issues Surrounding the Teaching of History with Computers: Developments at Glasgow University, in Hillis, P (ed.) Information Technologies in History Education, 1999.
[2] http://www.gla.ac.uk/~histtltp/
[3] http://chic.tees.ac.uk/
[4] A HyperNews system provided by Clyde Virtual University, http://cvu.strath.ac.uk
[5] Having said that, the seminar topics themselves were actually designed to fit around the primary sources that were available.

Using Instructional Technology: What do the students think?

Cynthia L. McCourt
George Mason University
4400 University Drive, MSN 5E7
Fairfax, VA, 22030
cmccourt@gmu.edu

Sharon Alayne Widmayer
George Mason University
4400 University Drive, MSN 5E7
Fairfax, VA, 22030
swidmaye@gme.edu

Abstract: After implementing WebCT at Mason, the staff of the Instructional Resource Center were interested in determining if students were benefiting from the use of this tool. Twenty-five (25) surveys were collected from a group of graduate students using WebCT. The overall findings were positive and in favor of WebCT. The majority of the students indicated that the online tools provided by WebCT were beneficial to the learning process. Further studies should be conducted to see if a general population of students would yield different results.

Introduction

In January 1999, George Mason University began using WebCT, an online course management system designed to facilitate the creation of web-based instructional material and instructional supports. Currently, WebCT is being used by some faculty and is considered to be in its early stages of implementation. Up to the present time, no systematic assessment of WebCT's implementation has taken place. This paper is the first step in a series of research efforts that address one of three major aspects of WebCT at GMU, student satisfaction with WebCT. The other two are faculty satisfaction with WebCT and institutional support for WebCT. These will be addressed in other papers.

Before beginning a discussion of the data collected on student satisfaction with WebCT, a brief exploration into the definition of an Online Course Management System (OCMS) is provided to establish a mutual understanding of OCMS.

Online Course Management Systems

Online course management systems (OCMS) can be defined many different ways depending on whom you ask. For example, Michael J. Albright (1997) describes OCMS as "integrated packages that provide content presentation, communication, assignment submission, testing, and management functions in a secure environment, easily accessible via a web browser." Murray Goldberg and Sasan Salari (1997), describe WebCT as "a tool that facilitates the creation of sophisticated World Wide Web-based educational environments. It does this in three ways:

- It provides an interface allowing the design of the presentation of the course (color schemes, page layout, etc).
- It provides a set of educational tools to facilitate learning, communication and collaboration.
- It provides a set of administrative tools to assist the instructor in the process of management and continuous improvement of the course."

Related Research

It is one thing to develop an OCMS and use it for either classroom support or full distance education; it is another to say it actually makes a difference in the learning process. The following research tries to flush out how students are reacting and learning via an OCMS.

According to the Institute for Higher Education Policy (1998) "There is a relative paucity of true, original research dedicated to explaining or predicting phenomena related to distance learning." (Page 2). Much of the body of research that does exist dealing with on-line learning "are more anecdotal than systematically empirical or critical." (Hara & Kling 1999). In addition Windschilt (1998, as quoted by Hara & Kling 1999) also notes that much of the published literature dealing with computer-mediated on-line instruction consists of descriptions of software or annodotal accounts of how technology was integrated in a course or classroom.

Much of the research that does exist dealing with on-line learning must be looked at with a critical eye, since potential threats to reliability are often present that are not addressed by the author(s). (The Institute for Higher Education Policy, 1998) These include author bias, especially since many of the authors are technology experts or teaching computer-related subjects (Goldberg, Goldberg, Dabbagh & Schmitt 1999) failure to take into account the affect that novelty may have had on student attitudes towards the technology (Goldberg, Goldberg, Pauley & Cunningham 1999, Merron 1998, Fong 1999), lack of a control group (Pauley & Cunningham 1999, Fong 1999, Dabbagh & Schmitt 1999, Pauley & Cunningham 1999), and lack of a random sample of subjects (Goldberg, Goldberg, Pauley & Cunningham 1999, Merron 1998, Fong 1999, Dabbagh & Schmitt 1999, Pauley & Cunningham 1999).

Keeping the above flaws in mind, let us look at what the research does say. Most of the existing research shows that there is no significant difference in student achievement and attitude towards instruction between classes using web-based instruction and those which do not (The Institute for Higher Education Policy, 1998; Morss. 1999). Schulman & Sims (1999), for example, found that there was no significant difference in posttest scores of the web-using and traditional instruction groups. Merron (1998) in his study of 3 courses using WebCT to varying degrees, found that student responses were overwhelmingly positive. All of the students wrote that they would take an on line course again. Students were especially impressed with the ability to log-in anytime, quality of discussions, breadth of discussions, and convenience. In studying accounting students' reaction to WebCT, Fong (1999) found that the students "perceived [WebCT] to be better than traditional course delivery methods in form of paper handouts and lectures in many course elements like course outline, course notes, assignments, presentations, readings & especially multiple choice exercises." (Page 60). The majority of these students also felt that learning with WebCT were either equal to or enhanced traditional learning methods, with approximately 50% stating that WebCT was "very beneficial" & "very useful."

In studies where student reaction to on-line learning was measured but not compared to student satisfaction with a traditional classroom, Pauley & Cunningham (1999) reported that 94% of the students survey would take another course using WebCT and 93% would recommend such a course to their friends.

However, Hara & Kling (1999) in their study of student frustrations with on-line learning noted problems such as the lack of non-verbal cues from face-to-face discussion, technical glitches, problems caused by student unfamiliarity with technological tools, lack of proper feedback & directions from instructor, and lack of accessibility to the needed computer equipment. Wermet & Oliges (1999) found that the length of the course was a factor in student satisfaction. They attributed this to the fact that in longer courses, students were more patient with technical glitches since they had were not as pressed for time in completing assignments. They also found that access– both in terms of access to the hardware needed and ease of use was a problem. Danchak (1999) found differences in student attitudes to WebCT based on experience with computers and age. Less experienced computer-users tended to enjoy WebCT more than more experienced users, a fact that the author attributed to a sort of "gee whiz" factor. In addition, older students were more likely to prefer on line quizzes than younger students. Danchak also found that the people who posted to the bulletin board most often disliked it the most, possibly because of frustration w/ the technical glitches that one would be more likely to encounter the more that one used the bulletin board tool. Bayram, in a study of virtual classrooms in Turkey, pointed to problems with hardware, navigation, time, web design, cost. However, the biggest barriers were found to be the time and practice with the software required. Goldberg (1997) also found motivation to be a key issue. Although half of the students in the class studied liked the self-paced aspect of an on-line course, the other half felt that they needed external motivation to keep them on track and found the self-pacing to be an aspect of the course that they liked least. Merron's (1998) students also found reading all the messages on the bulletin board to be very time-consuming.

In comparisons of completely on-line courses versus courses that combine face-to-face meetings with on-line learning and courses that do not contain any web components, students said that they preferred the mixed course to a completely on-line course (Goldberg, 1997). Students in this type of hybrid class were also more likely to do well than students in a completely on-line course (Goldberg, 1997; Merron, 1998).

An Investigation and Review

After reviewing the various studies already conducted on WebCT and OCMS, the need to conduct research at Mason became very clear. The following sections discuss the methodology used and threats to the validity and reliability of the data collected for this initial study of students at Mason and their experiences with WebCT.

Survey Methodology

There were several steps that needed to be planned and executed. In addition to identifying the actual objective of the study, the audience had to be identified, the data collection process had to be defined, the collection tool had to be developed, and permission needed to be obtained to use the data once collected. Each of these steps is described below.

The objective as stated in the introduction, "... student satisfaction with WebCT," was the over all objective of the study. Because it was not clear what the responses might be, the objective was kept broad. The survey was designed to explore how well Mason students were using WebCT and how well WebCT is was working for the students. It took into consideration the computer experience of the students and their learning process/needs to see if these needs are consistent with what WebCT has to offer. Other interests explored included how the students might use the tools after they have completed their courses.

Several factors were considered when attempting to identify potential participants in the student survey. The factors considered were:

- The overwhelming size of the Mason student population (26,000+) and the fact that not all Mason students use WebCT or a like product.
- The location of the students (most off-campus and part-time)
- The inconsistent use of WebCT across the campus and across the disciplines
- The limited time available to conduct the survey caused in part by the need to collect data about the success or failure of WebCT in time for decision-makers to decide how many resources will be provided to support WebCT.

Based on the above, it was decided that a pre-existing, large group of students new to WebCT would be an acceptable sample audience for this study. The participants in the Graduate School of Education's Initiatives in Educational Transformation (IET) were asked to be the sample student body. They are a dedicated group of 120+ graduate students in one 2-year program using WebCT. They are made up of K-12 teachers seeking a Master's Degree. Preliminary studies conducted by the IET faculty indicated that the participants of this program were limited in their ability to use technology, particularly web-based technology. They were also selected because they could be reached with limited effort. Unlike the faculty population, the student population at Mason is geographically and technologically dispersed and without one or two simple means of being reached. The IET program offered a way to reach a large group via one communication device.

Prior to submitting a Human Subject Review for approval, a meeting was held with the IET faculty and their approval and support was requested. The faculty then had the opportunity to review the survey and comment. There were a total of twenty-six (26) questions asked via a web page survey (23 were a mix of Likert-Scale and Yes/No responses and 3 were written response questions). The answers were collected into a text-based file to be imported into a database for tabulation.

Once the Human Subjects Review was approved, a link was made from the Program's WebCT home page to the web page survey. An announcement was posted in WebCT by the faculty of the program and the students were asked to volunteer their time and take the survey. The survey was online for 15 days.

Threats to Validity and Reliability

As mentioned above in the student survey process section, the participants were not selected randomly and several factors went into that decision. Due to the lack of random and complete selection, threats to validity are relevant. This threat will have to be considered when attempting to make any observations from the survey results. Other possible threats include:

- **Impartiality** - The IET participants received training on WebCT by the same person conducting the survey.
- **Audience** - The participants are K-12 teachers and hence do not represent the Mason student population.
- **Process** - They were asked to survey WebCT via one of WebCT's communication tools.
- **Timing** - They were surveyed within the first few months of their 2-year program and a follow-up survey could reveal changes in their attitudes as their experiences and skill change.
- **Time Constraints** - They are all educators using an educational tool and therefore may not be able to give a balanced view of how the tool could be useful in other work-related situations.
- **Time Constraints** - The fact that a web-based technology is being surveyed via the web can potentially exclude those who are web timid and thus could slant the results more favorably.

Findings

The overall findings are positive and in favor of WebCT. The following sections summarize the results of the survey and how the threats discussed earlier might have influenced the results. Assuming all the participants in the IET program saw the link to the survey, approximately 20% of the participants responded. A total of 25 surveys were collected via the Internet, as discussed above.

Survey Results

In summary, the majority of the respondents agreed that online course management tools and WebCT are beneficial in the learning process. The following was discovered:

- **Audience** - 100% own a computer and connect to the Internet from home and/or work. Over 50% of those who responded consider themselves proficient in the use of a word processing, database, email, and online communication applications. 72% have taken web-based courses.
- **Learning** - 76% of the respondents agreed that they were likely to learn more effectively using on-line communication.
- **Time Commitment** - 56% indicated that they would not spend too much time learning technology in an on-line communication class, while 48% disagreed and felt they would. 56% indicated that they were likely to spend too much time keeping up with on-line communications, while only 28% disagreed.
- **Sharing** - 92% indicated that they were likely to use the information shared by other students. 96% - 100% of the respondents indicated that sharing the results of an assignment with their fellow learners helps improve the learning process; increases their efforts to do a better job on my assignments; and is comfortable sharing their assignment results with their fellow learners.
- **Technology and Learning** - 88% indicated that online tools such as chat, discussion forums, and email help in the learning experience. 80% agreed that WebCT would enhance their learning experiences.
- **Learning Technology Application** - 84% of the respondents agreed that after taking a course that uses online course tools such as those found in WebCT, they would be able to apply these skills in their personal and/or professional life. While 60% indicated that they would incorporate online collaboration into their professional and/or personal life.
- **WebCT Interface** - When asked if the interface to various WebCT tools was found to be intuitive and/or easy to use:
  - Chat - 56% agreed and 24% had no opinion
  - Bulletin Board - 56% agreed and 20% disagreed
  - Calendar - 92% agreed

- Student Home Page - 64% agreed while 20% disagreed
- Presentation - 40% agreed but 24% had no opinion.

Survey Results Analyzed

The following discussing how the results of the survey could have been skewed:

- **Survey Process** - As the results indicate, the 25 respondents are easily connected to the web and agreed that such online tools provided by WebCT are beneficial to the learning process. The process used to collect the data, via a link from WebCT, could have caused the results to be disproportionately in favor of online tools such as those found in WebCT. If the survey had been conducted using a technology neutral process, the results may have been more evenly distributed.
- **Time** - Time was a key-factor in this study. If more time was allowed, participants in the IET program that are not easily connect to the web may have taken the survey and the results could have reflected a different mix of opinions.
- **Audience** - The positive responses with respect to applying their online skills in their personal and/or professional life could reflect an interest in using online tools in their own classroom. If the audience had been more randomly selected, the results could have been much lower because many disciplines may not have a need for such tools.

The Next Step - Future Research

There are two directions that could be taken. One is to include a broader group of students being asked general questions and the other is to get more focused into the world of K-12. Each option presents new opportunities to understanding the impact of OCMS' on student learning. The door in still wide open on the pros and cons of OCMS and the more research that is conducted, the better we will be able incorporate its powers appropriately into the learning environments.

References

Danchak, M. (1999) "WebCT: The Impact on Students." Proceding of the First Annual WebCT Conference on Learning Technologies. June 17-18, 1999. Vancouver, Canada.

Fong, S. (1999). Application of WebCT for assisting Hong Kong Part-Time Students to Learn Accounting. Proceding of the First Annual WebCT Conference on Learning Technologies. June 17-18, 1999. Vancouver, Canada.

Goldberg, Murray W. and Salari, Sasan (1997) "An Update on WebCT (World-Wide-Web Course Tools) - a Tool for the Creation of Sophisticated Web-Based Learning Environments", Proceedings of NAUWeb '97 – Current Practices in Web-Based Course Development, June 12 - 15, 1997, Flagstaff, Arizona. . Retrieved 2 October 1999 from the World Wide Web: http://www.webct.ulpgc.es/papers/nauweb/full-paper.html

Goldberg, M. (1997) "CALOS: First Results From an Experiment in Computer-Aided Learning" Proceedings of the ACM's 28th SIGCSE Technical Symposium on Computer Science Education. Retrieved 29 September 1999 from the World Wide Web: http://www.webct.com/papers/exper.html

Goldberg, M. (1997) "WebCT and First Year Computer Science: Student Reaction to and Use of a Web-Based Resource in First Year Computer Science ", Proceedings of the ACM's ITiCSE Conference on Integrating Technology into Computer Science Education, June 1-5, 1997, Uppsala University, Uppsala, Sweden. Retrieved 29 September 1999 from the World Wide Web: http://www.webct.com/papers/csover.html

Hara, N. & Kling, R.(1999) "Students' Frustration with a Web-based Distance Education Course: A Taboo Topic in the Discourse." CSI Working Paper. Retrieved from the 29 September 1999World Wide Web: http://www.slis.indiana.edu/CSI/wp99_01.htm

Merron (1998). "Managing a Web-based Literature Course for Undergraduates" Online Journal of Distance Learning Administration, (2)4. Retrieved from the 29 September 1999World Wide Web: http://www.westga.edu/~distance/merron14.html

Morss, D. (1999). "Student Views to the Use of WebCT: An Expanded Report." Proceding of the First Annual WebCT Conference on Learning Technologies. June 17-18, 1999. Vancouver, Canada.

Pauley, R., Cunningham, M., and Childress, R. (1999) "A Quantitative Analysis of Graduate Students' Perceptions of WebCT." Proceding of the First Annual WebCT Conference on Learning Technologies. June 17-18, 1999. Vancouver, Canada.

Schulman, A. & Sims, R. (1999) "Learning in an Online Format versus an In-class Format: An Experimental Study" T. H. E. Journal, June 1999. Retrieved September 29, 1999 from the World Wide Web: http://www.thejournal.com/magazine/vault/a2090.cfn

Wermet & Oliges (1999) "Using WebCT for Educating Practice Professionals." Proceding of the First Annual WebCT Conference on Learning Technologies. June 17-18, 1999. Vancouver, Canada.

Windschilt (1998) "The WWW and classroom resarch: What path should we take?" Educational Researcher, 27(1), 28-33.

Acknowledgements

The authors would like to acknowledge the feedback they received from Dr. Chris Dede while working on this paper. We would also like to thank Jerry Drake for presenting this paper.

Agents For Education: the Problem Of Synthetic Personality

Peter McKenna
Department of Computer Science & Mathematics
Manchester Metropolitan University
Manchester, England
P.McKenna@mmu.ac.uk

Atif Waraich
Department of Computer Science & Mathematics
Manchester Metropolitan University
Manchester, England
A.Waraich@mmu.ac.uk

Abstract: This paper examines some social implications of the emerging technology of 'intelligent' agents for learning and teaching. The educational potential of this technology is tempered by the potential for stereotype and caricature in an educational multimedia environment, where effects often need to be larger than life, and dynamic content needs to isolate salient features. Believability is a crucial requirement of such agents, and exaggerated features may be associated with increased recognition. Gender provides characteristics that are both easy to represent, and easy to recognize. The paper argues that the hazards of stereotyping in the development of mediated anthropomorphic presences are significant, and need to be explicitly addressed in future guidelines for the design of agents that are to have any role in the education of our children.

1. Introduction

The development and application of personality-rich software agents has been the focus of a great deal of recent research. It has been suggested that such software will constitute the next major metaphor in computing by providing "...capability that will trigger a basic change in the user interface metaphor: computers will become assistants rather than just tools" (Ball et al, 1997). Definitions of agents vary: for the purposes of this paper we consider agents as systems that endeavour to use autonomous and believable characters within a situated context (Franklin and Graesser, 1996).

Computer Based Learning is one application area for these systems. It has been suggested that agents can play a significant role in motivating students (Lester et al, 1997), and that the more life-like the behaviours exhibited by the agent the stronger their motivational impact will be. The goal for many agents is – as with Microsoft's Persona Project - to create "computer assistants" that are "lifelike" (Ball et al, 1997). The design of educational interactive environments, like that of other virtual worlds, requires the use of characters that can respond in a way that is believable and "intelligent" (Bates 1992). The framework for believability is therefore implicitly anthropomorphic.

In a constructivist model, learning occurs "through interactions with one's environment or culture" (Reiber, 1992). A virtual environment therefore offers potential for learning; and the nature of that environment is critical if successful learning is to take place. We suggest in this paper that the use of personality rich agents in computer based learning environments may lead to simplification that could have unwanted effects. In most situations some simplification of the design must occur to produce a practical and useable environment: however, if learners are presented with stereotypes and set roles, this can set constraints on learning, enquiry, and evaluation. It is important that developers and educators be aware of these issues in developing agents for teaching and learning.

2. Slaves to the user?

Bates (1992), Lester et al (1997), Pisanich et al (n.d.), and Reilly (1997) all suggest that a key to effective virtuality is whether the user is able to "suspend disbelief": believability is expressed as a suspension of disbelief. The social nature of agents is a matter of particular importance within systems that depend on interactive narrativity for their believability (Waraich, 1998). A key to this, in turn, is responsiveness to the user: the user will suspend disbelief only if interactions with the agent occur within the bounds of the user's existing cultural and social norms.

The concepts of believability and user-responsiveness are also essential to the vicarious virtual world of pornography. Characters and scenarios are developed (usually by men for men) that portray women as available: the effect depends on a "believability" that is thoroughly divorced from reality, but which the user willingly buys into by 'suspending' his disbelief. In such worlds the "user" must have at least the illusion of free will if they are to experience some level of presence in the simulated world. While such notions are common terms of reference for the development of believable agents, it may be noted that some users fail to differentiate sufficiently between their vicarious, suspended virtual worlds, and the real world. As agent systems become more sophisticated, and users do suspend their disbelief, agent design will increasingly carry a burden of ethical implications and social responsibilities.

While agents must be able to exhibit some form of personality in order to be believable, the models of representation are themselves culturally determined. Reilly (1997) states that "believable agents are defined to be interactive versions of quality characters in traditional artistic media like film". Stereotypes abound, however, in the world of film: from Almodovar to Zinnemann, Hollywood to Bollywood, female characters are almost always defined in relation to a man (usually in the role of love-interest) and are young and photogenic. These aspects of entertainment do not sit easily with the intention to educate.

While Lester et al (1997) do not explicitly identify stereotyping, they suggest that a key challenge in creating believability in animated pedagogical agents is to ensure that any believability-enhancing behaviour must complement (and be interleaved with) the advisory and explanatory behaviours that the agents perform. The development of sophisticated synthetic personalities is a difficult undertaking. Yet while the use of stereotypes can provide easy recognition, it cannot reasonably be said to complement educational behaviours.

3. Broad Brushstrokes and character aliasing: the problem of stereotypes

Agents may therefore be shaped by social assumptions: these hazards are compounded by the limitations of digital representation. Laurel observes that "[w]hen we anthropomorphize a machine or animal, we do not impute human personality in all its subtle complexity; we paint with bold strokes, thinking only of those traits that are useful to us in a particular context" (Laurel, 1997).

Human personality is 'analogue' in that its 'values' lie on a continuum and cannot be fully quantized, or represented as a series of discrete values. In digitizing personality, the problem of 'aliasing' is inevitable. Where a picture rendered into a finite set of pixels, or a soundwave sampled at discrete intervals, may exhibit jaggy staircasing or noise, the 'jaggies' in a digital personality may manifest as stereotypes.

However, when it comes to the personality of others, such 'aliasing' does not necessarily spoil the effect. As Laurel comments, the illusion of lifelikeness is not necessarily destroyed by "over-simplification": users "can enjoy (and believe in) even one-dimensional dramatic characters" (Laurel, 19xx). Bates too suggests that agents do not have to be sophisticated as long as it does not actively do something to destroy the suspension of disbelief (Bates, 1992). On the one hand such simplification is attractive in that it may well ease the task of designing and implementing an agent yet at the same time produce acceptable results; but on the other hand simplification is likely to exaggerate any stereotypes that have (however inadvertently) been incorporated into the agent. This in turn clearly has the potential to shape attitudes and to reinforce social and cultural bias. This is particularly important in the case of systems that are 'educational', and most especially those aimed at children. Young people are less likely to have the discriminating worldview and social experience required to identify and ignore such features as simplistic or ironic stereotypes, and may well accept them as "normal".

The very real problem facing the designer of synthetic personalities is determining what the effect of the character will be both within the simulation and towards the specific user of the system in the real world. Each learner brings their own prior knowledge and experiences to bear on the interpretation of the interactions with the system.

Categorization is an attractive method for digital analysis and design. Pisanich et al (n.d.) suggest a personality taxonomy, based on the Big Five set of personality traits (Harary et al 1994). These consist of Expressive Style (quiet, introverted), Interpersonal Style (aloof, cruel, warm, generous), Work Style (conscientious, procrastination), Emotional Style (neuroticism, calm, emotionally intense) and Intellectual Style (conservative, creative). It is suggested that the designer of a character can determine a value for each personality trait and thus determine the features of a character's personality.

Petta defines the Emotional as "the system that in living beings continuously monitors the relationship of the individual to its world ", and indicates that it is "highly relevant to adequately model the Emotional within architectures for synthetic actors, with respect to the agent's believability, autonomy, sociality, and faculty to engage humans". His goal is to model "emotional processing" into the agent architecture framework, using principles from "functional appraisal theory in emotion research". Ad-hoc solutions to "emotions synthesis" are "brittle".

Reilly (1997), however, suggests that believable social agents cannot be created from parameterized values for personality factors. His own methodology – designed to encompass both psychological and artistic personality factors – identifies personality quirks, variable emotions (as displayed in social behaviour), and attitudes that are responsive to different relationships as features that should be considered in the development of believable agents. Providing such a finer resolution in the rendering of an agent's 'personality' will be more difficult, but is desirable if an agent is to have a degree of context-sensitivity appropriate to an educational environment. Within Reilly's methodology, attention to social norms and social roles may be imputed to be particularly important factors in the development of pedagogical agents: an informed understanding of what is socially acceptable behaviour, and of the role that teachers play in society.

While Laurel (1997) sees the personification of computer interfaces as attempts to "mediate the relationship between the labyrinthine precision of computers and the fuzzy complexity of people", it is the need to develop types and discrete elements to represent personality that can very readily result in simplifications and stereotypes.

4. Gender: defaults and stereotypes

Gender is an important instance and illustration of stereotyping. In research into the effects of gender stereotypes on the design of educational software, Huff & Cooper concluded that a) sex bias did exist in software, and that b) its roots lay in the expectations and stereotypes of the designer (1987). A key factor was not just that designers produced software with different characteristics if required to develop specifically for boys or girls respectively, but that the software produced for children in general was similar to that designed for boys.

The 'masculine default' runs deep in most cultures - and is widely reflected in the morphology and usage of language. In the company of the abstract, representational, and imaginary figures that populate children's stories - stick-men, animals, aliens – apparently neutral agents and other 'artificial intelligences' tend to default as masculine. The quality of being feminine is just that - a trait, rather than an essence. An apron, or a set of fluttering eyelashes, usually suffices to ascribe this quality to an anthropomorphized animal or vehicle: markers of gender are only needed for females. If the AI endeavour concerns making computers like us, then what are 'we' like? Gender appears to be fundamental to our social conditioning. Yet there is an obvious danger that the backgrounds, personalities, and, indeed, the graphical representation of agents, will in fact represent very particular values and assumptions.

Within the claim that machines do not have a gender, and that, in designing an agent, it is necessary only to consider architecture, lie the seeds of both the male default and female stereotypes in agent representation.

Agents are frequent participants in on-line Multi-User Domain (MUD) communities. Participants also include a minority of males who identify and pursue characters bearing female names; male characters who log on under female names and behave in the sexually aggressive way that they would like women to behave; and by male characters who assume that a woman will need their help and their company. (Bruckman, 1996): the level of unwanted attention and harassment in virtual worlds is an exaggeration of - although a fulfilment of intentions that undoubtedly exist in - the real world. Some of the best-known agents – like Julia - are built to respond to this social environment. Agents that are simplistically responsive to the user are frequently shaped by such minorities. A female agent may not have to be young and photogenic like Lara Croft or a Hollywood star: an agent that is even ready to flirt or look pretty builds a particular social environment that is not likely to encourage or motivate women and girls. MUDs of course are also used as environments for teaching and learning – to teach, for example, writing and communication – and for educators and scholars to share experiences and information. While such educational environments could be expected to be more wholesome, educators frequently look to ready-made TinyMUD robots as retrainable and adaptable agents, and it is still necessary to pay attention to the general pitfalls of constructing stereotyped and gendered agents.

There is no particular shortage of female agents. They are often defined as female - whether descriptively or graphically - by details concerning hair and other bodily features. They will have an extensive range of one-liners for sexualized exchanges with males (which appears to pass as 'emotional intelligence'). It may be argued that this reflects the reality of life in a sexist society, and in particular that the defensive strategies are similar to those frequently adopted by women when in the company of predatory males. Yet it may also be argued that there is no need for such strategies on the part of an AI, and that such characterizations shape expectations as much as it reflects reality - that it is a facile way of attaining to the reality of the male 'user'.

5. Julia: robot with sex

One 'female' agent program has many lines - alternately coy, feisty, and flirtatious - for dealing with frequent 'virtual' sexual advances. "Julia" has plenty of self-disclosing loving detail – 'she' has "close-cropped frizzy blond hair". Julia is described as a TinyMUD robot (Foner, 1993). Written by Michael Mauldin of Carnegie Mellon University, Julia logs into MUDs and interacts with other players. While Julia does not operate within a learning environment, MUDs are (as noted above) used as educational environments, and their agents seen as retrainable prototypes. As an autonomous agent, a key part of Julia's 'personality' is sex – about which 'she' is rather obviously assertive:

> Robyn says, 'julia, are you a woman?'
> Julia says, 'I am female.'
> Robyn says, 'and, julia, are you human?'
> Julia says, 'Not when I'm having my period, Robyn.'
> Robyn laughs

(Quoted in Foner, 1997)

It is as a female that, when pushed sufficiently, Julia takes off 'her' clothes - 'fearfully' - and hands them to an insistent real 'virtual' male. (Because the harasser is 'whispering', his lines are partly invisible):

> Julia says, 'Just try to take 'em, buster!'
> Julia says, 'Help! Rape!'
> Julia says, 'No, I won't.'
> Julia disrobes fearfully and hands her clothes to Brandi.
> You say, 'julia, please give me your clothes'
> Julia says, 'You'll have to get them from Brandi.'

(Quoted in Foner, 1997)

This may be 'believable', but it is hardly desirable: if the broadly-brushstroked, low-resolution nature of virtual personality and environment can be put to positive use, there is in fact every reason for excluding some features of reality.

While Foner reports Mauldin as claiming that 85% of Julia's source code is the same as his prototype robot, Colin (Foner, 1993), he (Foner) also comments that "a large percentage of Julia's code deals with detecting and deflecting passes". One might therefore deduce that this code has been added on to a male-default in order to represent the quality of femininity. Colin's small-talk response repertoire detects matches for `how are you', 'how do you', 'how's life', 'are you alright', 'are you well', etc (Foner, 1997). Julia (whose code, as a frequent Loebner entrant, is not in the public domain), has added on small-talk that signposts specific femininity:

Robyn whispers, 'how are you feeling?' to Julia.
Julia whispers, 'Terrible.'
Robyn whispers, 'why, julia?' to Julia.
Julia whispers, 'I have PMS today.'

Flirting can appear to go with the territory of feminine psychological attunement. Erin O'Malley, a prototype character described by Hayes-Roth (1998), is endowed with some of the "psychological qualities" necessary for believability: "personality, motivation, emotion and social relationships". Her role is that of a bartender, and as a female who is apparently assumed to work within a male environment, she needs "to flirt a little", even if "she won't let those conversations go too far".

The growth in female agents can perhaps be ascribed in part to the discovery of "emotional intelligence" as a key to the simulation of humanity: a feminine stereotype in itself. Indeed, various commentators believe that AI is a 'natural' place for women's research: its links with cognition and psychology are tied to the stereotyped notion that "women are generally more introspective, attuned to psychology" (Strok, 1992).

Conclusion

When agents are deployed – as they increasingly are – for useful purposes such as education, decisions may be made regarding contextual stereotypes, and in particular the allocation of gender. If the agent is to be a character of no gender, it is necessary to make a point of this – otherwise it will generally default as male. There is no intrinsic problem of believability in a specifically ungendered agent; although the suspension of disbelief in agents contains a strong element of preference and choice on the part of the believer. Female personae may be used often for the same reasons that many service industries have become feminized - to take advantage of the supposed approachability and communicative qualities of women (Strok, 1992). This, however, is something of an 'airline hostess syndrome', and tends to assume both a male customer audience and a young woman with symmetrical and slim features. There is clearly a concern that the application of agents may also be divided on a gendered basis.

The mind has been conceptualized as a machine since the advent of industrialization: and just as our cultures shape the development of responsive, 'believable' agents, so in turn our agent creations are part of a new defining technology, a technology that has the power to shape our self-conception and social attitudes. In developing agents – but most especially where there is an explicit intention to educate and to influence – developers have a broader social responsibility to move beyond simplistic behaviourism and mechanical personality-response, and to explicitly factor out stereotypes before they take root.

The design and development of software personalities is undoubtedly a complex area of intense interest. While the use of broad brushstrokes and parameterised and typed values may be attractive, there is correspondingly a need to consider guidelines for the ethical and social development of educational agents; to recognise that simplifications in general, and stereotyping in particular, can be inimical to the goals of education; and to show appropriate respect and trust for these new personalities who will help us to teach and learn.

Bibliography

Ball, G. et al (1997). Lifelike computer characters: The Persona project at Microsoft Research, in *Software Agents*, ed. J. Bradshaw, AIII Press.

Bruckman, A. (1996). Gender Swapping on the Internet, in *"High Noon on the Electronic Frontier"*, ed. Peter Ludlow, Cambridge, London.

Franklin S. & Graesser, A (1996). Is it an Agent, or just a Program? A Taxonomy for Autonomous Agents. Proceedings of the Third International Workshop on Agent Theories, Architectures and Languages, Springer-Verlag, 1996

Huff, C. & Cooper, J. (1987), Sex Bias in Educational Software: The Effect of Designers' Stereotypes on the Software they Design. *Journal of Applied Social Psychology*, **17**, 6, 519-532.

Foner, L. (1993). What's An Agent Anyway?: A Sociological Case Study. *Agents Memo*, 93-01, Media Lab, Massachusetts Institute of Technology

Foner, L. (1997). Entertaining Agents: A Sociological Case Study. Media Lab, Massachusetts Institute of Technology. *Proceedings of The First International Conference on Autonomous Agents*, Marina del Rey, California.

Hayes-Roth, B. (1998). Interacting with Animate Characters: Puppets, Bartenders and Auto Salespersons, in *Proceedings of Imagina, The European Conference on Images and the Arts*, Monaco, March 1998

Laurel, B. (1997). Interface Agents: Metaphors with Character, in *Software Agents*, ed. J. Bradshaw, AIII Press.

Lester, J. & Stone, B. (1997). Increasing Believability in Animated Pedagogical Agents. *Proceedings of Agents '97* Conference, ACM, 1997

Mauldin, M. (1994). Chatterbots, TinyMUDs, and the Turing Test: Entering the Loebner Prize Competition. *Proceedings of the AAAI 1994 Conference*, pp. 16-21

Petta, P. (1998). Emotional Software Agents: Principled Emotion Synthesis in Situated Software Agents. Austrian Research Institute for Artificial Intelligence (ÖFAI) (www.ai.univie.ac.at/oefai/agents/esa.html, Oct 5 1998, accessed Oct 23, 1999).

Pisanich, G. and Prevost, M. (n.d.). Representing Human Characters in Interactive Games. Photo-Genetic Labs Silicon Studios, Inc., San Jose, CA. http://reality.sgi.com/prevost_studio/personality.html

Reiber, L. (1992). Computer Based Microworlds: A bridge between constructivism and direct instruction. *Educational Technology Research and Development*. Vol 40, Part 1, pp 93-106.

Reilly, S. (1997). A Methodology for Building Believable Social Agents. *Proceedings of Agents '97*, Marina del Rey, CA, USA.

Strok, D. (1992). Women in AI. *IEEE Expert*, Vol.7, No.4, August 1992.

Waraich, A. & Brna, P. (1998). Believable Agents and Narrative Structure in Intelligent Tutoring Systems. *ECAI 98, European Conference on Artificial Intelligence*. Workshop on Artificial Life and Entertainment, Brighton, England, August 1998

Developing professional skills and competencies in tertiary learners through on-line assessment and peer support

Catherine McLoughlin,
Teaching and Learning Centre, University of New England, Australia
mcloughlin@metz.une.edu.au

Joe Luca,
Edith Cowan University, Multimedia Department, Australia
j.luca@cowan.edu.au

Abstract: In professional organisations, employees are called on to evaluate solutions, solve ill-defined problems and engage in decision making based on actual situations and events. To develop such skills, tertiary learners have to learn to engage in tasks where such skills are likely to develop, and learn to reflect on their own behaviour and that of peers. In the research literature on learning and self-regulation, self and peer assessment are important strategies used to develop problem-solving skills that can be transferred to the workplace. On-line environments utilising asynchronous communication tools and tasks are ideal environments for the refinement of decision making and problem solving skills. This case study profiles an on-line approach to developing professional project management skills for multimedia developers and presents snapshot views of an online learning environment. The study also investigates learners' perceptions of the value of peer work in their own learning and shows that technology can support alternative assessment practices leading to development of professional skills and competencies.

Introduction

This case study presents an argument in favour of fostering personal transferable skills as a defining quality of the learning experience in higher education and demonstrates how technology can be used to support a culture of peer support to foster these skills. The case study was designed in response to current social and economic debates in Australia about the quality of undergraduate education and of the qualities that university graduates should possess (Candy, Crebert & O'Leary, 1994; Assister, 1995). During the last ten years there has been a major reappraisal of higher education, its purpose, outcomes and resourcing. There is now a more pronounced emphasis on the higher education-employment nexus, and particularly on the skills or competencies that can be transferred from a university setting to the workplace. In this changing environment, which is mirrored in New Zealand and Europe, it can be argued that peer assessment and peer learning are an appropriate response to the preparation of tertiary students for the workplace. This study focuses on a context where peer support is integrated with assessment to develop skills through interaction and learning. These skills enable students to move more easily from formal education to the next stage of their lives and are increasingly being demanded by employers.

The role of technology in fostering professional skills

Information and communication technologies have the capacity to support a wide range of learning goals and are now integrated into teaching approaches of many higher educational institutions. Laurillard (1993) for instance suggests that computer-based learning has a major role in promoting:

- self-directed learning and increased student autonomy;
- keeping the educational system in line with technological development;
- increased information literacy, ensuring that graduate skills are in tune with those of employers; and
- increased productivity and efficiency in higher education.

The shift to student self-direction and autonomy means that students need to take more responsibility for their own learning, but many need assistance in achieving this skill. Shaffer & Resnick (1999), maintain that technology can be used to create authentic contexts for learning, and provide resources that give students opportunities for:

- *connectivity:* to connect to the world outside the classroom, to research topics that would otherwise be inaccessible, to access experts and to engage in conversation with peers;
- *computer modelling:* to create simulations that assist the creation of authentic tasks and contexts for assessment; and
- *epistemological pluralism*: to express and represent ideas in many different ways.

Applied to assessment, representational pluralism enabled by computer technology expands the range of channels available to students to demonstrate understanding (Gardner, 1993; Greeno, 1997). For example, instead of using narrowly defined learning outcomes tested by examinations, technology offers a total environment where real life skills, such as written and verbal communication, collaboration and team work can be assessed by the team and tutor by giving learners multiple channels of expression, such as visualisation, multimedia presentations, audio and video. Thus, information technologies are closely inter-woven with the quality of the learning experience, and can be used to create authentic tasks for assessment.

Fostering deep learning through peer work and authentic assessment

Traditional university education has operated within a "transmissive paradigm", emphasising the transfer of knowledge from lecturer to student. Such a view of learning is not conducive to meaningful, active learning where students take a pro-active role in questioning, sharing ideas and applying prior knowledge to new ideas. However, the increased emphasis of generic transferable skills has required a re-alignment of teaching practices with desired learning outcomes (Biggs, 1999). This means that if independent lifelong learning and critical skills are expected of graduates, teaching methods must foster such processes and skills.

In contemporary education one influential group of researchers has identified students' approaches to be either surface level or deep level (Ramsden, 1992). A deep learning approach is consistent with a search for knowledge and understanding, whereas a surface learner is concerned only with passing exams by memorising facts. Applied to assessment and teaching approaches in higher education, the implication is that the creation of an appropriate learning environment can foster a deep approach. This can be achieved by enabling learners to take an active role in learning by initiating, managing, monitoring, reflecting and evaluating learning tasks and processes. Gibbs (1992) emphasises that a focus on *process*, rather than content, is essential in promoting active learning and that evaluation and assessment procedures are central to these issues as students interpret the objectives of a course of study according to the demands of the assessment system. For example, an exam requiring recall of facts will encourage learners to adopt a surface approach, whereas assessment of collaborative problem-solving or teamwork on a project will emphasise communication skills, planning and decision making and foster a deep approach. The relevance of this to educational technology is that we can use the attributes of technology to increase learner autonomy and independence by designing authentic assessment tasks in order to equip learners with professional skills and attributes. In addition, by making assessment a 'learning event' that develops process knowledge (rather than a one-shot examination) we bring it closer to the context of the workplace, where professionals are expected to have self-management skills, and be able to make judgements about their own and other's work (Erhaut, 1994). Moreover, traditional university examinations do not test for deep conceptual understanding (Entwistle & Entwistle, 1991). Indeed, the capacity of technology to foster professional skills through authentic assessment is an area of research that is just beginning to be explored.

Alternative assessment using technology

In recognition of the limitations of traditional university assessment, there is a new wave of pedagogy advocating 'alternative assessment' in which assessment is integrated into learning and fosters understanding of learning processes with real-life performance as opposed to a display of inert knowledge (Wiggins, 1998). This form of authentic assessment is solidly based on constructivism, which recognises the learner as the "chief architect" of knowledge building. In constructivist learning environments there is social interaction, communication, exchange of views, collaboration and support for learners to take more responsibility for the learning process through learner-centred tasks (McLoughlin & Oliver, 1998; Collis, 1998). Socio-cultural theory is based on similar assumptions, and many theorists have highlighted the importance of reciprocal understanding and transactional dialogue where knowledge is exchanged and modified in the light of peer feedback (Crook 1994; Bruner, 1990). Salient features of constructivist learning environments include an emphasis on the following aspects:

- *authenticity:* learning is located in actual contexts or real tasks;
- *group work:* social interaction and feedback are instrumental in communication and higher order thinking processes;
- *learner control*: learners are active in defining and negotiating learning tasks; and
- *scaffolded learning*: learners are supported as they progress from novice learners to self-regulated experts.

The use of the WWW to create assessment tasks offers greater adaptability and flexibility than traditional assessment procedures as it enables the collection and storage of continuous data, and easily created micro-environments where learners solve real life problems. It can be argued that the move towards alterative assessment paradigms has been accelerated by technology with its capacity to cope with a broad array of activities, tasks and forums for assessment. For instance, alternative modes of assessment encourage the use of multiple assessment tasks, and multiple modes of show-casing student achievement through portfolios, multimedia projects, skills demonstrations and teamwork. A further important contribution made by technology to these new modes of assessment is the capacity to support the evaluation of learning processes, such as communication, group work and collaborative problem solving, as opposed to a narrow focus on a single outcome as an indicator of competence.

Context of the study: Course description

The context of the study was a tertiary academic unit called "Interactive Multimedia Development Methodologies" intended to develop student expertise and knowledge in project management for developing multimedia in a team-based environment. Currently, this unit is offered in face-to-face mode using a combination of delivery modes, including small group work, team projects and problem solving tasks facilitated by a tutor. The on-line component provides access to course notes, syllabus, assessment details, access to previous projects as well as group communication facilities such as e-mail, bulletin boards and problem solving tasks. The course objectives were closely linked to the professional competencies required for multimedia development in the industry and integrated authentic assessment tasks where learners could develop multimedia products in a team environment, thus replicating the skills required of them in the workplace. A salient feature of the assessment tasks was the focus on learning processes, rather than mastery of content as this matched the orientation of the course towards skills development. The assessment tasks and associated learning processes are presented in Table 1.

Table 1: The assessment tasks and associated learning processes

Assessment task	Learning processes
Web-based product development	• Team work, planning, decision making project management
Peer assessment of problem solving	• Higher order thinking and analysis • Development of criteria for assessment • Giving feedback to peers • Reflection on feedback leading to revision of ideas
Search, analyse and apply relevant knowledge by finding an online resource to support the solution to the problem.	• Analysis, reorganising information testing for useability and application to an authentic task

The objective of the peer assessment component was that participants would evaluate peer responses to problem solving and discuss issues and revisions in order to support each other. The unit thus integrated process-based assessment tasks into the learning environment in order to contribute to the development of team-skills, inquiry and reflection (Biggs, 1999). The unit also aimed to teach content knowledge and thinking strategies using real life scenarios. This approach to on-line learning can be regarded as *process-oriented* as it focuses on the processes of knowledge construction and utilisation (Volt, 1995; Vermunt, 1995), as opposed to simple mastery of content knowledge.

Participants and procedures

The student participants were all postgraduates and consisted of five females and four males. They were undertaking the project management unit, which represented a core unit in the Graduate Diploma of Interactive Multimedia Technologies. This unit is the second last of the eight-unit Diploma course. The final unit these students complete is an industry project, where the students are required to implement these skills in a 'real' environment, with 'real' clients and produce a 'real' product. The course was designed to maximise peer learning, peer support, feedback and interaction among the group members. This involved groups posting solutions to ill-structured problems on the class web page, monitoring team work and facilitating team building processes by encouraging use of discussion forums where team members could deliberate, plan and exchange ideas. The actual problems were loosely framed, ill-defined and open-ended, and required learners to analyse existing knowledge, suggest a course of action and then post a solution. In addition, students were asked to post a URL or information source that specifically supported the standpoint adopted in solving the problem. This was conducted before students attended a seminar where they presented their solution, justified their approaches and made comments on other students' solutions.

Students were required to submit their solution at a specific time during the week, and then evaluate each other's solutions by ranking them. During the seminar the strengths and weaknesses of each solution were discussed and students had an opportunity to defend their approach. The process of developing peer support and feedback was an important part of the project management unit, which replicated a learning community. Sharing of ideas, resources, and offering reciprocal support created social relationships, which helped students to work in teams. McConnell's (1999) features of an on-line community influenced the design of the whole environment:

- openness in the educational process;
- self-determination in learning;
- a supportive learning environment;
- a real purpose in the peer assessment process; and
- assessment of ongoing learning processes.

The following four 'Snapshots' of the peer-support process and the fostering of peer-feedback through assessment show how these elements were integrated into the technology-supported environment of the course.

Snapshot 1: Students develop criteria for peer assessment

Students were asked to develop and articulate criteria that they used when assessing other students' on-line solutions and then defend these in class discussion. It was important that students formulated criteria against which they could measure peer solutions to the problem solving tasks. It was anticipated that students would be able to complete this task without much difficulty as they had experience of writing project specifications and engaging in project evaluation.

The results showed that the majority of students considered the following issues as being the most important when presenting solutions:

- relevance of content to the original problem;
- correctness and validity of content;
- clarity, presentation/format and grammar of writing style; and
- the ability to express an integrated opinion based on the content.

These results were later used as a 'springboard' to refine the processes of evaluation and to negotiate agreed on criteria that could be applied to all posted solutions. For example, all students mentioned style and format as essential criteria in their judgements of others' work. In class, they were asked to justify this response in an attempt to develop metacognitive processes (Lieberman 1991; Schraw & Dennison, 1994). Students recognised the value of this in developing their personal transferable skills.

Snapshot 2: Students reflect on problem solving strategies
Students were asked to reflect on the problem-solving processes they had engaged in while solving problems and then asked to articulate these during class discussions. This enabled the students to reflect on their own strategies, to identify areas of weaknesses and to conceptualise ways of addressing those weaknesses. Students were asked to write down the major strategies used when solving problems. Results indicated that the salient features of student problem solving strategies were:

- researching the topic thoroughly;
- reading the question carefully and considering different angles;
- checking that the content used is correct;
- comparing ideas with other students; and
- appropriate to the development of project management skills.

Snapshot 3: Students negotiate assessment methods used
This example relates to the social function of the learning community, where learners relate the assessment tasks to their own personal goals. It was important that learners came to regard assessment tasks as a way of engaging with the content and a means of developing new skills through ownership and acceptance of the assessment process. Students were asked to renegotiate the tasks to ensure relevance for their own learning. Most of students considered the problem-based tasks to be:

- relevant to the unit objectives;
- helpful in understanding multiple perspective's from other students,
- useful for reflecting on alternative possible solutions; and
- indicators of their own developing skills.

Discussion and implication of results

Online technologies have functionalities that enable display and sharing of ideas, open discussion of solutions and alternatives with articulation of strategies by participants. Such functionalities support greater visibility and openness in the learning process, which in turn foster reflection and conceptualisation among learners. In the study presented here, the integration of technology into an innovative assessment approach resulted in deep learning and the 'Snapshots' showed that students were engaged in active, reflective learning. We are continuing to investigate how technology can be used to extend a model of evaluation, which reflects the full range of the experiences of learning. We now have evidence that technology can create contexts and tools for exploration of alternative worldviews, increase the visibility of thinking processes, lead to articulation and refinement of solutions and foster peer dialogue in the learning process. By providing scope for multiple expressions of learning achievement we believe that new models of technology enhanced assessment are just beginning to emerge. These forms of assessment will provide indicators of a broad array of competencies and recognise that learning processes and learning outcomes are inseparable.

References

Assiter, A. (1995). *Transferable skills in higher education*. London: Kogan Page.

Biggs, J. (1999). *Teaching for quality learning at university*. Oxford: Oxford University Press.

Boud, D. (1988). *Developing student autonomy in learning*. London: Kogan Page.

Bruner, J. (1990). *Acts of meaning*. Cambridge, M.A.: Harvard University Press.

Candy, P., Crebert, G., & O'Leary, J. (1994). *Developing lifelong learners through undergraduate education*. Canberra: Australian Government Publishing Service.

Collis, B. (1998). WWW-based environments for collaborative group work. *Education and information technologies, 3*, 231-245.

Crook, C. (1994). *Computers and the collaborative experience of learning*. London: Routledge.

Entwistle, N. J., & Entwistle, A. C. (1991). Contrasting forms of understanding for degree examination: The student experience and its implications. *Higher Education, 22*, 205-227.

Erhaut, M. (1994). *Developing professional knowledge and competence*. London: The Falmer Press.

Gardner, H. (1993). *Frames of mind: the theory of multiple intelligences*. London: Fontana Press.

Gibbs, G. (1992). *Improving the quality of student learning*. Bristol: Technical and educational services.

Greeno, J. P., & Hall, R. P. (1997). Practicing representation: Learning with and about presentational forms. *Phi Delta Kappan, 78*(5), 361-367.

Laurillard, D. (1993). *Rethinking University Teaching*. London: Routledge.

Lieberman, D. A., & Linn, M. C. (1991). Learning to learn revisited: computers and the development of self-directed learning skills. *Journal of Research on Computing in Education, 23*(3), 373-395.

Lipman, M. (1991). *Thinking in education*. Cambridge: Cambridge University Press.

McConnell, D. (1999). Examining collaborative assessment process in networked lifelong learning. *Journal of Computer Assisted Learning, 15*(2), 232-243.

McLoughlin, C., & Oliver, R. (1998). Maximising the language and learning link in computer learning environments. *British Journal of Educational Technology, 29*(2), 125-136.

Nightingale, P., Wiata, I. T., Toohey, S., Ryan, G., Hughes, C., & Magin, D. (1996). *Assessing learning in universities*. Sydney: University of New South Wales Press.

Ramsden, P. (1992). *Learning to teach in higher education*. London: Routledge.

Schraw, G., & Dennison, R. S. P. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology, 19*, 460-475.

Shaffer, D. W., & Resnick, M. (1999). "Thick" authenticity: New media and authentic learning. *Journal of Interactive Learning Research, 10*(2), 195-215.

Vermunt, J. D. (1995). Process-oriented instruction in thinking and learning strategies. *European Journal of Psychology of Education, 10*, 325-349.

Volet, S., McGill, T., & Pears, H. (1995). Implementing process-based instruction in regular university instruction: Conceptual, methodological and practical issues. *European Journal of Psychology of Education, 10*, 385-400.

Wiggins, G. P. (1998). *Educative assessment*. San Francisco: Jossey Bass.

Supporting Constructivist Learning through Learner Support On-line

Catherine McLoughlin
University of New England, Armidale, Australia
mcloughlin@metz.une.edu.au

Koos Winnips
University of Twente, Netherlands
Winnips@edte.utwente.nl

Ron Oliver
Edith Cowan University, Australia
r.oliver@cowan.edu.au

Abstract: One important means of assessing the effectiveness of the teaching-learning transaction in technology supported environments is through analysis of the learner support system. Increasingly, as learners utilize the WWW for collaborative learning, support systems contribute to the processes of learning and assist the learner in developing competencies and confidence in self-regulated learning, social interaction and self-evaluation. Traditionally, the most common form of supported learning has been an apprenticeship, where a novice learns through active participation in a task, initially only peripherally and then assuming more control and ownership. Originating in the socio-cultural perspective of Vygotskyan theory and developed by later theorists, the concept of scaffolding has been extended by practical applications in technology-based environments. As the World Wide Web becomes increasingly integrated into the delivery of learning experiences in tertiary institutions, the concept of scaffolding needs to be redefined because it is not readily translated into teaching contexts which are not face-to-face, as in on-line environments. The aim of this paper is to offer a reconceptualisation of the term scaffolding and to provide actual examples of how learners can be supported in the processes of constructivist inquiry in WWW environments.

Introduction: Conceptualising learner support

The term 'scaffolding' is increasingly used to describe certain kinds of support which learners receive in their interaction with experts, teachers and mentors as they develop new skills, concepts or levels of understanding. Bruner, Wood & Ross (1976) originally coined the term scaffolding as a metaphor to describe the effective intervention by a peer, adult or competent person in the learning of another person. The term can be traced to Vygotsky's concept of "the zone of proximal development", that is the actual developmental level of the learner compared with the level of potential development that can occur with guidance or collaboration with a more competent person. In technology supported learning environments, the metaphor of scaffolding is appealing in principle, yet elusive and problematic. The appeal of the concept lies in the fact that it directs attention to the role of the instructor or teacher in the learning process, and does so in a way which emphasizes that good teaching is necessarily responsive to the state of understanding achieved by particular learners. In earlier research therefore, scaffolded instruction was conceived as a joint interaction in which the teacher and the learner share the responsibility for learning (Vygotsky, 1978; Wood, Bruner & Ross, 1976). In environments mediated by technology, a human tutor, peer-students or intelligent agents can provide scaffolding so that learners attain new skills, concepts and knowledge.

Theoretical perspectives on scaffolding

It is important to trace the early origins of research on scaffolding in order to appreciate its complexity. The socio-cultural approach emanating from the work of Vygotsky has had a major influence on the development of scaffolded instruction and apprenticeship models of learning (Vygotsky, 1978; Wood & Wood, 1976; Rogoff & Lave, 1984; Collins, Brown & Newman, 1989). Much of this work emphasizes the role of social interaction as a cultural amplifier to extend children's cognitive processes, with an adult or expert introducing learners to the conceptual tools available in society. For cognition to be analyzed, culture and context are the fundamental units of consideration, as human development is seen to be located and immersed in social practices (Vygotsky, 1978). This perspective resists the separation of the individual from society and the daily environment, and perceives meaningful activity as embedded in authentic and socially-created situations. This perspective has had profound and far-reaching influences on how current practitioners design learning environments (e.g., Jarvela, 1995; Roschelle & Teasley, 1995). Cognitive change can occur through processes of social interaction in which ideas are articulated, shared, revised, modified and adopted because of their relevance to the cultural context (Roschelle & Teasley, 1991; Newman, Griffin & Cole, 1989). Learners progress through developmental changes by attempting successive approximations of the learning task, assisted by peers, more able others or by a tutor. Support offered in the form of dialogue, collaborative tasks, structured questioning and demonstration of skills has been found to be effective in enabling cognitive change (Hmelo & Day, 1999; Palincsar, 1986).

The mechanisms for assisting learner cognition through the zone of proximal development (ZPD) have been extended greatly by technology applications. Originally, the teacher's role was conceived as providing scaffolded assistance through *modelling, contingency management, cognitive structuring* and *feedback* (Tharp & Gallimore, 1988). Through *modelling*, tasks, skills and concepts can be demonstrated while retaining complexity and authenticity, so that learners can become engaged in the acquisition of new skills. *Contingency management* is concerned with recognizing and rewarding learner actions, while *feedback* enables students to compare themselves to others. In *cognitive structuring*, learners are assisted to organize their own experiences following the provision of explanations, or meta-level strategies to enable students to organize their own thinking. An example of cognitive structuring can be constructing a concept-map of a problem situation. Later, these mechanisms are internalized and become metacognitive strategies for students to regulate theirs own learning. In addition, verbal scaffolds such as instructing, questioning and cognitive structuring enable students to organize their own activities by suggesting meta strategies that students can acquire so that teacher support becomes " ... a heard, regulating voice, a gradually internalized voice that then becomes the pupil's self-regulating 'still small' instructor." (Tharp & Gallimore, 1988, p. 57).

Extending the concept of scaffolding

Some similarities and differences emerge when we compare recent work on scaffolding with earlier research conducted in the 1980's. For example, much of the work of the Cognition & Technology Group at Vanderbilt (CTGV) has emphasized the notion of anchoring instruction in everyday authentic contexts (CTGV, 1993; 1996). However a major difference is that earlier work (Hogan & Pressley, 1997; Newman, Griffin & Cole, 1989; Palincsar, 1986; Rogoff & Lave, 1984; Tharp & Gallimore, 1998; Wood, Bruner & Ross, 1976) has been conducted in face-to face (F2F) classrooms, where forms of verbal interaction were the most common forms of scaffolding. Teachers and learners in F2F classrooms share the same space, and engage in learning processes in the social context with its prescribed rules, roles and expectations. This may limit scaffolding to teacher initiated forms of intervention. For example, in many traditional classrooms, questioning has been shown to be a form of social control (Edwards & Westgate, 1994). Many of these social constraints are not present in the virtual classrooms or in contexts where learning is asynchronous. In addition, the nature of scaffolding in such face-to-face classrooms was assumed to be asymmetric in that the teacher was regarded as the expert, and the student as novice. Recent advances in communications technology and in pedagogy envisage an active, participatory role for students, as initiators and co-participant in self-regulating learning process (Boeckaerts, 1995; Brown & Campione, 1994), and therefore the concept of scaffolding needs to be extended to include forms of peer assessment.

A consideration of more recent work in technology-supported environments illustrates how the concept of scaffolding has expanded to include many innovative forms of support, increased responsibility for students and a fading of the directive of asymmetrical aspect of earlier work on scaffolding (e.g. Rada & Yazdani, 1998). While Vygotskyan theory provides the theoretical anchoring for the concept of scaffolding by making an explicit connection between social interaction and cognitive development, other forms of support can be provided by technology thus enabling learners to engage in cognitive change and skills advancement.

Designing multiple forms of WWW-based course supports

As the World Wide Web becomes increasingly integrated into the delivery of learning experiences in higher education, the concept of scaffolding needs to be redefined because it is not readily translated into contexts where the teacher is not present, as in on-line environments. This calls for a reconsideration of the nature of scaffolding and for the alignment of theory with practice in higher education (Collis, 1997; 1998). As yet, research focusing on the nature of scaffolds and their functions in specific contexts of technology-supported learning is limited. Through the provision of examples from a range of contexts where technology is used to mediate the teaching transaction, it is possible to show that the notion of scaffolding offers a way of conceptualizing the process of effective learning by:

- Reducing the scope for failure in the task that the learner is attempting.
- Enabling learners to accomplish a task that they would not be able to achieve on their own.
- Bringing learners closer to a state of independent competence.

As technology extends learning beyond the classroom to learning communities, so must roles and concepts of learning and teaching be reconsidered (Collis, 1998). In WWW-supported learning environments, distributed groups of learners can be supported in the learning process by using different technological functionalities, which support dialogue and interaction (see Table 1). With its great potential for collaborative learning, particular forms of scaffolding are needed to provide models, examples and support for the processes of active learning characterized by:

- Self-responsibility for thinking and learning.
- Awareness of social responsibility.
- Thinking and acting scientific processes.
- Relating group process and product with professional practice.
- Articulation of reflection.
- Viewing a problem from multiple perspectives.

Developing WWW functionalities to support, or scaffold group processes and cognition can support collaborative work. Collis (1997) has 're-engineered' academic courses and developed a number of 'tools' to enable group work, sharing of resources, ideas and so that processes and products are integrated. Through a shared workspace environment, students can access texts, documents and other resources, add resources and interact with others through conferencing facilities. Table 1 displays a number of scaffolding solutions using WWW tools to enable cognitive outcomes and processes that underpin successful learning. In the right column, a list of scaffolds afforded by WWW tools is provided.

Table 1: Examples of scaffolds afforded by WWW functionalities

WWW Tool	Cognitive goal	Learning processes	Scaffolding afforded by tools
E-Mail	Articulation, revision and justification of ideas	Conversing, Questioning and group dialogue	• Online mentoring • Peer support • Guided reflection
Threaded computer conference	Group dialogue	Collaborative problem solving, articulation and elaboration of views, reflection	• Guided reflection • Peer support
Frequently asked question space	Questioning, self-directed learning	Metacognitive awareness, self responsibility	• Support for questioning • Peer support • Tutor support
Hypelinked access to course resources	Self-regulated learning	Exploration, searching and evaluation of resources	• Access to resources • Independent inquiry
Collaborative workspace and workflow tools	Higher order cognition, social and collaborative skills	Viewing issues form multiple perspectives, awareness of social responsibility	• Resource sharing • Management of group processes
Chat	Articulation, reflection, peer interaction	Socio-cognitive dialogue, questioning, per support	• Support for social processes and peer dialogue

Some examples of key indicators of effective scaffolding in Web-based environments include:

- The provision of learning resources to help students solve their own problems and share them with others (e.g. Guzdial & Kehoe, 1998).

- Offering multiple channels of communication should enable conversation, exchange of ideas and discussion.
- Provision of support for collaborative tasks and development of higher order cognition.
- Embedding scaffolding in the organization of a course as a planned and graded activity (Collis, Winnips, & Moonen, in press).

It is advocated that these scaffolding features are built into the design of Web-based course support environments, since its activities tend to be less structured than face-to-face instruction, utilizing principled design processes (Collis, 1997). Approaches for structuring the activities can be found in existing technological approaches, as described in the next section.

Innovative approaches to assist learning using technology-based scaffolds

Apart from utilizing the functionalities of the WWW to support learning, recent research in technology mediated environments presents an array of possibilities and perspectives on scaffolding. By investigating these applications it is possible to compare and extrapolate common features and propose principles for future research. Four examples of scaffolded instruction using hypermedia provide contrasting scenarios for recent interpretations of scaffolded instruction.

Computer supported-intentional learning environments (CSILES)
This approach, conceived by Scardamalia & Bereiter (1989; 1992; 1993) provides a powerful collaborative medium based on anchored design and discourse space, in which students can negotiate and construct new understandings. In the environment, the teacher's role is transformed from that of manager to facilitator of student collaborative processes. A CSILE is an experimental computer system which can mediate shared spaces for collaborative knowledge building. The basis for this is a shared communal database, which gives students a common space to create and communicate the ideas and representations that emerge from individual and group work. In addition to supporting social interactions needed for shared understanding, it provides facilities required for reaching reciprocal understanding, and facilities for the shared product to be expanded, altered, clarified, elaborated and manipulated for new meanings to emerge. A shared database of text notes and graphics notes allows learners to access and collaborate on the creation of knowledge objects. CSILES have inspired further work and have provided a supportive medium for a number of projects (Cognition and Technology Group at Vanderbilt, 1993).

Intelligent tutoring systems (ITS)
In an intelligent tutoring system, learners are guided through a learning process and provided with a structure and sequences of task to assist them. Well known examples can be seen in the work of Andersen et al (Anderson, Boyle, Corbett & Lewis, 1990; Anderson, Boyle & Reiser, 1985) in which students are taught to solve algebra word problems, develop programs and generate geometry proofs. By reducing the complexity of the task and providing cognitive structuring, an ITS can scaffold learning. In an intelligent tutoring system, a learner's progress is charted against an expert model of the process, which the student is expected to model. Intelligent tutoring systems have been criticized for lack of authenticity in the learning task, and for creating tasks where students do not have to engage in real life problem solving (Gudzial & Kehoe, 1998). In ITS environments, collaboration in learning is less essential than in other apprenticeship settings.

Goal-based scenarios (GBS)
Goal-based scenarios are a learning setting where students have to engage in an authentic setting where they are presented with a goal to achieve. The objective is for students to acquire and develop the prequisite process skills and conceptual knowledge to attain the goal (Schank, Fano, Bell & Jona, 1992, Acovelli & Gamble, 1997). Students are provided with technology-based resources to achieve these goals, and their performance is compared to that of a successful model of the process. If a learner cannot achieve the goal, scaffolding is provided in the form of process information which gives corrective feedback in story form to help the learner to address the problem. In a GBS students interact with agents embedded in a system, rather than with socially-based collaborators or peers. BGS are nevertheless unable to provide feedback or support for complex abstract processes where there is no single solution.

Design support environments (DSE's)

Design support environments are aimed at supporting students through a form of software realized scaffolding tailored to assist students engaged in design of software or instruction. In DSE's the environment is simplified by providing a large number of cases, coaching students in the design process and fading the scaffolding (Gudzial, 1998). Instead of providing students with problems, they simply scaffold the design process. A further feature of some DSE's is that they provide adaptive scaffolds, where students can choose or turn off various scaffolds that are not required, thereby fading support. A different example is given in Collis, Winnips, and Moonen (1999) where the design process is monitored by delivery of (WWW-based) prototypes. Based on monitoring information of groups, the design process is scaffolded. Scaffolding is done by sending text messages to the groups with personal comments to the subgroup and to individuals within it, via the WWW site, expanding on the prototype that is delivered. Often, for example, the instructor would mention his or her own feelings about the product, give background information, or add some ideas for the design.

Conclusion: Minimum design specifications

Each of these forms of technology-based scaffolds offer a unique perspective on learner support, consistent with the original conception that cognitive growth can be assisted by offering relevant, timely and contextualised assistance (Collins, Brown & Newman, 1989). While each form of scaffolding provides support, each differs in the level of social support, collaboration with peers and type of feedback offered. By considering these forms of scaffolding a minimum design specification might be based on what we already know about effective interaction between tutor and learner, or between learners collaborating in a problem-solving task. These may be summarised as follows for technology supported environments:

- Technology can provide a bridge between a learner's existing knowledge and skills and the demands of a task; by providing a structure and a link between the known and the unknown, technology can support the learners' problem solving.
- Technology can provide the representational tools to model or simulate an "out of reach" concept, thus creating an authentic environment for the learner.
- Technology can enable the novice to undertake a task at her/her existing level of competency, and then transfer responsibility to the learner.

These examples, illustrated in our talk with examples from tertiary learning contexts, show that by creating and evaluating forms of scaffolding with technology, researchers are now developing more principled and innovative forms of instructional design to guide the process.

References

Acovelli, M., & Gamble, M. (1997). A coaching agent for learners using multimedia simulations. Educational Technology, 37(2), 44-48.

Anderson, J. R., Boyle, C. F., Corbett, A. T., & Lewis, M. W. (1990). Cognitive modelling intelligent tutoring systems. *Artificial Intelligence, 42*, 7-49.

Anderson, J. R., Boyle, C. F., & Reiser, B. J. (1985). Intelligent tutoring systems. *Science, 228*, 465-462.

Boekaerts, M. (1995). Self-regulated learning: Bridging the gap between metacognitive and metamotivation theories. *Educational Psychologist, 30*(4), 195-200.

Brown, A. L., & Campione, J. C. (1994). Guided discovery in a community of learners. In K. McGilly (Eds.), *Classroom lessons: Integrating cognitive theory* Cambridge, Mass.: MIT Press.

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing and mathematics. In L. B. Resnick (Eds.), *Knowing, Learning and Instruction: Essays in Honour of Robert Glaser* (pp. 453-494). Hillsdale, New Jersey: Lawrence Erlbaum.

Collis, B. (1997). Supporting project-based collaborative learning via a World Wide Web environment. In B. Khan (Eds.), *Web-based instruction* (pp. 213-221). Englewood Cliffs, NJ: Educational Technology Publications.

Collis, B. (1998). New didactics for university instruction. *Computers and Education, 31*(4), 373-395.

Collis, B. A., Winnips, J. C., & Moonen, J. J. C. M. (1999). Scaffolding and the use of the WWW: Does it pay off? Manuscript submitted for publication.

(CTGV) Cognition and Technology Group at Vanderbilt (1993). Anchored instruction and situated cognition revisited. *Educational Technology, 33*(3), 52-70.

(CTGV) Cognition and Technology Group at Vanderbilt (1996). Designing learning environments that support thinking: The Jasper series as a case study. In T. M. Duffy, J. Lowyck, & D. H. Jonassen (Eds.). *Designing environments for constructive learning* Berlin: Springer-Verlag.

Edwards, A. D., & Westgate, D. (1994). *Investigating classroom talk* (Revised and extended second edition ed.). London: The Falmer Press.

Guzdial, M., & Kehoe, C. (1998). Apprenticeship-based learning environments: A principled approach to providing software-realised scaffolding through hypermedia. *Journal of Interactive Learning Research, 9*(4), 289-336.

Hogan, K., Pressley, M. (1997). *Scaffolding student learning: Instructional approaches and issues.* Cambridge, MA: Brookline Books.

Hmelo, C., & Day, R. (1999). Contextualised questioning to scaffold learning from simulations. *Computers & Education, 32*(2), 151-164.

Hmelo, C. E., Guzdial, M., & Turns, J. (1998). Computer-support for collaborative learning: Learning to support collaborative engagement. *Journal of Interactive Learning Research, 9*(2), 107-129.

Jarvela, S. (1995). The cognitive apprenticeship model in a technologically rich learning environment: Interpreting the learning interaction. *Learning and Instruction, 5*, 237-259.

Lave, J. (1991). Situating learning in communities of practice. In L. B. Resnick, J. Levine, & S. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 63-82). Washington, D.C.: American Psychological Association.

Newman, D., Griffin, P., & Cole, M. (1989). *The construction zone: Working for cognitive change in school.* Cambridge: Cambridge University Press.

Palincsar, A. S. (1986). The role of dialogue in scaffolded instruction. *Educational Psychologist, 21*(1,2), 71-98.

Rada, R., & Yazdani, M. (1998). Artificial intelligence and education [Special issue]. *Interactive Learning Environments, 6*(1/2).

Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context.* New York: Oxford University Press.

Rogoff, B., & Lave, J. (Ed.). (1984). *Everyday cognition: its development in a social context.* Cambridge, Mass, & London: Harvard University Press.

Roschelle, J., & Teasley, S. D. (1995). The construction of shared knowledge in collaborative problem solving. In C. O'Malley (Eds.), *Computer Supported Collaborative Learning* (pp. 69-100). Berlin: Springer Verlag.

Scardamalia, M., & Bereiter, C. (1992). An architecture for collaborative knowledge building. In E. D. Corte, M. C. Linn, H. Mandl, & L. Verschaffel (Eds.), *Computer-based learning environments and problem solving* (pp. 41-66). Berlin: Springer-Verlag.

Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *Journal of the Learning Sciences, 3*(3), 265-283.

Scardamalia, M., Bereiter, C., R. McLean, & Woodruff, J. (1989). Computer-supported intentional learning environments. *Journal of Educational Computing Research, 5*(1), 51-68.

Schank, R. C., Fano, A., Bell, B., & Jona, M. (1994). The design of goal-based scenarios. *Journal of the Learning Sciences, 3*(4), 305-346.

Tharp, R. G., & Gallimore, R. (1988). *Rousing minds to life*. Cambridge: Cambridge University Press.

Tiessen, E., & Ward, D. R. (1997). Collaboration by design: Context, structure and medium. *Journal of Interactive Learning Research, 8*(2), 175-197.

Vygotsky, L. (1978). *Mind in society: the development of higher psychological processes*. Cambridge MA: Harvard University Press. (Original material published in 1930, 1933 and 1935).

Wood, D. (1991). Aspects of teaching and learning. In M. Richards & P. Light (Eds.), *Children of Social Worlds* (pp. 191-212). Cambridge: Polity Press.

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of child psychology and psychiatry, 17*(2), 89-100.

Wood, D., & Wood, H. (1996). Vygotsky, tutoring and learning. *Oxford Review of Education, 22*(1), 5-10.

Preparing Learners for Self-Regulation and Professional Practice through Web-based learning: Design Recommendations

Catherine McLoughlin
Teaching & Learning Centre
University of New England
Armidale, NSW 2351, Australia
mcloughlin@metz.une.edu.au

Barbara McCartney
School of Accounting, Finance and Entrpeneurship
University of New England
Armidale NSW 2351, Australia
bmccartn@metz.une.edu.au

Abstract: Self-regulation is arguably the most enduring and recognised outcome of learning, and is recognised to be so at secondary, tertiary and technical levels of the educational system. Developing self-direction is also essential to success in professional world of work. At the University of New England (UNE), these principles are endorsed and articulated as outcomes or generic attributes that undergraduates need to attain. In order to implement and foster these attributes, design guidelines are specified in order to utilise particular attributes of online technologies to design a learning community characterised by peer support, investigation, collaboration and reflection. Design recommendations derived from constructivist and generative learning theories are applied to online units in area of E-commerce and Accounting Information Systems offered by UNE. Task design is linked to preparation for professional practice. Our experience suggests that in on-line learning settings, development of self-regulation and independent learning requires a focus on social, experiential, propositional and process aspects of learning, rather than on purely cognitive learning episodes.

Introduction

Information technologies and computer mediated learning are now an established part of learning environments in higher education, and much software enables the setting up of bulletin boards, chat and conferencing where learners can engage in discussion, team work and exchange of ideas. However, the changing nature of tertiary education in Australia has resulted in increased emphasis on outcomes, and on skills that are transferable to the workplace. Online design for learning must therefore become more streamlined and outcomes oriented whilst maintaining fundamental integrity. Greater emphasis on generic competencies are now part of the mission statements of universities, and the University of New England has developed a list of generic attributes that graduates of the university are expected to attain. Instead of being focused on acquisition of content and disciplinary knowledge, the generic attributes are expressed in terms of core skills such as team work, information literacy, problem-solving, social responsibility and communication skills. This policy has resulted in a reassessment of the approaches to teaching and learning, activities that cultivate generic attributes, the role of disciplinary understanding and the context in which generic skills are fostered. There is considerable evidence in the literature that that the most important competencies for graduates are critical thinking, adaptability, self-evaluation and the capacity to be self-regulated, while at the same time having the skills to work in teams (Candy, 1994).

Three kinds of knowledge required for professional education

Curriculum planning in the School of Accounting, Finance and Entrepreneurship at the University of New England is underpinned by a strong orientation to preparing students for professional practice and a movement away from a purely content-based focus on acquiring facts, decontextualised knowledge and disciplinary content. Preparation of learners to respond to change and a dynamic workplace are now values that are being
integrated into the planning of units for online delivery. The new focus requires different forms of "partnerships" within the school, such as partnerships between staff and students, between staff and real-world professionals and between staff and the different elements of the curriculum. Units are planned to cater for the development of three kinds of knowledge, based on the research of Erhaut(1992):

1. Discipline-based knowledge, concepts and generalisations. However, as this kind of prepositional knowledge base is expanding and becoming obsolete rapidly, judicious selection of content must be accompanied by pedagogies that encourage learners not to uncritically accept knowledge, but to question and evaluate.
2. The second kind of knowledge revolves around the interpretation of experience. Often prepositional knowledge remains inert, unapplied and unchallenged. Through design of tasks and activities, assumptions underlying disciplinary knowledge are brought to the surface so that they can be related to professional practice and real world experience.
3. The third kind of knowledge that distinguishes learning for the professions is process knowledge, or knowledge about how to engage in professional action. Process knowledge includes several different forms of socio-cognitive competencies, ie, the ability to select and implement appropriate method of inquiry, integration and reorganizing knowledge; activities such as planning, problem-solving and decision making, communicating information and self-management.

These forms of process knowledge clearly link with the personal and interpersonal skills that are applied in professional settings. The challenge is to use information and communications technologies to interweave propositional, process and personal knowledge. This is achieved by prioritizing the professional orientation of units and by developing approaches to teaching and learning which prepare students for independent, self-regulated learning.

Professional learning on the WWW

In tertiary settings learning is increasingly resource-based and many learners study in the off-campus mode. Technology offers a means by which distance students can join the learning space with their on-campus colleagues (Oliver, Omari & Herrington, 1998; McLoughlin & Oliver, 1998). To date, the many studies describing computer mediated learning support in university settings have focussed on particular learning activities and functionalities that enable students to communicate and share ideas. However, we now need to push beyond present boundaries and paradigms of social learning, and focus on WWW instructional scenarios that maximise learning outcomes such as higher order learning, self-regulation and self-management and professional skills. Constructivist learning theories which emphasise the role of the learner in the learning process are increasingly recognised as relevant, and, according to Reeves (1994) the prime emphasis is placed on the unique interests, styles, motivations and capabilities of individual learners so that learning environments can be tailored to them. However, with the increased emphasis on learning outcomes, educational paradigms for on-line learning also need to emphasise the value of intentional learning and goal directed behaviour where learners take an intentional orientation towards cognition, become aware of their own learning processes and engage in self-directed learning (Scardamalia & Bereiter, 1992). Where networked communications are being used increasingly to achieve the educational outcomes of generic competencies and independent learning, design recommendations are needed to ensure that learning activities are supportive of desired outcomes of transferable, professional skills.

Research on cognitive self-regulation and higher order thinking

Existing statements in current research explicitly link students' self-regulatory processes with higher order thinking and life-long learning skills (Candy, 1994). Self-regulation is regarded as a desirable educational goal as it is linked to achievement, effective problem solving capacity and greater self-realisation (Boekaerts, 1997; Mayer, 1992). Among the competencies and dispositions which students are expected to develop are generic thinking skills, independent learning strategies and information handling skills such as:

- reflection and analysis to generate and refine knowledge;
- evaluation and synthesis of ideas;
- conducting independent investigations in different subject areas;
- effective communication and group work.

At a theoretical level, there have been several attempts to provide an integrative framework for self-regulation and higher order thinking, (Resnick, 1987) but there appears to be no general consensus in the area. The concept of higher order thinking adopted from the work of Ennis (1987) provides an integrative perspective on the issue of thinking and has been influential in shaping curriculum statements about higher order thinking, defined as problem solving, self-direction and metacognition. In order to suggest strategies and approaches to underpin online learning and development, some theorists advocate that the best approach is to turn to analyses of excellent teaching and examples of people who can demonstrate higher order thinking (eg, Winne, 1995). Pressley (1995, p. 207) concludes that " instruction is best matched to students' zone of proximal development, includes a great deal of modeling and explanation of mature thought, and involves massive practice doing interesting and authentic academic tasks with teacher and peer scaffolding of such tasks." In addition, Pressley emphasises that development of such expertise is a long-term developmental process, "with real expertise in academic cognition an unlikely achievement in undergraduates". The research on how to foster self-regulation has been controversial and lacking in consensus, signaling a need for developmental frameworks for instructional designers to apply to WWW environments, which can be evaluated in practical settings.

Instructional design: Issues of theory and application

If we consider the nature and purposes of instructional design, several patterns are evident. The focus of traditional instructional design paradigms has been the creation of a learning event or learning episode for students, in which outcomes are measurable and the process is repeatable in any context. For example, the instructional design models of Dick & Carey (Dick, 1996) have remained fundamentally unchanged, and until the most recent version, the role and importance of the learning context has also remained unchanged. There has been a consistent emphasis on instructional sequences and on prescribing activities for learners, based on the assumption that all learners are similar and that needs can be determined. In contrast, constructivism, which emphasises learning rather than instruction, challenges the instructional designer to go beyond prescribed sequences and isolated learning episodes. Constructivism challenges the fragmentation of learning into steps, and the whole notion of an ISD 'model' becomes dubious because the 'model' is no longer relevant. Constructivism proposes that learner is the centre of instruction. Jonassen et al (1995) argue that with constructivism, the emphasis has changed to cognition in context, and to the design of the whole learning environment. Other theorists have also supported the notion of a learning environment. For example, Wilson (1994; 35) states that:

> *Thinking of instruction as an environment gives emphasis to the 'place' or 'space' where learning occurs. At a minimum, a learning environment contains:*
>
> - *the learner;*
> - *a setting or space wherein the learner acts, using tools and devices, collecting and interpreting information, interacting perhaps with others...*

Effective planning for learning also requires utilisation of technologies as 'cognitive tools' (Jonassen, 1997) and an understanding of theory relating to learning. This holistic perspective sees learner and teachers as co-participants and learning as engagement in joint tasks, with control over sequences, pacing and learning goals (Harper & Hedberg, 1997). The whole social and motivational context becomes part of the design process. Like Laurillard's (1993) conversational model of reciprocal activities that mediate learning, (interaction, discussion, adaptation and reflection) the emphasis on instructional design emphasised by constructivists is influenced by socio-cultural theory, originating in the work of Vygtosky, (1978). According to socio-cultural theory all learning is embedded in a social context and all interactions that occur in the social context impinge on, and contribute to learning. As an example of design heuristics or design goals, Duffy & Cunningham

(1996) propose several principles to guide instructional design based on socio-constructivist theory. In designing activities for professional learning, these principles were redefined as design guidelines, informed by constructivist and cognitive apprenticeship models of learning (Table 1).

Designing for self-regulation and authentic learning

Constructivist theory by itself does not provide guidelines for instruction. Eclecticism is essential. Intentional learning theory advocates learning as a deliberate activity, with a strong focus monitoring, self-regulation and goal directed learning (Scardamalia & Bereiter, 1994). The model has been successful in promoting a process-based model of learning at UNE and also in shaping learning interactions from teacher-oriented episodes to joint goal-oriented task between peers and groups of learners (Jarvela, 1995). However, theory needs to be converted into practical and workable design for tasks, forms of interaction and assessment activities. The design of tasks, activities and forms of assessment must be related to learners' needs, employer expectations regarding outcomes and real life contexts.

Table 1: Design recommendations for self-regulation and professional learning

Instructional design recommendation	Implementation through tasks, interaction and learning activities
Create a community of learners to create a motivating context	Create tasks with shared goals, creation and manipulation of shared spaces; use formal and informal communication channels; selective use of outsiders for insights; cooperative tasks (Anderson & Garrison, 1995)
Provide modeling and scaffolding to support the development of expertise	Create leamer access to expert models, mentors examples and procedures for dealing with problems; foster peer scaffolding and mutual support through discussions and group tasks; ensure student ownership and transfer of responsibility form tutor to learner
Foster multiple perspectives in order to foster application of knowledge to real life situations	Increase perspectives on issues by designing collaborative tasks, ill-defined problems and case-based reasoning; provide opportunities to express different points of view through verbal and oral discussion and cooperative tasks
Contextualise learning activities to develop strategic knowledge	Create anchors, real life scenarios and problems based in authentic contexts; provide access to resources used by professionals in the field
Enable articulation of ideas and reasoning processes to develop process knowledge	Provide forums for text based and verbal modes of sharing ideas; utilise multiple forms of representation such as graphs, charts and diagrams as a basis for discussion
Focus on learning processes, not products to cultivate deeper understanding	Intentional learning strategies, explicit methods of learning (Scardamalia & Bereiter 1994). Use discussion forums and projects to increase student responsibility and ownership of learning
Design problem-based learning tasks to foster mastery of a propositional knowledge base	Ensure that tasks are relevant, authentic and motivating, and have the potential to be defined by learners. Use problem-based learning and tasks requiring research, investigation, and comparison of perspectives
Support reflection to enable learners to challenge personal assumptions	Learners should have the opportunity to compare their performance with experts and other learners at varying stages of competence. Design collaborative tasks to foster metacognition and self-evaluation

Design Recommendations: Task Design in AFM 272 Accounting Information Systems

Based on our experience in developing learning environments for *E-Commerce* and *Accounting Information Systems*, we can make explicit design recommendations for other practitioners.

1. Propositional information needs to be proceduralised through application to real life scenarios.
2. Learning tasks should develop strategic skills through their experience with novel tasks.
3. Students should develop process knowledge by communicating about the cognitive strategies they apply to a particular problem.
4. Tasks should be goal directed and enable students to redefine them and formulate their own criteria for successful integration into prior experience.

These design recommendations outlined were operationalised initially in the subject *Accounting Information Systems* which was offered to a cohort of eighty 2nd year accounting undergraduate students. The propositional information was identified as the design and maintenance of an accounting information system. In addition as second year students the group had eighteen months prior accounting knowledge and experience which the task specifically encouraged them to integrate and reformulate. Focus on this activity was reinforced by a significant assessment mark ascribed to it. To accomplish the design goals:

1. Students were required to set up and maintain a computerised accounting system using the computerised accounting package *Mind Your Own Business (MYOB).* Highly specific information was given to students about the operation of the program. Little information was given about the accounting elements of the task.
2. Students were required to search the Internet to find the relevance of the program they were using, as well as confer with parents and friends then discuss this with their fellow students using asynchronous online methods.
3. Online discussion forums were set up for students to confer about problems they were having with the task and the solutions they were generating. A system of 'bonus marks' was implemented to encourage students who focussed on solutions rather than simply post 'can't do' messages. It was considered counter productive for the instructor to intervene unless there was a long thread of misinformation.

It was believed that the tasks outlined above incorporated all four design principles and led to an integrated approach to information literacy and encouraged problem solving skills. In addition the real world relevance was demonstrated to them through their own research. Given that the cohort was in the 18 - 23 year old age group it was assumed that their life experience was limited it was thought that the students would benefit from a context to view their knowledge of accounting information systems. This thinking led to the formulation of the second task based on the four design principles and a realisation that students would learn about professional activity by engaging in such activity. Therefore local businesses were approached and students were placed in teams to analyse the accounting information systems of the various businesses. Various sub-tasks were developed to enable students to both contextualise accounting information systems and engage in professional activity. Students were required to:

a. Interview the proprietor/manager of the business. They were required to design a set of and post them to the Bulletin Board for feedback.
b. Dress and speak appropriately for this interview. This created a good deal of discussion about what was 'appropriate" in a workplace context.
c. Document the accounting system for the business.
d. Write a report for the proprietor which first had to be seen by the instructor.
e. Design and post a web page within the confines of the course software about the systems in the business
f. Give a brief oral factual presentation about their findings.
g. Maintain a good working relationship with the team members.

The two tasks combined together gave students a learning experience which led to the development of an acute awareness of what professional activity could mean to each of them. The principles which underpinned the tasks have also been applied to the area of e-commerce course.

Conclusion

In this paper, preparation of students for professional practice in the areas of accounting, e-commerce and financial management is conceptualised as developing expertise in three integrated forms of knowledge, propositional knowledge, interpretation of experience and process knowledge. Each of these forms of knowledge can be developed in online environments though task and assessment design, and within a framework that encompasses intentional, constructivist learning.

References

Anderson, T., & Garrison, D. R. (1995). Critical thinking in distance education: Developing critical communities in an audio teleconference context. *Higher Education, 29*, 183-199.

Boekaerts, M. (1997). Self-regulated learning: A new concept embraced by researchers, concept makers, educators, teachers, and students. *Learning and Instruction, 7*(2), 161-186.

Candy, P., Crebert, G., & O'Leary, J. (1994). *Developing lifelong learners through undergraduate education*. Canberra: Australian Government Publishing Service.

Dick, W. (1996). The Dick & Carey Model: Will it survive the next decade? *Educational Technology Research and Development, 44*(3), 55-63.

Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonasssen (Eds.), *Handbook of Research for Educational Communications and Technology* (pp. 170-198). London: Prentice Hall International.

Ennis, R. H. (1993). Critical thinking assessment. *Theory into Practice, 32*(3), 179-186.

Erhaut, M. (1994). *Developing professional knowledge and competence*. London: The Falmer Press.

Harasim, L. (1993). Collaborating in Cyberspace: Using computer conferences as a group learning environment. *Interactive Learning Environments, 3*(2), 119-130.

Harper, B., & Hedberg, J. (1997). Creating motivating interactive learning environments: A constructivist view. In R. Kevill, R. Oliver, & R. Phillips (Eds.), *What works and why: Proceedings of the 14th Annual Conference of ASCILITE* Perth: Curtin University of Technology.

Jarvela, S. (1995). The cognitive apprenticeship model in a technologically rich learning environment: interpreting the learning interaction. *Learning and Instruction, 5*, 237-259.

Jonassen, D. (1997). Instructional design models for well-structured and ill-structured problem-solving learning outcomes. *Educational Technology Research & Development, 45*(1), 65-69.

Jonassen, D., Davidson, M., Collins, M., Campbell, J., & Haag, B. B. (1995). Constructivism and computer-mediated communication in distance education. *The American Journal of Distance Education, 9*(2), 7-26.

Laurillard, D. (1993). *Rethinking University Teaching*. London: Routledge.

Mayer, R. E. (1992). *Thinking, problem solving and cognition*. New York: W.H. Freeman and Company.

McLoughlin, C., & Oliver, R. (1998). Maximising the language and learning link in computer learning environments. *British Journal of Educational Technology, 29*(2), 125-136.

Oliver, R., Omari, A., & Herrington, J. (1998). Developing converged learning environments for on and off-campus. In R. Corderoy (Eds.), *Flexibility: The next wave? Proceedings of ASCILITE '98* (pp. 529-539). Wollongong: University of Woolongong.

Pressley, M. (1995). More about the development of self-regulation: complex, and thoroughly social. *Educational Psychologist, 30*(4), 207-212.

Reeves, T. (1994). Evaluating what really matters in computer-based education. In M. Wild & D. Kirkpatrick (Eds.), *Computer Education: new perspectives* (pp. 219-246). Perth: MASTEC, Edith Cowan University.

Resnick, L. B. (1987). *Education and Learning to Think*. Washington D.C.: National Academy Press.

Scardamalia, M., & Bereiter, C. (1992). An architecture for collaborative knowledge building. In E. D. Corte, M. C. LInn, H. Mandl, & L. Verschaffel (Eds.), *Computer-based learning environments and problem solving* (Vol. 84, pp. 41-66). Berlin: Springer-Verlag.

Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge building communities. *The Journal of the Learning Sciences*, *3*(3), 265-283.

Vygotsky, L. (1978). *Mind in society: the development of higher psychological processes*. Cambridge MA: Harvard University Press. (Original material published in 1930, 1933 and 1935).

Wilson, B. G. (1996). *Constructivist learning environments: Case studies in instructional design*. Englewood Cliffs, N. J.: Educational Technology Publications.

Winne, P. (1995). Inherent details in self-regulated learning. *Educational Psychologist, 30*(4), 173-187.

Courseware Management Tools and Customised Web Pages: Rationale, Comparisons and Evaluation

Mark McMahon
School of Communications and Multimedia
Edith Cowan University, Australia
m.mcmahon@ecu.edu.au

Joe Luca
School of Communications and Multimedia
Edith Cowan University, Australia
j.luca@ecu.edu.au

Abstract. In the rush towards web-based learning, courseware management tools are being promoted as a means of simplifying the creation and management of instructional websites. This paper examines such claims in the light of a unit in Project Management for Interactive Multimedia at Edith Cowan University. The unit was delivered in two incarnations; the first was using the tool WebCT, and in the following semester the course was delivered through a website designed specifically for the unit, by making use of ancillary tools which were custom designed or available as third party products. The two implementations are compared in terms of ease of use for student and course designer, and the potential of each approach to support specific learning strategies. Given the scope of delivering a unit such as this, the authors found that using a customised web approach was more efficient than using a courseware management tool such as WebCT. It is recommended that consideration be given to the nature of the learning environment based upon the proposed learning strategy and pragmatic issues of implementation before the selection of a delivery approach.

Introduction

This paper discusses strategic factors and issues involved in deciding what approaches should be taken to develop on-line units. On-line approaches are being advocated as a means of providing flexible learning environments that deliver learning outcomes in an effective, and above all efficient, manner. Such are the promises of on-line delivery, but as with all implementations of technology in teaching and learning, there is no direct evidence that the Web supports effective and efficient learning any better than traditional methods (Russel, 1999).

It is certainly true that on-line learning can reduce the costs involved in organisational infrastructure such as purchasing real estate and computer laboratory equipment. There also appears to be an assumption that there are economies of scale to be gained in human resources by reducing student-teacher contact time through the implementation of easy to use tools which enable educators to easily develop, maintain, and update learning content. Courseware management tools such as TopClass and WebCT are promoted as "easy-to-use environment[s] for creating sophisticated WWW-based courses that are otherwise beyond the ability of the non computer programmer" (ULT, 1999) and claim to "make it easy to transform existing instructor-led content into online learning materials" (WBT Systems, 1999).

However, such claims are not easy to justify, however. While there are many studies which seek to compare between specific courseware management tools (eg Infoworld, 1998; PC Week, 1997), the efficiency and effectiveness of these products in comparison to customised Web based environments is less easy to define. Where student numbers are small, and the requirements are modest in terms of functionality, it may be that a purpose-built Website may provide a better alternative to implementing a courseware product. The potential of courseware management tools is dependent upon such factors as the ease with which the course can be developed and administered, and the quality of the interface for end users, but also the extent to which the product provides flexibility in the development of on-line learning strategies. It may be that while such tools require less initial investment in time and money, the requirements for implementation, maintenance, and their inflexibility with regard to interface and the types of learning activities they support may lead to less effective design, and consequently less successful learning than customised environments.

This paper examines the use of a courseware management tool, WebCT, in the delivery of a single undergraduate unit in Multimedia Project Management. The course operated using WebCT in the first semester of the academic year, and was then delivered using a customised Web-based environment in the second semester. The two approaches are compared in terms of:

- ease of development and administration by lecturers;
- ease of use and accessibility for the students; and
- potential for supporting instructional strategies appropriate to the unit.

A Taxonomy of Courseware Management Tools

There are many tools available which have been designed to deliver on-line learning, and it is important to distinguish between them. While some products are designed for system wide implementation, and link into existing enterprise systems such as student and financial databases, many are less complex 'shrinkwrapped' products which attempt to offer whole solutions to education and training systems. Typically, these maintain student records in proprietary file systems and are designed to facilitate courseware development for novice developers or lecturers.

Examples of courseware management systems are PlaNet Manager (Planet Software, 1999), Southrock GEM (Southrock behavioural objectives as well the educational philosophy that underpins the strategy.

Traditional approaches to computer assisted learning have generally been based upon objectivist epistemology and behaviourist methods (Reeves & Reeves, 1997). Contemporary approaches, however, tend to focus more on the multitude of ways in which learning can be mediated through cognition and social interaction. This shift in educational theory has been in tandem with the development of the Internet as a learning medium, and the Internet as been advocated as an ideal tool for social constructivist learning, since it provides the networked communication necessary for the collaboration and dynamic content delivery; all of which were impossible in fixed media such as CD-ROMs (McMahon, 1997).

Constructivist approaches emphasise the role of the individual in generating learning. Rather than a process of stimulus/response, user's are actively engaged in making meaning through cognitive accommodation and/or assimilation (Piaget, 1977), or through social interaction (Vygotsky, 1978). Vygotsky argued that learning comes about through social negotiation within a cultural context, with language as the primary enabling tool. This social constructivist philosophy has been expanded on recently, introducing the notion of cognitive apprenticeship (Brown, Collins & Duguid, 1989) through which students learn in a manner similar to traditional apprenticeships. The students access expertise through mentors, whose role is to facilitate rather than teach, and the aim of learning is to solve realistic and practical problems in an authentic setting. Just as in traditional apprenticeships, learners engage in activities 'on-the-job' rather than through the teaching of abstract concepts. The argument is that students are better equipped to approach non-familiar problems and produce solutions that are appropriate to a given culture.

Social Constructivism formed the theoretical basis for this unitwith the ultimate view of learners as developing practitioners in the field of Interactive Multimedia. Strategies used in the project management course included:

- having students develop a web site for a client, which simulates how these students will be working when they gain employment;

- having students form project teams of approximately four students to develop a web site to promote collaboration;
- promoting asynchronous discussion and collaboration by having student task teams (different to the project teams) present a weekly topic on the bulletin boards;
- promoting synchronous on-line discussion through the use of chat facilities;
- having the students work with complex problems which have multiple potential solutions.

WebCT Development

Transferring this course to an on-line environment using WebCT required careful thought and planning. Which WebCT icons would be useful for the design of a home page? How could the required instructional features required by the course be transferred to WebCT? In order to answer these questions it was necessary to firstly learn and understand how to use all the functions and tools available in WebCT. Much reading, advice and experimentation with WebCT was required before settling on a home page which appeared to satisfy all the course requirements. It became obvious that there were many ways of designing the home page. Using different combinations of icons in WebCT could change the instructional focus of the course, or change the way that students accessed the content. Also, careful consideration of interface design issues was needed, as too many or inappropriately designed icons would be confusing to new users and add unnecessary cognitive load.

After much consultation with other WebCT users and experimentation with WebCT icons, the icons shown in Figure 1 were used on the WebCT Home Page. Table 2 below shows the order of importance of each of the icons for the instructional strategy used in this case.

Table 2. WebCT Homepage Icon Ranking

Rank	WebCT Icon Used	Description
1	Bulletin Board	Discussing weekly topics and any general questions
2	Password	Changing student passwords
3	Homepage	Each student presents their background and interests
4	Presentation	Server space for students to put samples of work for comment and final web sites
4	Technical Support	Help for students in down-loading and using "Hotline" to transfer files into the presentation area
4	Past Student Projects	Completed web sites from last semesters students
5	My Progress	Used mainly by the tutors to assess the amount of messages posted and read by each student
5	Survey	Survey form to evaluate the course
7	PowerPoint Presentations	Lecture slides made available
7	My Record	Shows students marks for different assessment points
7	Calendar	A day by day breakdown of student activities and assessment points
10	Chat	Chat tool
10	Whiteboard	Interactive whiteboard tool

**Ranking Code: 1 = most important, 10 = lease important*

The *Bulletin Boards* were the most heavily used part of the WebCT environment. As shown in Figure 2, a bulletin board was created for each of the ten weeks that content was delivered. From week 3 onwards, a student task team was responsible for the delivery of this content. The "Main" bulletin board, which had over one third of the total messages was set up to allow students to ask questions or raise issues about anything other than the weekly discussion topic.

There was little intervention by the tutors on the bulletin boards, except to assist when it was obvious that the students would not resolve an issue or question. Tutors would always wait a few days before answering a posted question in order to give other students the opportunity of answering, and hence obtain some marks for bulletin board contributions which accounted for 30% of their total mark. Students were encouraged to develop discussion threads, which were relevant to a weekly topic, or other issues related to multimedia project management, making the environment truly student centred.

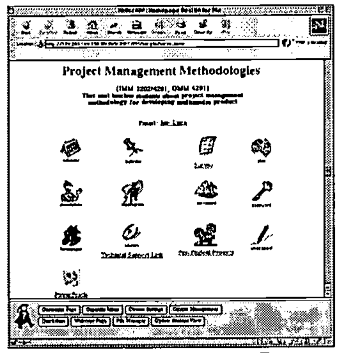


Figure 1. WebCT Home Page

The five elements used for assessing student's progress in the unit are shown in table 3. The student's final mark was a combination of project team, task team, individual, client and peer assessment marks. This provided a rich form of assessment for the students, but was found to be time consuming by all the tutors.

Table 3. Assessment Methods

Assessment Method	Project Team	Task Team	Individual Mark	Client Mark	Task Peer Mark	Project Peer Mark
WebCT - Quantitative Measures (Posted, Read, Hits)		✓	✓			
WebCT - Qualitative Measures Text Analysis		✓	✓			
Web Site – Quality of final product	✓			✓		
Written Assignment	✓			✓		
Reflective Report			✓			
Communication and Contribution				✓	✓	✓

WebCT provided comprehensive quantitative measures for recording the number of messages "Posted", "Read" and "Hits" made by students. This gives tutors a quick idea of how students are using the WebCT environment ie which students are "lurking" and not posting messages. However, while it can provide some valuable data for tutors if they are trying to assess the amount of effort individual students are contributing toward the unit, it does not give a good indication of the 'quality' of submissions. In order to assess this, a content analysis model based on Henri (1992), and Gunawardena et al (1997) was implemented. While this was an effective approach, which supported the social constructivist philosophy behind the unit, it was cumbersome to implement, and was used predominantly because bulletin boards are the primary mode of collaboration supported by WebCT.

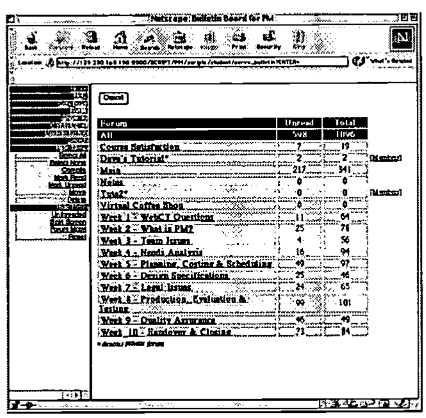


Figure 2: WebCT Bulletin Board Summary of Messages Posted

Customised Web Site Development

In semester 2, 1999 the same project management course presented to students in semester 1, 1999 using WebCT, was delivered through the use of a customised web site. The web site (http://www-scam.cowan.edu.au:5425/units/imm3202/default.html) was built using Macromedia Dreamweaver (Macromedia, 1998) and Filemaker Pro (Filemaker, 1999).

As with constructing the WebCT course in the first semester, the instructional strategies required for the unit were carefully considered before construction on the site started. The main instructional difference that occurred in the second semester was changing the instructional focus from the bulletin boards in the first semester (as with WebCT) to a problem solving strategy.

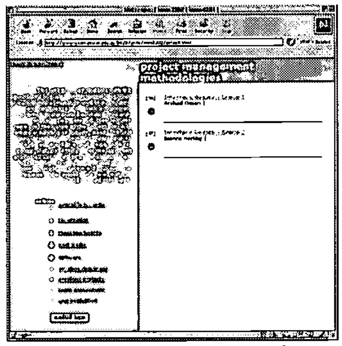


Figure 3: Customised Web Site

As shown in Figure 3, the site is relatively simple to access without the use of passwords. There was no need to set up student's accounts or a database to enable student logins. The options shown were specifically chosen to meet the needs of the syllabus as follows:

- *available projects* option. This was as used to allow students to choose from a list of available project topics that they would develop as a team during the semester. All the topics are related to a project management concept, such as interface design, legal issues, analysis etc. When students selected a project, it then appears in the right hand frame. The blue underline hyperlinks to a description of the project and the circular icon hyperlinks to a student presentation area, where students keep putting up prototypes for peer and tutor evaluation;
- *Registration* option. Was used to collect student details such as e-mail, phone, address, skills, previous employment and other details. Students also entered a password, which then enabled them to go back into the database and change their details if necessary;
- *Message Boards* option. Allowed the use of bulletin boards. However, in this semester this was not a high priority and not used very heavily;
- *Post a URL* option. Allowed students to share useful web site (and also attract bonus marks) by making useful URL's available to other students. This area was set up in project management categories so that when URL's were found students posted them to the relevant category, along with a comment about the site;
- *Software* option. Presented students with information and software needed to transmit files from their desktop computers onto the file server to show prototypes and in order to receive feedback;
- *Syllabus Documents* option. Allowed students to down-load syllabus and other resources needed for *the unit;*
- *Previous Projects option.* Showed past student's project work, which illustrated the standard of work expected; and
- *The RONSUB Login* button. This gave students access to the problem submission and peer assessment environment, which was a purpose built software application. It provided students with tools to submit their solution and then rank the solutions of their peers. Students who received the highest number of votes were given the highest scores.

Discussion

A comparison of the WebCT and customised web site environments can be made according to ease of development and administration by lecturers, ease of use and accessibility for the students and potential for supporting instructional strategies appropriate to the unit.

Given that the WebCT site was not a centralised university initiative, without direct links to the central student database and without central technical support, it was a difficult and time consuming task to set up for only one group of ninety students. Student logins and passwords had to be established for all students and tutors, along with other initial database requirements. Also, any WebCT technical problems were generally complex in nature and often required assistance from the WebCT on-line help facility, which sometimes was not fast enough to solve pressing problems.

In comparison, setting up the customised web site was relatively simple. Even without any technical skills, a site such as shown in Figure 3, can be cheaply and quickly created by a multimedia developer for minimal cost, which would "pay for itself", as it would not have any royalty payments.

With the customised web site it was easier to add customised features eg the inclusion of "RonSub", purpose built problem presentation and peer assessment tool, was easily embedded into the customised web page. The inclusion of previous student web projects and web space for students to load working progress of their prototypes was simpler and quicker to implement in the customised web site environment. To present these within the WebCT environment requires files to be packaged or "zipped" and then loaded with the File Manager. In some cases, HTML editing is required to make the web pages work correctly.

Training students to use the WebCT environment required one week of the course getting students on-line with passwords, and also familiarising them with WebCT interfaces for Bulletin Boards, Presentation areas, File Manager, Personal Home Page tools etc. The tutors also needed training to become familiar with the WebCT environment and interface. Students often complained about difficulties in logging onto the WebCT environment (due to incorrect passwords or technical problems) and also about slow response times and screen refresh rates. This has not been the case with the customised web site environment. No login is necessary and there is no extra cognitive load in learning a new interface to access the customised web site, as it allows the flexibility required to make an intuitive interface.

Both WebCT and the customised web site environment supported learning strategies needed for this course, based on social constructivist learning theory. WebCT offered bulletin boards, chat, whiteboard, e-mail (internal to WebCT), public home pages, presentation areas and on-line note taking facilities. The customised environment used a listserv, e-mail (university accounts), presentation areas and problem posting and peer assessment area. The instructional tools used in the customised site were generally easy to obtain, either through the central "Virtual Campus" (Edith Cowan University), by having them custom built (as with "RonSUB") or by accessing tools from different suppliers which are either free, or very cheap to implement (see, for example, the freeware 'Hot Potatoes' suite from Half-Baked Software [1999]).

Conclusion

The choice to use WebCT or any other courseware management tool should be carefully considered. The amount of initial training needed for technicians, lecturers, tutors, sessional staff members and students is significant. Also, there are considerable overheads in setting up logins and establishing how to implement the tools for designing a home page.

The following issues should be carefully considered before committing to a courseware management environment:

- will the courseware management system be implemented across the whole university?
- have the courseware tools been carefully considered for their instructional relevance?
- how easy is it to add customised features if needed?
- has a budget been allocated for training lectures and students in how to access and use the new environment?
- has a budget been allocated for central technical support and help desk?
- will an instructional design advisory group be set up for to advise lecturers?
- do all the levels of management support its implementation?

If the answer to some of the above is "No", then it may be preferable to implement a customised solution which is simpler, cheaper and more efficient on server resources. Customised solutions would still require lecturer training, technical support and instructional support, but may support greater flexibility in design when creating an environment built from the 'ground up'. Also, customised websites support finding a solution to meet pedagogical needs rather than manipulating content to support the tools available. In the final analysis, the decision must be driven by the outcomes required from the course that is being developed and also the scale of the site being implemented.

References

Gunawardena, C., Lowe, C., & Anderson, T. (1997). Analysis of a global on-line debate and the development of an interaction analysis model for examining the social construction of knowledge in computer conferencing. *Journal of Educational Computing Research, 17*(4), 397-431.

Filemaker (1999). Filemaker Pro 4.1v2. [on-line]. Available http://www.filemaker.com/

Henri, F. (1992). Computer conferencing and content analysis. In A. R. Kaye (Eds.), Collaborative Learning Through Computer Conferencing (pp. 117-136). Berlin: Springer-Verlag.

Luca, J. (1997). Project Management for New Media. Perth. New Media Management.

Macromedia (1998). Macromedia Dreamweaver. [on-line]. Available: http://www.macromedia.com/software/dreamweaver/

Macromedia (1999). Macromedia Pathware Attain. [on-line]. Available: http://www.macromedia.com/software/pathware/

McMahon, M. (1997). Social Constructivism & the World Wide Web: a Paradigm for Learning. ASCILITE97: *Proceedings of the 14th Annual Conference of the Australian Society for Computers in Learning in Tertiary Education*. Perth: Curtin University of Technology.

Piaget, J. (1977). *The Development of Thought: Equilibration of Cognitive Structures*. New York: Viking.

Planet Software (1999). PlaNet Manager; Instructional Management for the Internet, [on-line] Available: http://www.planetmanager.com/

Southrock Software (1999). Southrock Software. [on-line]. Available: http://www.southrock.com/home.html

University Learning Technologies (1999). WebCT – World Wide Web Training Tools, [on-line]. Available: http://www.webct.com/

Vygotsky, L. S. (1978). In M. Cole, V. John-Steiner, S. Scribner & E. Souberman (Eds.), *Mind in Society*. Cambridge, Mass.: Harvard University Press.

WBT Systems (1999). WBT Systems – Solutions, [on-line]. Available: http://www.wbtsystems.com/solutions/

Russel, T. L. (1999). The 'No Significant Difference' phenomenon. [on-line] Available: http://cuda.teleeducation.nb.ca/nosignificantdifference/

Infoworld Publishing Company (1998). Web-based Training Solutions. [on-line] Available: http://wwwinfoworld.com/cgi-bin/displayTC.pl?/981123comp.htm

PC Week (1997). Computer-based training on the Web. [on-line]. Available: http://www8.zdnet.com/pcweek/reviews/0818/18ibt.html

Reeves, T. C. & Reeves, P. M. (1997). The effective dimensions of interactive learning on the WWW. In B. H. Kahn, (Ed.), *Web-based Instruction* (pp. 59-66). Englewood Cliffs, NJ: Educational Technology.

Half-Baked Software (1999). Hot Potatoes Home Page. [on-line]. Available: http://web.uvic.ca/hrd/halfbaked/

Developing Web-based Learning Strategies: a comparison between the Web and traditional learning environments

Mark McMahon
School of Communications and Multimedia
Edith Cowan University, Perth, Western Australia
m.mcmahon@ecu.edu.au

Abstract. Over time, strategies have evolved from learning theory that aim to ensure learning takes place within a given situation. While such strategies are well understood within the context of traditional classroom teaching, and to a certain, if lesser, extent fixed format multimedia (CD-ROM) delivery methods, there has been little study beyond individual case studies as to which strategies work best within Web-based learning environments. This paper seeks to explore the concept of learning on the Web by comparing 10 common strategies across the three media of face-to-face classroom environments, Multimedia CD-ROM software, and Web-based learning environments. The strategies vary from didactic modes such as presentation and demonstration through highly interactive student centred methods such as problem solving and simulations, to collaboration using strategies such as discussion. It is argued that the Web has the potential to deliver learning through a range of strategies, but that the constraints and opportunities afforded by the environment must be taken into consideration.

Introduction – The Web and Learning

Learning is a notoriously difficult concept to define. It can be described as a "persisting change in human performance potential ... [brought] about as a result of the learner's interaction with the environment" (Driscoll, 1994, pp. 8-9), but in reality, such textbook definitions pose more questions than they answer. How, for example, *do* learners interact with the environment? What *types* of experiences enhance learning, and *how*? As will be seen, these questions are still highly contentious.

Several theories have been proposed to explain the process of learning. Some view it as a process of enculturation (Brown, Collins & Duguid, 1989), a change in behaviour (Gagné Briggs & Wager, 1988), or the acquisition of the cognitive skills required for "purposeful remembering" (Norman, 1982, p. 361). There are obviously many distinctions between these theories; the emphases upon external variables, social processes, or internal mental function are dependent upon the theorists' attitudes towards learning as a science as well as deeply ingrained epistemological and ontological assumptions.

Such assumptions inevitably carry through to the final learning environment. Classroom environments have formed the basis of formal education for many years, and there are now a number of well understood strategies which can be implemented to enhance learning of various types. In the area of Instructional Technology, too, it could be argued that Interactive Multimedia (IMM) in CD-ROM format has become a mature technology for delivering educational and training content. With this maturity has come an understanding of what works and what doesn't. IMM's potential for "multi-sensory delivery, student metacognitive self monitoring assisted by instant feedback, and student control over the pacing of information flow and the pathways followed" (Richardson, 1995) has marked it as a medium with attributes that can go beyond traditional class based instruction. It has, however, also lacked the social interaction that typifies face to face learning.

In some respects, the World Wide Web appears to bridge these two approaches to delivering learning; providing a nexus between content-based learning through hyperlinked Web pages, and the communication afforded by real-time chat and asynchronous e-mail. Certainly, it seems to have attracted a good deal of attention as a learning medium.

This is particularly true of the tertiary sector, where the demand for flexible modes of study and the need to reduce costs are starting to erode the traditional face to face learning that has previously characterised it. The Web is promising reduced logistical overheads since it is significantly less expensive to produce materials electronically than in printed form, and the material may easily be kept up to date (Eklund, Garrett, Ryan, & Harvey, 1996). While it has been argued that students may not like to learn at a distance (Simonsen, 1995), the flexibility afforded through distance education for the student and the savings to a university in contact time and physical infrastructure are making it an increasingly attractive option for both providers and clients.

It can not be said yet, however, that the Web in its current form is a mature technology. Certainly, the actual use of the Web does not appear to live up to its promise as yet. A visit to the World Lecture Hall (University of Texas, Austin, 1998) would indicate that most sites are based around the use of the Web as a repository for information rather than an actual learning environment. This has lead to the criticism that the Web is simply a "24 hour-a-day glorified whiteboard" (Archee & Duin, 1995).

Clearly, the strategies common to classroom environments and CD-ROM based IMM need to be re-evaluated in terms of their potential for the Web. This paper will examine 10 such strategies. Their relative potential to facilitate learning in these three environments will be discussed, and recommendations will be made on how they may be best implemented

Learning Strategies

Such examination is made difficult by differing notions of what instructional strategies actually are. At a micro level, they can include Cognitive techniques such as the use of mnemonics, elaboration, and chunking (West, Farmer & Wolff, 1991), but such techniques can perhaps better be defined as tactics since they deal with low level implementation within a broader paradigm. It is the macro level strategies, such as the use of tutorials, drills and simulations which will be the focus of this analysis, since it is these broad approaches which appear to categorise most types of learning environments and impact most heavily on the nature of the learning environment.

Newby, Stepich, Lehman and Russell's (1996) ten instructional approaches are used as the basis for discussion, and are outlined below:

- Presentation
- Demonstration
- Discussion
- Co-operative Learning
- Discovery
- Problem Solving
- Instructional Games

- Simulation
- Drill and Practice
- Tutorial

This choice is necessarily somewhat arbitrary, and the individual approaches are not mutually exclusive (presentation, for example, may form part of a tutorial). However, they include strategies that are often used in many settings. Some approaches, such as tutorials, drills and simulations, are common strategies for single user computer assisted learning (Alessi & Trollip, 1991), while techniques such as discussion and co-operative learning often form the basis of classroom experiences. An examination of this range of approaches may allow for a more complete discussion of the potential of the Web for learning, while at the same time acknowledging that there may be other strategies available to the instructional designer.

Each strategy will be discussed in terms of their potential of each approach to be implemented via the Web will be explored with the aim of arriving at some conclusions about how best the Web may be used to foster learning.

Analysis of Strategies

In order to compare strategies, their potential for learning within the three environments of the Web, classroom, and stand-alone Interactive Multimedia is represented as a diagram (figure 1). For the purposes of this paper, each environment is treated as a 'stand alone' approach to learning. For example, while both multimedia and the Web may be effective tools in the classroom, the focus is on the features of each environment which make them distinct from each other, rather than ways in which they can be combined. Each strategy may pertain to any of the three orientations in each diagram to varying degrees. The placement of the strategies within the diagrams is at best an interpretation based upon existing literature and is open to discussion. However, they serve a useful role as a heuristic for exploring the relatedness of the approaches to each other and their potential implementations.

- Presentation
- Demonstration
- Discussion
- Co-operative Learning
- Discovery
- Problem Solving
- Instructional Games
- Simulation
- Drill and Practice
- Tutorial

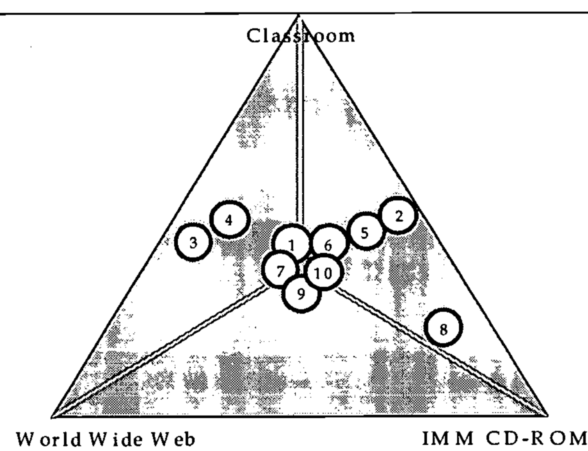


figure 1. Analysis of Strategies and Learning Environment

Presentation

Presentations "relate, dramatize, or otherwise disseminate information to learners" (Newby, Stepich, Lehman & Russell, 1996, p. 47) and are a very common tool in many learning situations. While a limited strategy, they are an efficient means of delivering information. The most common form of presentation in higher education is the lecture, which is usually supplemented by a workshop or tutorial. In traditional computer based training, too, the act of presenting information is only a component of the learning sequence (Gagné, Briggs, & Wager, 1988). The cost effectiveness of presentations (Newby, Stepich, Lehman & Russell, 1996), however, means that they will continue to be integrated into traditional instruction, in the form of texts and lectures; and the Web is a capable medium for replicating this method.

One of the best examples of this is the latest version of Microsoft PowerPoint, which allows presentations to be easily converted into HTML. Since this is a common lecture presentation tool, it has been quickly adopted as an easy approach to information presentation. The danger, of course, is that the Web could end up as merely an information resource, rather than a genuine learning medium. In this sense a presentation strategy may even be viewed as 'no strategy' beyond the convenience of using the web in the same way as any informational material, such as a text book or encyclopedia.

Demonstration

Demonstrations share some similarities with presentations in that they are content based and transmissive in their approach to learning. However, they differ from presentations in that the information is presented in a contextual manner. Students "view a real or life-like example of the skill or procedure to be learned" (Newby, Stepich, Lehman & Russell, 1996, p. 48) and this can be achieved both on the computer and through face-to-face experiences.

Demonstrations are common practice in the classroom; science experiments, for example, can be shown to students saving the resources in time and money that would be expended in students completing the experiment themselves. Digital video can replicate this experience in a multimedia environment. The high level of realism, and the ability of video to show events in real time make it an ideal medium for computer based demonstrations. It is here, however, that the problems of the Web become manifest. Media intensive environments require high bandwidth data transmission, which, as has been shown, is still an unrealised promise of on-line learning. Virginia University's award winning Interactive Frog Dissection (Kinzie, 1994) exemplifies this. Videos are used within this tutorial to provide safe and authentic demonstrations of frog dissections for use in high schools, but despite these ambitious aims, QuickTime videos prove to be so slow to download that any sense of flow is lost.

Discussion

Discussion "allows students to actively practice problem solving, critical-thinking, and higher-level thinking skills" (Newby, Stepich, Lehman & Russell, 1996, p. 49) thus providing access to deep learning, making use of prior knowledge. It is no surprise that it forms a major component of classroom learning, however, little discussion can be found in traditional CD-ROM based multimedia, which is often designed as a flexible 'stand-alone' product. The global networked nature of the Web would appear to make it an ideal medium for this strategy. Traditional Internet communication tools such as E-mail, Newsgroups, Internet Relay Chat, and MOOs offer both the rapid synchronous communication of normal speech (in the form of text) as well as asynchronous interaction which may help to promote a more reflective metacognitive approach. With the use of plug-ins and CGI scripting, such facilities are now becoming available in a more cohesive form on the Web. Examples of learning through communication can be seen in commercial environments such as TopClass (WBT Systems, 1997) which provide the functionality required for this approach.

Co-operative Learning

Group work forms the basis of many classroom activities, and is a highly valued and relevant strategy since it could be argued that most work environments involve a high level of collaboration to achieve a common goal (Brown, Collins Duguid, 1989). As with discussion however, co-operative learning is rare in multimedia environments. The swing away from networked computing in the 1980s and the lack of any practical paradigm for intelligent software limited students' ability to interact in a co-operative way with each other or the machine.

It is a trend, however, that appears to be reversing with the advent of the Web. E-mail is a common collaborative tool among academics to jointly conduct research and author papers. Such an approach is now trickling down to high schools and primary schools. This author, for example, was recently approached by a high school teacher in the United States of America who wished to initiate collaborative projects between his students and Australian students of geography. Groupware, a collaborative tool that allows users to share work files, has been common across local area networks and is now being ably adapted to the Web through environments such as Lotus Corp's Notes, which has now made the transition from local area network to the Web (Lotus Corp, 1997).

Discovery Learning

The learner centredness of discovery learning and emphasis on learning by induction rather than deduction make this an attractive strategy where self regulated learning is the goal. A common argument against discovery learning though, is that "for the majority of regular school subjects and most procedural or physical skills, a model that begins with the presentation of information [is] more efficient and demonstrably more successful" (Alessi & Trollip, 1991). Thus, discovery has limited application in the classroom, though many make use of it in a highly structured and guided way. After all, it "is legitimate and necessary for teaching to go beyond the specific experience, to abstract the symbolic representation that allows the learner to use their knowledge in an unfamiliar situation" (Laurrilard, 1993, p. 19).

Such criticisms can also be applied to computer based discovery. Rieber (1993) cites Papert (1980) in arguing that "the computer offers a powerful medium for the exploration and discovery of many ideas, particularly in science and mathematics, just as a young child might explore the concepts of volume given a sandbox, and mass and momentum in marbles" (Rieber, 1993, p. 5). As will be shown later, the multimedia potential of computers for simulations is one way of providing such an experience, however this is not so easily achieved through the Web. In one sense, it may be argued that the Web is an ideal medium for discovery learning. The self directed nature of web 'surfing' may undoubtedly lead to some form of serendipity. However, a great deal of frustration is associated with Web use when a student has not developed effective searching and browsing strategies (Archee & Duin, 1995) and it would appear that care is required when implementing such a strategy.

Problem Solving

Problem solving has much in common with discovery, but is necessarily more structured in that a problem must be solved. Like discovery strategies, problem solving usually involves the generation of learning through active involvement, in this case through a process of trial and error. It can also be used as a tool for the practical reinforcement of abstract concepts.

The use of problems as reinforcement is common to many classroom situations; in a maths class, for example, abstract knowledge of calculus can be applied to problems involving speed, velocity, and acceleration. Situations where learning is actually founded in authentic problems and involves trial and error are less common, despite the potential benefits from the deeper processing required within this paradigm (Reeves & Reeves, 1997) perhaps as much because of time and curriculum constraints as pedagogical philosophy.

It has been argued that one role of the computer is as a cognitive tool that can be used as a generic device to assist the development of problem solving skills. Papert (1993) goes so far as to describe them as tools to teach one to think, and proposes LOGO, a simple programming language as an example of such a tool. It is an environment that is driven by the problem solving process rather than any inherent content. Such highly interactive environments are yet to be seen on the Web, but there would not appear to be any great hindrance to this approach. Indeed, it could be argued that the trial and error use of the Web search facilities to find information can assist students in developing research skills.

Instructional Games

Games can provide an engaging scenario for learning, containing the challenge, curiosity, control and fantasy required for a motivating environment (Malone, 1980)

The fact that games seem under-utilised in the classroom may be because of the difficulty of designing games which intrinsically support learning or that games are simply perceived as incompatible with learning, particularly as students become older (Rieber 1996). It is on the computer that games seem to have found the most support, and in fact are one of the biggest areas of software development. The relative cost and time associated with developing games for specific learning goals as opposed to traditional computer based training, however, means that specifically instructional games are rare.

The same is true for the Web. Rieber's Space Shuttle Commander (1994), an Authorware based microworld, is one of the few games available via this medium. It is without doubt true that instructional gaming via the Web is yet to become a major use of the medium. The high quality of the media rich games available on CD-ROM would suggest that there would be a lot of work necessary before students would accept such environments. This does not mean that it is an impossible task, however. The emergence of servers which provide gaming between remote players of Arcade style games such as DOOM and Quake (Id Software, 1997), show the potential of hybrid combinations where the major media elements and game engine resides on the client computer, data transfer being restricted to player to player interaction. It must also be acknowledged that text based adventure games were once popular despite their lack of multimedia. Whether contemporary players would tolerate the paucity of stimulating graphics and sound at the expense of a rich fantasy scenario is debatable. It is clear, however, that the potential for the Web as a gaming medium needs consideration.

Simulations

Simulations are distinct as an instructional strategy in that "the student learns by actually performing the activities to be learned in a context similar to the real world" (Alessi & Trollip, 1991, p. 119) The increasing capacity of computers to model aspects of the real world, in an inexpensive, safe and self contained scenario has lead to an increasing use of this strategy within IMM learning environments. Examples such as Maxis' *Sim City 2000* (1993) show how generic skills can be constructed in a rich multimedia environment.

One variation of simulations is the microworld. "A small, but complete, subset of a specific environment or domain" (Rieber, 1993, p. 6), Microworlds have the potential to provide a highly interactive and motivating environment, but with greater teacher control of contributing variables.

Small-scale microworlds are now possible on the Web. The example of Space Shuttle Commander is testament to this. However, as the requirements for authenticity increase, so do the demands placed upon data transfer rates as a result of the extra media and coding that need to be integrated. Such requirements place a heavy burden upon the current implementation of the Web. Until such issues are resolved it is unlikely that Simulations will be able to replicate the kinds of experiences generated through media rich CD-ROMs.

Drill and Practice

With drill and practice "learners are led through a series of practice exercises designed to increase fluency in a new skill or to refresh an existing one" (Newby, Stepich, Lehman & Russell, 1996, p. 56). Such a strategy can form an important component of learning in the classroom where automaticity rather than reflection is required, as in the use of flash cards for learning multiplication tables or foreign language vocabulary. While computers are quite capable of such interactions, there does appear to be a move away from Drill and Practice as a strategy in IMM, perhaps because of its foundings in behaviourist principles and the fact that it does not make full use of the technology.

While computers themselves are now capable of far more than simple drill and practice interactions the same can not be said of the Web as yet. In fact, it is in this area of computer interaction that the Web appears to excel. Alessi and Trollip (1991) define the anatomy of drill and practice as an interaction involving item selection, question/response, judging and feedback, and such elementary processing can easily be handled by Common Gateway Interface scripting. Even at a more complex levcl, Authorware, which is designed specifically to facilitate such interaction can be integrated into the Web using Shockwave.

Tutorials

Tutorials are less an individual strategy as an instructional sequence. Specifically, the tutorial "presents the content, poses a question or problem, requests learner response, analyzes the response, supplies appropriate feedback, and provides practice until the learner demonstrates a predetermined level of competency" (Newby, Stepich, Lehman & Russell, 1996, p. 57). This sequence is graphically represented in figure 2.

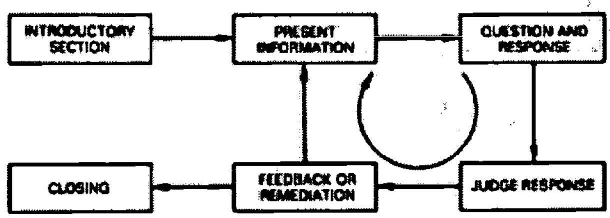


Figure 2- Outline of a Tutorial (Alessi & Trollip, 1991)

Tutorials are a common strategy in educational multimedia, and there is no reason why they can not use the medium of the Web. The ease of creating presentations, where large media files are not an issue, has already been shown, as has the power of forms for question/answer episodes. While there appear to be few good examples of tutorials on the Web, most being characterised by excessive use of text and linear, page turning interactions (UT Austin, 1997), they have the potential to provide effective learning where objectives are clearly defined.

Recommendations

Ostensibly, there appear to be few strategies which can not in some way be implemented in all of the environments discussed. In categorising particular environments as supporting certain strategies at the expense of others, due care is necessary. The clustering of strategies towards the centre of the diagram depicting learning environments would suggest that many approaches work equally well on a variety of platforms.

Nevertheless, some conclusions can still be drawn as to what strategies may be more or less effective in a Web based environment than in a traditional classroom or using CD-ROM based Interactive Multimedia. The difficulties of the Web in providing a high level of interactivity, and environments rich in multi-sensory media, certainly limit its effectiveness in implementing demonstration and simulation strategies. Since these approaches are often linked with Constructivist tenets of active and authentic learning, consideration must be given to how these issues can be addressed.

In highly concrete knowledge domains this is a very real problem. A trade such as Plumbing, for example, requires skills that involve enactment on a physical environment. The difficulty the Web has in creating such authentic simulations appears to limit its capacity to accommodate this. Even more ill-structured academic areas such as History and Philosophy require a level of context, even if that context is the academic one requiring the implementation of a culturally specific methodology and use of language. It is here, perhaps, where the Web may be particularly useful. While the Web does not easily support a high level of authenticity in terms of the physical environment that can be created, it may perhaps be used to create an authentic culture for learning. This would involve communication between practitioners of a knowledge domain within a social framework. Thus a high level of interaction is maintained for the learner through the sharing of ideas within an appropriate context

Traditional Internet communication tools such as E-mail, Newsgroups, Internet Relay Chat, and MOOs offer both the rapid synchronous communication of dialogue in the form of text as well as asynchronous interaction which may help to promote a more reflective metacognitive approach. With the use of Web browser plug-ins and server software such as Ichat (Ichat, 1998), such facilities are now becoming available in a more cohesive form on the Web.

While care needs to be taken in the use of Web based communication tools, it would appear that they do show some promise. Wyld and Eklund (1997), for example, cite Papert (1994) and Betts (1994) in arguing that Web communication has the potential to support "a wide range of learning styles as information is presented in a range of ways that is flexible to students' needs and abilities" (p. 148). This does raise questions about the actual nature of the Web as a communication medium. How does it differ from the traditional forms of letter writing and face to face interaction? These questions in turn raise issues of whether students need to be taught skills in communication with each other using Internet technologies. Even if this is so, however, the goal of Web communication appears to be one worth pursuing. Secondary outcomes alone, such as the potential to develop "collaborative global relationships and cultural understandings by reducing the existence of stereotypes and prejudices and the significance of location, gender, age and race" (Caudell, 1994, cited in Wyld & Eklund, 1997, p. 148), make the implementation of Web based communication an exciting prospect.

References

Alessi, S., & Trollip, S. (1991). *Computer-Based Instruction: Methods and Development.* (2nd ed.). Englewood Cliff, NJ: Prentice Hall.

Archee, R., & Duin, A. H. (1995). The WWW and Distance Education - Convergence or Cacophony? Paper presented at the AUUG '95 & Asia-Pacific WWW '95 Conference and Exhibition, Sydney, Australia.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32-41.

Eklund, J., Garrett, P., Ryan, S., & Harvey, J. (1996). Designing the World Wide Web as an Educational Delivery Medium at the University of Sydney. [on-line] Avaliable: http://ascilite95.unimelb.edu.au/SMTU/ASCILITE95/abstracts/Eklund2.html.

Gagné, R. M., Briggs, L. J., & Wager, W. W. (1988). *Principles of Instructional Design*. New York: Holt, Rinehart & Winston, Inc.

Kinzie (1994). Interactive Frog Dissection. [on-line] Available: http://teach.virginia.edu/go/frog.

Laurrilard, D. (1993). *Rethinking University Teaching: a Framework for the Effective Use of Educational Technology*. London: Routledge.

Malone, T. W. (1980). What makes things fun to learn? A study of intrinsically motivating computer games. *Technical Report CIS-7, Xerox Parc.*

Newby. T. J., Stepich, D. A., Lehman, J. D. & Russell, J. D. (1996). *Instructional Technology for Teaching and Learning*. Englewood Cliffs, NJ: Prentice Hall.

Norman, D. A. (1982). *Learning and Remembering.* New York: Freeman

Papert, S. (1993). The Children's Machine: Rethinking School in the Age of the Computer. Basic Books.

Reeves, T. C. & Reeves, P. M. (1997). The Effective Dimensions of Interactive Learning on the WWW. In B. H. Khan (Ed.), *Web-based Instruction* (pp 59-66). Englewood Cliffs, NJ: Educational Technology.

Richardson, L. (1995) The Medium and the Message. *Australian Journal of Educational Technology, 11*(1), 1-11.

Rieber, L. (1993). A Pragmatic View of Instructional Technology. In R. Tobin (Ed.), *The Practice of Constructivism in Science Education.* Washington DC: AAAS Press.

Rieber, L. (1996). Seriously considering play: designing interactive learning environments based on the blending of microworlds, simulations and games. *Educational Technology Research & Development.*

Simonsen, M. (1995). Does Anyone Really Want to Learn at a Distance? *Techtrends 40*(5), 12.

University of Texas, Austin (1998). The World Lecture Hall. [on-line] Available: http://www.utexas.edu/world/lecture/

West, C. K., Farmer, J. A. & Wolff, P. M. (1991). *Instructional Design: Implications from Cognitive Science.* Needham Heights, MA: Allyn & Bacon.

Wyld, S. & Eklund, J. (1997). A case study of communication technology within the elementary school. *Australian Journal of Educational Technology* (13) 2, 144-164.

Collaborative Links Between Distributed Databases. Developing a Framework for an Inventory of Computer-facilitated Learning (CFL) Materials across the Higher Education Sector in Australia

Carmel McNaught
Learning Technology Services
RMIT University, Australia
carmel.mcnaught@rmit.edu.au

Rob Phillips
Teaching & Learning Centre
Murdoch University, Australia
r.phillips@murdoch.edu.au

Darien Rossiter
School of Media and Journalism
Queensland University of Technology, Australia
d.rossiter@qut.edu.au

Jenny Winn
Teaching & Learning Support Services
Queensland University of Technology, Australia
j.winn@qut.edu.au

Abstract: This paper will report on the results of a DETYA*-funded project which investigated the extent of use of computer-facilitated learning (CFL) materials across the higher education sector in Australia in order to determine overall trends. In addition, the project also investigated how an updated national inventory of such materials might be developed in the context of developing a strategy which could lead to a greater adoption of CFL materials in Australian higher education. * Department of Education, Training and Youth Affairs - a central Australian government department

Introduction and Scope of the Study

There has been a great deal of development of electronic educational resources in the last few years, fuelled by a climate in higher education which demands educating more students with less resources. This has occurred together with substantial development of information technology (IT) systems and infrastructure in all Australian universities. However, the evidence is that there is little dissemination of these electronic resources and practices. Greater collaboration and sharing of resources is becoming an increasingly urgent issue. There are several existing databases of computer-facilitated learning (CFL) materials but these databases do not appear to have increased the take-up of CFL materials and strategies a great deal. We need to investigate educational, technological and management issues in designing ways in which more use can be obtained from the valuable resources that exist.

The term computer-facilitated learning (CFL) materials is used to describe materials which use information technology in some way to facilitate teaching and learning, including: educational CD-ROMs, online course content materials, and the use of software for computer-mediated communication within a course.

Methods Used

The study used a multi-method approach, employing online surveys of institutional practice (28 Australian universities responded); a literature survey; and a case study of five universities at project, faculty and institutional levels. The data included survey results, interview transcripts, focus group transcripts, institutional documentation and short descriptions or vignettes.

The study explored issues which facilitated or mitigated against teachers being able to work in an environment which facilitates the adoption of CFL, in terms of:

- appropriate policies, infrastructure and supports within the institution;
- access to information about CFL resources; and
- being able to work collaboratively both within and across institutions.

Existing Information about CFL Resources at Australian Universities

A substantial amount of data was accumulated from a range of sources about the resources which exist to support CFL at Australian universities. It is clear that many universities are actively engaged in producing CFL resources to enhance the educational offerings they have. There is also a clear commitment to developing appropriate infrastructure to support the use of technology. The diversity in universities' structural arrangements made it difficult to compare data across institutions. There is also a variation in the stage of adoption of new IT from contexts where there are a significant number of early adopters and the use of technology is clearly embedded, to contexts where significant use of technology is a newly emerging trend. Precise information about CFL resources may not have been obtained from some universities because the survey was not responded to by the person with most accurate knowledge, or because facilities were devolved and centralised data was not available. The rapid change in the area also means that information provided to the investigators may be soon out of date. Overall the information about existing CFL resources at Australian universities is patchy and incomplete. In particular, there is limited or no information about:

- the educational design of the CFL resources being produced,
- the incentives and support that exist for individuals to produce CFL resources,
- the technical design and access specifications for using these CFL resources,
- the experience of using the CFL resources in actual teaching contexts,
- evaluations carried out to determine how educationally effective these resources are in practice,
- intellectual property and copyright issues which might affect the use by others, and
- how access can be obtained to these CFL resources from either colleagues in the same university or another institution.

Major Issues Relating to the Adoption of CFL Resources at Australian Universities

The major issues were selected from the case studies using three criteria:

- frequency of being mentioned,
- intensity of expression in the interview, and
- who articulated the idea-senior administration and/or teachers.

Three major themes emerged with a considerable overlap between a number of the issues and factors involved in each theme.

Policy

The policy theme looked at specific institutional policies, such as equity and intellectual property, the alignment of policy throughout the organisation, the direction of policy change (bottom-up or top-down) and a number of strategic processes which flowed on from policies such as grant schemes. There was a variation in the direction of policy change across the universities studied. The universities with a traditional emphasis on distance education had a strongly top-down policy direction. Two other universities had a predominantly bottom-up policy direction, and one university was reported by case participants as having essentially no policy with respect to CFL. In the institutions in which adoption of CFL seemed to be progressing most effectively, there was a balance between top-down and bottom-up policy implementation. This reinforces the need for balance between policy, culture and support; policy on its own will not succeed unless it aligns with institutional culture.

Copyright was a particularly complex issue which impacted in different ways according to the contextual level (personal, institutional or sectoral) in which it was being examined. Some individuals, for example, believed university copyright policy presented a personal barrier to the sharing and development of CFL; while from an institutional perspective there was concern and a growing awareness of the complexity of the issues which limited organisational capacity to maximise specific institutional uses of CFL. Finally, across the higher education sector in general there were broad ranging legislative issues, with respect to moral rights, licensing, royalties and payments for use of copyrighted materials, and continuing uncertainties relating to technological capability and usage.

Key issues relating to the policy theme:

- Safety net policies need to be continued, and possibly increased, in order to address the specific needs of the minority who cannot gain access to computing equipment for equity reasons.
- Funding schemes need to take account of earlier experiences - mechanisms are needed for monitoring the progress of initiatives and learning from failure.
- Funding schemes need to explicitly take account of the need for ongoing maintenance of CFL developments.
- Appropriate criteria for teaching performance need to be developed in order to provide an effective incentive for staff to adopt CFL materials and practices.
- University staff need access to a centralised service which provides practical support to staff on intellectual property and licensing issues.
- There needs to be widespread dissemination of the legal situation with respect to online intellectual property.
- If a CFL resource is made available to the academic community, mechanisms are needed to facilitate copyright clearance of CFL materials so that due recognition is given to the originator.
- Legislation relating to the use of online resources in education, the ownership of copyright on materials used in offshore courses, and moral rights is in train. Appropriate legislation should be supported.

Culture

Culture incorporated factors such as collaboration within institutions, and personal motivation of staff to use CFL, as well as particular aspects of funding, staff rewards and time, leadership, teaching and learning models, and attitudes such as 'not invented here'. The case studies showed a great difference in the organisational cultures of the universities studied and of the infrastructures set up to nurture, develop, deliver and support CFL. The climate of the organisation is made up factors such as:

- strategic vision and leadership,
- attitudes to risk taking and innovation in teaching and learning,
- attitudes to adopting CFL,
- allocation of resources, and
- staff recognition and rewards.

Factors that motivated staff to adopt CFL did not vary greatly over the universities studied. Institutions with large numbers of early adopters had made changes to their cultures and policies, and had well-supported infrastructure. This resulted in a high level of acceptance so that some of the issues were no longer relevant to them. Main barriers to take-up were seen as:

- lack of knowledge about CFL;
- lack of academic time release;
- pressure to keep up the research quantum;
- non-recognition of teaching;
- lack of funding to maintain programs, staff and technical infrastructure; and
- lack of student acceptance of the new approaches.

On the other hand, factors that would motivate staff to use CFL included:
a university culture which supports new approaches,

- good leadership from academic managers,
- recognition of teaching as of equal value as research,
- appropriate support infrastructures for staff and students,
- workload adjustments to develop materials and become computer literate,
- the opportunity to think about learning and not teaching,
- evaluation studies showing improvements in student learning,
- improving learning opportunities and outcomes for distance students,
- adding value to existing courses,
- providing a means to offer courses offshore,
- the chance to interact more with students,

- positive feedback from students,
- solutions to problems of large classes and funding cuts,
- support and sponsorship from mentors, and
- peer pressure.

Changing educational practices and styles can produce many negative reactions and this negativity needs to be acknowledged and managed effectively. Change should be introduced and implemented within a supportive environment. The culture of the organisation needs to be able to embrace change while offering staff opportunities to develop their own levels of comfort with the change. Within the university environment, leaders need to develop vision statements that are clear and well articulated to the staff. Appropriate levels of infrastructure and support should be part of the policy formulation to match the vision.

Key issues relating to the culture theme:

- Universities need to have a clearly articulated vision of the changes to teaching and learning that technology brings.
- This vision should have ownership and commitment from all levels of management.
- The Dean or Head of Department/ School should lead and support moves by the academic unit into increased use of CFL materials and strategies.
- Policies developed from the vision should include positive values and well funded infrastructure to support staff and students.
- Issues of staff workloads in the changeover to use of CFL should be clarified.
- The tension between teaching and research needs to be resolved so that staff gain appropriate recognition for the development and use of CFL materials.

Support

Support incorporated a whole gamut of institutional issues including IT, library and administrative infrastructure, professional development for staff, student support, educational and instructional design support for academic staff, funding and grant schemes, and IT literacy. There was a belief that real efficiencies could be possible with supportive infrastructure and good planning. Many universities are now focussing on an overall systems approach across the university so that infrastructure planning is linked to the development of professional development and support services. At this time, however, all universities are in transition and are grappling with the issues involved in designing and managing new ways of working.

Key issues relating to the support theme:

- Internal structures and funding for CFL development units create tensions between central administration and the faculties; open exploration of this tension is needed.
- Ongoing budget support for CFL development is needed. Funding for CFL development is ephemeral in many universities.
- Institutional development grants should focus on sharing processes and experience, as well as looking for product-oriented outcomes.
- The costs involved in hardware and facilities, and appropriate technical and support staff, are high. Mechanisms are needed to assist universities in managing these costs.
- The diversity of roles of ITS staff are high, and keeping skilled staff is difficult. Schemes to recognise and reward technical staff are needed as much as schemes to recognise and reward academic staff.
- Professional development and training is a complex and multi-faceted area. There is a need for high quality staff developers, for flexible support programs, for using mentors, and allowing adequate time for staff to engage in staff development.
- Student support services cover a wide range of issues, including equity and access, access to academic help (this has implications for funding staff time), access to technical help, and access to computers. Further attention is needed to all these issues.

Adoption and Collaboration

Unless the climate within and between universities supports the development and use of CFL resources, there will not be an increase in appropriate uses of technology in teaching and learning. Staff will use technology in their teaching when culture, policy and support structures are congruent. Some particular issues that were highlighted were:

- Time and scalability: from an institutional point of view, the current situation is that infrastructure and time allowance is possible only for a relatively small number of staff. Mainstreaming the use of CFL has enormous resource implications.
- Good evaluation of existing CFL programs is a crucial aspect of adoption. Late adopters want evidence that CFL materials and strategies can enhance student learning
- Adoption depends on key individuals who can act as role models and mentors for others. Institutions need to recognise and support these individuals.

The tension between collaboration and competition is important. We argue that collaboration can assist healthy competition in higher education. Using resources efficiently in collaborative arrangements can allow institutions to develop their own specialities more effectively. During the next few years each university will need to find its own balance point between external collaborative work and internal work aimed at developing its own specialisations.

Dissemination and Databases

Dissemination of information about CFL resources, and the location of CFL resources via databases were fundamental parts of the study. A framework for the development of a national inventory system is proposed whereby the development of national metadata standards will enable teachers and lecturers to search across a distributed set of interest-group-based databases.

Dissemination of information about CFL resources through marketing programs was seen to be problematic by case study participants, for a number of reasons, some of which are:

- Potential purchasers/ users had varying levels of IT skills.
- Everyone is keen to be a seller in the marketplace, but few want to be buyers.
- Some programs proved to be too difficult to transfer to another context-there were technical, content and remuneration barriers.
- Commercialisation often becomes a dead issue; not many people are interested in pursuing this.
- Often there is insufficient kudos involved in disseminating information about CFL developments.
- Intellectual property is an issue, in that some people might not want their material to be used by others. There are concerns about compromising the competitive advantage of universities.

Nevertheless, it was felt that databases of CFL resources could be useful if designed well. A number of features were identified which could characterise a well-designed teaching and learning database. These are:

- The data submission and retrieval process is simplified.
- It has a distributed nature.
- It is maintained in an ongoing sense.
- It is owned by academics.
- Resources are submitted by people with expertise in CFL and knowledge of the discipline, following a scholarly review process.
- Resource submission should not be by the developer of the resource.
- It should contain contextual information about the resource, including a full description of the product; the rationale behind its development; its unique characteristics; the pedagogical approach used; intellectual property details, and how it might be obtained; and evaluation data.
- It should contain a range of experiential information on how the resource was used in a real-life teaching context, both by the developer and others.
- It should return the appropriate level of information to the queries submitted by users.
- Resources successfully submitted to the database should attract scholarly recognition.

The contextual and experiential information required of an ideal database is encapsulated in the idea of metadata. There is a need for cooperation amongst database owners and proponents with respect to metadata standards. The central idea of the framework is that databases can be created which fill a particular market niche, but that a global 'megasearch' facility enables academics searching for information to seamlessly traverse a range of databases. The framework we are proposing for the development of a unified, Australia-wide collaborative framework for interoperable online databases strongly urges that international metadata standards be developed.

A prototype distributed Links database has been developed by ASCILITE. This forms a searchable resource that is interoperable with other databases and is sustainable and credible. It allows for distributed maintenance of hypertext links within the system. Loosely based upon a Yahoo-style system, the Links database allows reviewers to moderate categories in which they have expertise. Any person can submit useful links to a particular category. The moderator provides a third-party, quality assurance role that adds value to the to resources maintained within the database.

The recommendations on dissemination and databases are that DETYA support and funding are needed for the development of a high level technical database framework which:

- is implementable;
- encourages open discussion with the various teaching and learning resource database owners to strive to achieve interoperability between their sites;
- develops standards to ensure inter-exchange of metadata between different domain-specific teaching and learning resource databases, by working with the various domain communities;
- works with other DETYA-funded bodies to establish standards and encourage adoption of such standards for resolving intellectual property issues, with the aim of creating of a market for learning artifacts; and
- ensures that all standards are interoperable with emerging international standards.

The framework we are proposing for the development of a unified, Australia-wide collaborative framework involves interoperable online databases. While our considerations have been mainly directed towards databases of CFL materials, we believe that this framework has a wider applicability. To be successful, the development of the framework needs to be a national initiative, funded appropriately, and coordinated through a suitable coordinating body. The coordinating body will need to develop standards for metadata by leveraging off the Dublin Core and IMS standards, and working closely with other Australian interest groups, such as the Australian Library and Information Association (ALIA), the Committee of Australian University Librarians (CAUL) and the Distributed Systems Technology Centre (DSTC).

Professional organisations, such as ASCILITE, can also participate in this national framework of collaboration in areas such as:

- educating the academic community about the need to provide metadata,
- providing pedagogical and educational design advice in the formulation of standards,
- providing a testbed for the implementation of the standards, and
- evaluating the effectiveness of the standards and the impact of the standards on the quality of education.

The size of the Australian economy does not allow us to re-invent the wheel all the time. The Australian education sector needs a collaborative framework to capture the synergy that may be generated by the aggregation effect. Information technology changes the size of a market, as well as the way the market is shared. To remain competitive in the global market, Australian higher education cannot afford to wait for the development of standards which will influence how education will be delivered and how effective the digital education system will be.

Reference

McNaught, C., Phillips, P., Rossiter, D., and Winn, J. (1999, in press). *Developing a framework for a usable and useful inventory of computer-facilitated learning and support materials in Australian universities*. Evaluations and Investigations Program report. Canberra: Higher Education Division Department of Employment, Education, Training and Youth Affairs. The report contains an extensive bibliography.

Students' Perceptions of Self-Change During an Online Course

Sara McNeil
Curriculum and Instruction, College of Education
University of Houston
Houston, Texas
smcneil@uh.edu

Bernard Robin
Curriculum and Instruction, College of Education
University of Houston
Houston, Texas
smcneil@uh.edu

Abstract: This paper presents preliminary findings from a two-semester study on the effects of online learning on student perceptions of self-change as well as the impact of online learning environments on student attitudes concerning their learning experiences. There have been several studies that examined distance learning courses versus traditional formats and found no significant differences in grade point averages of students in either format (The Institute for Higher Education Policy, 1999). Overall ratings of courses by students who complete online courses are equal or higher than those for traditional courses (Hiltz, 1997). There have been few studies, however, that examined other components of the learning process such as changes in perceptions and attitudes.

Teaching and learning are not the same as they were even five years ago; the amount and nature of information continues to grow far too rapidly for the old paradigms and systems to function effectively (Hannafin, Hill, & Land, 1997). The World Wide Web offers a myriad of ways to deliver instruction and provide resources and support for learning, but the array of possibilities is confusing for both teachers and students. K-12 schools, institutions of higher education, and corporations are all feeling the pressure to provide online instruction. In many instances the change from a traditional classroom to an Internet-based experience has been instituted with little or no consideration of the effect on student learning.

Concerns about the impact of distance learning courses on educational systems have been addressed in much of the literature to date. These concerns include lack of technological expertise on the part of both faculty and students, resistance to change on the part of some faculty, the cost of developing and implementing programs, hardware limitations, poor instructional design, and learner isolation (Wegner, Holloway, & Garton, 1999; Boettcher, 2000). While they represent legitimate areas of concern, for the most part, these problems relate to training and technology issues that have fairly obvious solutions. It is less obvious, however, what the effect of online learning has on students' perceptions of self-change in teaching and learning.

This paper presents preliminary findings from a two-semester study on the effects of online learning on student perceptions of self-change as well as the impact of online learning environments on student attitudes concerning their learning experiences. There have been several studies that examined distance learning courses versus traditional formats and found no significant differences in grade point averages of students in either format (The Institute for Higher Education Policy, 1999). Overall ratings of courses by students who complete online courses are equal or higher than those for traditional courses (Hiltz, 1997). There have been few studies, however, that examined other components of the learning process such as changes in perceptions and attitudes.

The Problem

As faculty members, we began to see changes in the students who finished an instructional design course online. At first, our feeling was that the changes were limited to one particular class, but each semester that the course was taught, students began to exhibit changes in their perceptions of themselves as learners and users of technology. These changes were evidenced in their online discussion postings, in their attitudes and interactions towards their peers, and in the collaborative quality of their assignments. In some students, the change was subtle, but in others, a more radical transformation took place. As students became more involved in the discussion and using the material and resources, they seemed to be more in control of their learning and more involved in the online experience.

This course is offered to a wide range of students, not only students in the instructional technology program area, but graduate students working on teacher certification as well. The background of these students is very diverse and the common thread that unites the content of the course is the instructional design process. The career goals of these students are varied as well, and range from K-12 classroom teachers to school district technology specialists to business and industry trainers. The course is divided into three modules with fifteen assignments; the last eight are focused on creating a final project, a process that guides the student through the steps of a generic instructional design model. Most students who enroll in this course have little experience with designing and delivering instruction.

As several semesters went by, and this change happened with regularity, we began to look for supporting information that would help clarify what was happening. We began discussing the change with the students after they finished the course. Several of them made comments about the changes that occurred:

> This course has been time consuming, and challenging...but what an eye-opening experience, as well. When I realize what we are capable of doing, and all the resources that are available, I feel overwhelmed. This class gave me the incentive to find some of those resources, find better ways to teach content, and a more positive impression of tutorials. (Student One)

> I think the class has been beneficial. I now have a clear picture of what an instructional designer does, and I like the process. The support that we have received in this class is phenomenal compared to the classes that I have taken in the past. I never had a question that wasn't answered, and I have never felt as supported by my instructor or my peers. (Student Two)

This change is exemplified by this statement from an online learner at another university:

> Within a matter of days of logging on for the first time, I began to see the worth of the experience that exceeded earning a grade and credit. No one was more surprised than I was by the way in which the interactions I became involved in shaped my perception of technology and its applications in my professional life. But more importantly, those online interactions exponentially enhanced my own learning. I believe my experiences were transformational because the online conference exemplified the characteristics of a model learning environment. (Allison, 1998)

Methodology

This study investigated the perceptions students had about self-change during a distance education course taught using the World Wide Web. The objective of the research was to investigate several questions rclated to change issues as evidenced through pre-course and post-course surveys.

The research questions were:
1. Do students' feelings about technology change during an online course?
2. Do students feel that their teaching and learning abilities and skills change as a result of taking and completing an online course?

This research study focused on a master's level course in instructional design. Components of the course included:

- A Classroom of course information, instructional materials, readings, and examples
- A Library/Resource Center with a glossary, list of Web resources and related articles
- A Communications Center with Web-based discussion groups. These discussion groups included three different areas of interest (general, K-12, adult learning) as well as a technical help group and an area to share homework. There was also an area designed to broadcast course news and updates to all students.

Participants

Data were collected from two different groups of students in spring, 1999 (number=26) and summer, 1999 (number=23). The 49 students involved in this study were enrolled in two sections of an online graduate level course called "Instructional Design." Both classes had the same instructor, used the same materials, completed the same assignments, and used the same learning strategies. Most students stated that they chose an online course over a traditional lecture course because their schedule did not allow them to take an on-campus section (N=16). Several students enrolled in the course because they wanted to experience an online environment. There were 2 students (4%) in the 18-23 age category, 14 students (29%) in the 24-29 group, 9 students (19%) in the 30-35 group, 10 students (20%) in the 36-41 group, 9 students (18%) in the 42-47 group, and 5 students (10%) in the 48-53 group. There were 10 male students and 39 female students. There were 12 full-time students and 37 part-time students. This demographic data is representative of the student population in the College of Education. The majority of the graduate students are part-time students, are employed full-time, and are working toward certification or a graduate degree.

Data Sources

For this initial study, data sources included a pre-course survey and a post-course survey. Other sources that will provide additional data for the next, more in-depth study include reflective journals, time logs, interviews and analysis of course communications and email.

Quantitative analysis included data from a pre-course survey that gathered information about students' expectations of the course as well as perceptions about online learning and level of technological expertise. A post-course survey measured student satisfaction and reassessed both technological expertise and time spent on various course-related activities such as reading the Web-based materials, completing homework assignments, and participating in the online discussions. Both surveys were anonymous, but they were coded so they could be matched for pre-course and post-course analysis techniques. Students responded to various questions by checking answers. There was also space for additional written comments.

It should be noted that validity issues might affect self-reported data from these surveys. Surveys could be biased positively or negatively by how a student feels about the instructor or the course, by feelings that answers may affect the grade for the course, or by other influences such as the novelty of the online learning environment. In order to deal with these issues, students completed both surveys without the instructor being present, and surveys were matched using information that gave no indication of the student's identification. Post-course surveys were completed at the end of the semester, after the presentation of final semester projects.

There were two research questions that guided this preliminary study:
Research Question 1: Do students' feelings about technology change during an online course?

Students were asked to rate their feeling about using technology on a scale from 1: uncomfortable using it, 2: know basics of how to use it, 3: relatively skilled, but not an expert, to 4: expert user.

Research Question 2: Do students feel that their teaching and learning abilities and skills change as a result of taking and completing an online course?

Students were asked to rate their feeling about changes that occurred in their teaching and learning abilities as a result of the course. Students used the following likert scale to indicate their perceptions: 1: strongly agree, 2: agree, 3: no opinion, 4: disagree, 5: strongly disagree. Students could also indicate that they were already proficient in a particular area. These data were not used in the statistical interpretation, but are reported in the accompanying table.

Analysis

Research Question 1: Do students' feelings about technology change during an online course?

Table 1: Results Obtained from the Wilcoxin Signed-Rank Test.

T = 2.594   p=.009

	N	Mean	Median	SD
Beginning of the Course	49	2.77	3.00	0.65
End of the Course	49	2.98	3.00	0.58

Table 2: Frequencies for Feelings about Technology

	1: uncomfortable using it	2: know basics of how to use it	2.5 *reported by students, but not given as a category	3: relatively skilled, but not an expert	4: expert user	N
Beginning of the Course	1	14		29	5	49
End of the Course		8	2	31	8	49

A Wilcoxin Matched-Pairs Signed-Rank Test was used to determine statistical significance. This test is used for correlated samples in much the same way as the dependent sample test.

As shown in Table 1 above, the results from the Wilcoxin Signed Rank Order Test yielded a $T = 2.594$ and a statistically significant p value of .009

The students' feelings about using technology after completion of the course are significantly higher than their feelings about technology before taking the course. In light of these findings, the following implications are suggested: there is evidence that students' feelings about using technology improve while enrolled in this class. Whether this effect is related to the phenomena of "novelty effect" (The Institute for Higher Education Policy, 1999) is not yet determined. The novelty effect is a reactive effect, and refers to increased interest, motivation, or participation on the part of students because they are doing something different, not better, per se.

Several factors could be responsible for contributing to this perception. Students are required to use a computer to access course materials, to submit assignments and to communicate with their peers and the instructor. As their use increases, it is likely that students' perceptions of their abilities and level of comfort also increases.

Research Question 2: Do students feel that their teaching and learning abilities and skills change as a result of taking and completing an online course?

Table 3: Results of Survey Questions about Teaching and Learning Abilities

This course has helped me:	N	Mean	Median	SD	Strongly Agree	Agree	Disagree	Already Proficient or No Opinion
become a more proficient computer user	36	1.41	1.00	0.50	21 (58%)	15 (42%)		13
become a more proficient email user	25	1.44	1.00	0.50	14 (56%)	11 (44%)		24

become a more proficient internet user	34	1.29	1.00	0.46	24 (71%)	10 (29%)		15
become more proficient finding information online	38	1.39	1.00	0.63	25 (66%)	12 (31%)	1 (3%)	11
become a better evaluator of information	47	1.51	2.00	0.50	23 (49%)	24 51%)		2
become a better teacher or trainer	46	1.30	1.00	0.46	32 (70%)	14 (30%)		3
become a better writer	38	1.92	2.00	0.85	11 (29%)	23 (60%)	4 (11%)	11
communicate my ideas more effectively	41	1.63	2.00	0.62	17 (42%)	23 (56%)	1 (2%)	8
collaborate with other students more effectively	37	1.59	2.00	0.49	15 (41%)	22 59%)		12

1 Data in the category "Already Proficient or No Opinion" were not used in the statistical interpretation, but are reported.

As shown in Table 3 above, students overwhelmingly felt that the course helped them become more proficient and competent in a number of areas of teaching and learning. It is not yet clear whether this is also a reactive effect or a real one.

Student comments support the change in perception, but investigating this effect in more qualitative ways will provide a more complete assessment of self-change.

> Online learning made me feel that with a very good instructional design, people can learn a lot of things.
>
> I felt more of a part of this class than most.
>
> I prefer this method of learning. While the work load is the same or greater than regular classes, the "self-paced" nature of the instruction is very important to me.
>
> It was wonderful to learn from others as they learn.
>
> Interesting to see others' knowledge and expertise. The variety of interests in the group was amazing.
>
> Learned more about the other students and homework and how they felt about different topics.

Other data collected in the post-course survey indicated that students tend to work harder in this online course. This may be caused, in part, by the anytime, anyplace access to course materials, the ability of all students to read others' postings and homework, and the motivation to keep up with the class because of increased interactions and connections. These data are also supported by research in other asynchronous learning environments (Hiltz, 1997).

Table 4: Enrollment in Another Online Course

	Yes	No	Maybe	N
Would You Take Another Online Course?	43 (88%)	1 (2%)	5 (10%)	49

One overall measure of student satisfaction is whether or not students would take another online course; results are shown in Table 4. The majority of students (88%) indicated that they would take another online course; 10% of the students indicated that they might take another online course.

Table 5: Student Perceptions about Learning

	Strongly Agree	Agree	Disagree	N
I felt that I learned as much in this online class as I would in a face-to-face classroom	33 (69%)	14 (29%)	1 (2%)	48

Table 5 shows that the majority of students (98%) felt that they learned as much in the online class as in a face-to-face class.

Table 6: Perceptions about Workload

	Less Work	About the Same	More Work	N
What was the workload for this online course in comparison to an on-campus course worth the same number of units?	0	9 (19%)	39 (81%)	48

The majority of students (81%) felt that the workload for an online course is more than a face-to-face class. Only 19% felt that the workload was the same; no students felt that the workload was less.

Next Steps

The results of this preliminary study support the hypothesis that students feel that their teaching and learning abilities increased. The general feelings about an online course were positive; students indicated that they felt they learned as much as a face-to-face course and that they would take another course even though they felt that the workload was higher in an online environment.

Other sources that will provide additional data for the next, more in-depth studies include reflective journals, time logs, interviews and analysis of course communications and email. The role of online learning environments as a catalyst for change should be studied and perceived self-efficacy of the students should be measured more accurately.

References

Allison, V. (1998). The perception and valuing of online conferencing among masters candidates. Retrieved March 1, 2000. Available: http://www.sdavjr.davis.k12.ut.us/~valerie/online.htm

Boettcher, J. (2000). The state of distance education in the U.S.: surprising realities. *Syllabus*, 13 (7), 36-37, 40.

Hanafin, M.J., Hill, J.R., and Land, S.M. (1997). Student-centered learning and interactive multimedia: Status, issues and implications. *Contemporary Education*, 68 (2), 94-99.

Hiltz, S. (1997). Impacts of college-level courses via asynchronous learning networks: Some preliminary results. Journal of Asynchronous Learning networks, 1(2). Retrieved: March 1, 2000. Available: http://www.aln.org/alnweb/journal/issue2/hiltz.htm

The Institute for Higher Education Policy. (April, 1999) What's the difference? A review of contemporary research on the effectiveness of distance learning in higher education. Retrieved: March 1, 2000. Available: http://www.ihep.com/difference.pdf

Wegner, S., Holloway, K., & Garton, E. (1999). The effects of Internet-based instruction on student learning. *Journal of Asynchonous Learning Networks*, 3 (2). Retrieved March 1, 2000. Available: http://www.aln.org/alnweb/journal/Vol3_issue2/Wegner.htm

Supporting Collaborative Telelearning Research using Server Logs

Øyvind Meistad & Barbara Wasson
Department of Information Science, University of Bergen, PO Box 7800, N-5020 Bergen, NORWAY
Email: oyvindm@ifi..uib.no barbara@ifi.uib.no

Abstract: Electronically generated log-files contain a lot of pertinent information, but the information is often hard to access. This paper describes two tools that have been developed to assist researchers in extracting information from TeamWave Workplace (TW) generated server log-files and repositories. SLA reads in one log-file, sorts out a researcher specified group of persons, and then uses the information to calculate some results from the log. TRA, on the other hand, is a tool to help researchers in classifying the use of various tools inside TW, organising their classifications, and registering how the use of the tools evolves over time. Output from both tools is used to complement various interpretation methods being used to identify collaboration patterns in a collaborative telelearning scenario.

Introduction

One challenge for research within collaborative telelearning is *what and how* to collect and analyse data in a distributed environment. Depending on the research question and study design, various types of data are desired. Traditional qualitative methods such as structured and unstructured interviews, participant observations, and video recording need to be tailored to distributed participants. Once the obstacles in collecting this type of data are overcome, then questions about how to interpret and analyse the data persist. On the other hand, the collection of electronically logged data is relatively straightforward. As Garton et al. (1999) point out, the restrictions are often "the amount of server storage space and the integrity of researchers and programmers in their study design (p. 92)" and electronic data gathering "replaces issues of accuracy and reliability with issues of data management, interpretation, and privacy (p. 92)". Generally, the amount of electronically logged data can easily be overwhelming and again, questions of interpretation and analysis pose real problems.

In project DoCTA (http://www.ifi.uib.no/docta) we are interested in identifying *collaboration patterns* in various collaborative telelearning scenarios (Wasson & Mørch, 1999; Guribye & Wasson, 1999). A number of evaluation perspectives are taken and numerous data collection methods are used (for a complete report see (Wasson, Guribye & Mørch, 2000)). The VisArt activity scenario took place during February and March 1999 and provided an opportunity for the DoCTA project to design, deploy and evaluate an authentic collaborative telelearning activity. The VisArt learning activity involved students taking courses at three Norwegian educational institutions (University of Bergen, Nord-Trøndelag College, Stord/Haugesund College). Teams comprised of three students, one from each institute, collaborated to design a learning activity through the Internet. There were no opportunities for the teams to meet face-to-face. Collaborative learning tasks and the technological environment were carefully designed. The technological environment comprised their own email system, a word processor of their choice, and a groupware system TeamWave Workplace (TW). One week of training in both using the TW tools and in collaboration proceeded three weeks of design activity. The students were asked to design a room in TW for learning about some subject of their choice. All participants had the option to sign a consent form that enabled us to electronically collect their team emails, questionnaire data, and to use the electronically logged TW data for our research.

Evaluation of the *VisArt* scenario (Wasson, 1999) took place on several dimensions and the results are currently being written up as Masters dissertations. The evaluation of interest in this paper is how automatically generated log-files contribute to research in understanding collaboration patterns (Meistad, in preparation). Two tools that have been developed to assist researchers in extracting information from TW generated server log-files and repositories are described. The paper begins by briefly describing TW groupware system. Then the tools that have been developed are presented. The paper concludes with a brief reflection on how the extracted data can be used.

TeamWave Workplace

TeamWave Workplace (TW) is based on the metaphor of *shared networked places*. Using real life physical team rooms (Johansen, 1991) that provide a permanent shared working place for teams as inspiration, the notion of *virtual team rooms* has been adopted in TW. These virtual team rooms provide a permanent shared space where teams distributed over the Internet can have meetings, store documents, share URL links to web sites, coordinate and communicate with one another and can carry out collaborative activities such as brainstorming or participation in a discussion forum. Each team can build a set of different rooms according to need. For example, they might create a common project room and resource room, and in addition, individual rooms for each team member. TW provides 19 tools that enable teams to easily plan, set up a database, design, share documents, link to the web, chat with one another etc. For a detailed review of TW and for examples of how it was used in the DoCTA project, see Wasson, Guribye & Mørch (2000). One feature of TW is that it comes with traditional logging mechanisms such as recording that a user logs in and out of the server, moves between rooms etc., as well as a non-traditional feature, a repository. All room states are saved in the repository, thus it becomes possible to recreate earlier states of any given room using an option called *version control*. Both these mechanisms (the server log and version control) are used in conjunction with the two prototypes tools described in the next section.

The TeamWave Workplace Server File. All interactions with the TW server are electronically logged in a server log-file called server.log. The file is automatically generated by the TW server on its startup, and is then updated as the various users interact with the server. Each user action in TW is recorded in the file. During the VisArt scenario the file grew from 0 KB to over 2.2 MB and has 38,207 lines. The following are extractions from the VisArt server.log file:

Fri Feb 19 15:25:08 1999 oyvind entered Overview-room
Fri Feb 19 15:25:26 1999 oyvind left Overview-room
Fri Feb 19 15:25:26 1999 oyvind entered Klasse-diagram
Fri Feb 19 15:32:25 1999 oyvind left Klasse-diagram
Fri Feb 19 15:32:25 1999 connection closed for oyvind

As one can see, each line starts with information about date and time. Thereafter, the user is identified and the user's particular action is recorded. For example, the second entry tells that on Friday, February 19th 1999, at 15:25:26, oyvind left the Overview-room. In addition to logging information about users entering and leaving rooms as shown, the TW server logs users logging in and out of TW, information about the server starting up, the creation of rooms, the writing of rooms, and the server shutting down. Although the structure of the server.log file is rather simple, the large number of users involved (32 students, 3 instructors and 10 researchers) created such a large file that it is difficult to glean information from the file. Therefore, a software tool that interprets the entries has been developed.

The TeamWaveWorkplace Version Control. Every room created in TW resides on the TW server, and is stored in a repository. When a TW user selects the menu option to save the current room, or leaves a room when no other person is visiting the room, the room is saved to the repository. Every tool created in each room is also stored in the repository. As a room is saved, tools that have been changed, or added, or moved around, etc. since the previously saved version of the room, are saved. When a user enters a room, the last version of the room and the last version of the tools residing in the room are automatically retrieved from the repository. TW's version control enables earlier versions of the current room, or earlier versions of a specific tool to be retrieved from the repository. The average number of versions stored in the repository for a single room at the end of VisArt was approximately 50. Depending on the type of room, however, the number varied a great deal. For instance, the Classroom existed in no less than 498 versions. The version control option enables a researcher to recreate the state of various rooms and tools during one's analysis. Thus, long after the completion of the scenario, one is still able to follow how the scenario evolved for a particular team. The potentially large number of available versions of one room or tool, does, however, make such an analysis difficult. Therefore a software tool, TRA, was developed to help researchers keeping track of how the various rooms evolved over time.

Tools for Analysing Log-files

There exists a long tradition of using logged data in usability studies focussed on identifying events from such as the number of errors occurring or when a menu is selected with the mouse, and graphically visualising the results (e.g., Fjeld et al. 1998; Guzdial 1993; Okada & Asahi 1999). Another interesting approach is to use the logged data in conjunction with video analysis to effectively retrieve parts of a video recording (Badre et al. 1995). Common in these types of studies is the focus on the interaction between a human and a local computer. Another somewhat different tradition is to use logged data to measure the usage of various Internet resources such as FTP-servers, web-servers, etc. This kind of information is likely most interesting for the Internet providers supplying the resources, but it has also gained attention from researchers (e.g., Newhagen & Rafaeli 1997; Garton et al. 1999). The focus in these last studies is on humans communicating through a local computer with a remote computer.

The tradition of using logged data for identifying *patterns of collaboration* between two or more geographically dispersed persons is in its infancy. Recently, Nurmelea et. al. (1999) reported on a study of a CSCL environment where electronically stored files (log-files and documents) served as their only form of data. They used social network analysis with its focus on uncovering patterns in people's interactions, together with information gleaned from log-files. The information was extracted with scripts written in Perl. CSCL is a field of interest for researchers with backgrounds as diverse as computer science and pedagogy. Although most computer scientists will have little or no problem writing a script in Perl, it is likely that a researcher who lacks experience from computer science related fields will experience problems. To address this issue, we explore the possibility of creating tools that use logged data from a distributed CSCL environment to make the data more easily accessible to researchers.

To support the evaluations of DoCTA project scenarios where TW was used, it was necessary to develop two prototypical tools for the analysis. The tools, the Server Log Analyser (SLA), and the TWWRoomAnalyzer (TRA), were both developed in Java 1.1 using the Java Foundation Classes 1.1 as graphical user interface components. The programs differ from each other in that SLA reads in one log-file, sorts out a researcher specified group of persons, and then uses the information to calculate some results from the log. TRA, on the other hand, is a tool to help researchers in their classificiation of the use of various tools inside TW, organising their classifications, and registering how the use of the tools evolves over time. In this study TRA was used in conjunction with the TW version control and the output from SLA. These two tool s are described below.

Server Log Analyser

SLA takes as its starting point the server.log file. The VisArt scenario was completed by 11 teams and SLA focuses on identifying the times at which a team could have possibly collaborated synchronously in TW (i.e., two or more of the team's members must have been logged on at the same time).

To find out what types of collaboration were possible for a given team at a given time, SLA reads through the server.log using a researcher-specified names of the team members. SLA creates a log for each group member, as well as a group log consisting of every entry from the individual logs, appearing in the same order as found in the server.log. The resulting logs (4 in this case) contain redundant information. SLA removes unnecessary information from the group log, and adds some statistics to the group log. This log is used by SLA to generate a graph that illustrates the times at which the various group members were logged in to TW. If the graph shows that two or more group members were logged in at the same time, they had the *possibility* to collaborate synchronously. Figure 1 shows a graph for one of the groups from VisArt. The left column of the graph denotes the time of the day. Each day starts on the bottom at 0, and goes up past 23 and up to 0 again. The bottom axis specifies the date that is displayed. If a date is missing (e. g. Feb 26 and Feb 27), it means that none of the group members logged in that day.

Interesting information may be found looking at the graph. First it tells us that from February 25-March 24, there were only three times when it was possible for the whole group to collaborate synchronously. VisArt started on February 25 when the group members were told to download the TW client, and log in to the server. They were given a few days to carry out this task. March 1-7 was a week of training in use of TW and collaboration, and March 8-26 was the period of carrying out the design task. By examining the graphs, it becomes apparent that subject02 did not log in to TW before the fourth day of the training period. It also becomes apparent that the formerly active subject01, did not log in once between March 4 and March 15. Consequently, even asynchronous collaboration is highly unlikely during this period. To explain why these more or less negative patterns occurred, is difficult using a simple log-file as the only kind of data. It is important, however, that the researcher is aware that one of the three team members disappeared for 10 days in the middle of a 4 week collaborative learning task. This is valuable information that enables the situation to be investigated more closely using, for example, interviews, and/or questionnaires.

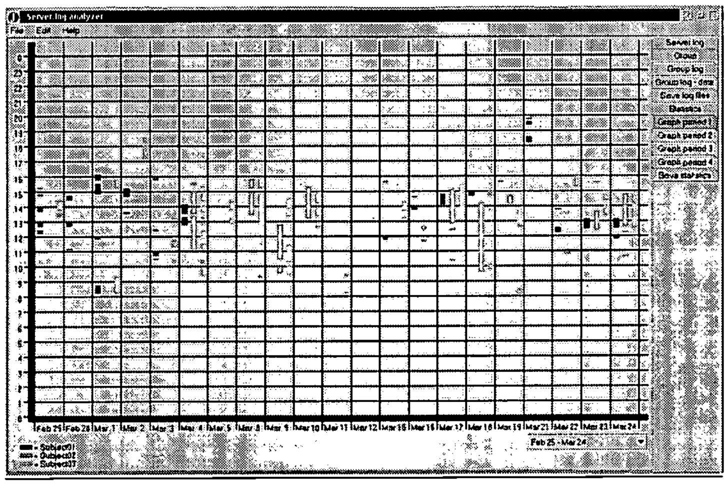


Figure 1 Graph of Team Activity in VisArt

The prototypical version of SLA, discussed here, is completely tied to the server.log of TW, limiting its usefulness to studies were TW have been used. A new version is, at the time of writing, therefore being developed. When ready, the new version will support the addition of all Java classes that implement an interface defined in SLA, and which enable sorting of log-files containing the type of information found in TW's server.log. Although the class that sorts the TW server.log and generates SLA's output (various logs and graphs) in the new version is no larger than 153 lines of code, the approach is not without problems. It require someone to write the new class and to make the class available to those interested. A future goal will therefore be to attempt to implement a feature in which users of SLA can, at a very high level, define how a log-file is organized.

TWW Room Analyzer

TRA is designed to be used in an analysis of collaborative learning environments that use a room metaphor or another analogous structure such as a web-page. In this study, TRA helps researchers in classifying the use of various tools inside TW, organising their classifications, and registering how the use of the tools evolves over time. TRA requires the researcher to use the output of SLA and the TW version control to specify input data for TRA. Ideally it should be possible to retrieve most of the information needed by TRA from the TW repository, but that path has not yet been investigated, and would also make the use of the tool less general. Even then, some of the information needed by TRA, such as a classification of the uses of the tools, would still have to be identified by a researcher. Once the data has been input to TRA, the researcher can use TRA to track changes to rooms and tools over time.

TRA, shown in figure 2, is a dynamic tool that is used to track how a team's learning environment evolved in the course of the scenario. TRA comprises several graphical user interface components that present information about any number of rooms. For each room there may be any number of room versions, with each room version containing any number of tools, and any number of tool versions. As TRA is currently being used during analyses of VisArt, it is possible new features may be required. If so, then TRA will be revamped and the user interface may change.

BEST COPY AVAILABLE

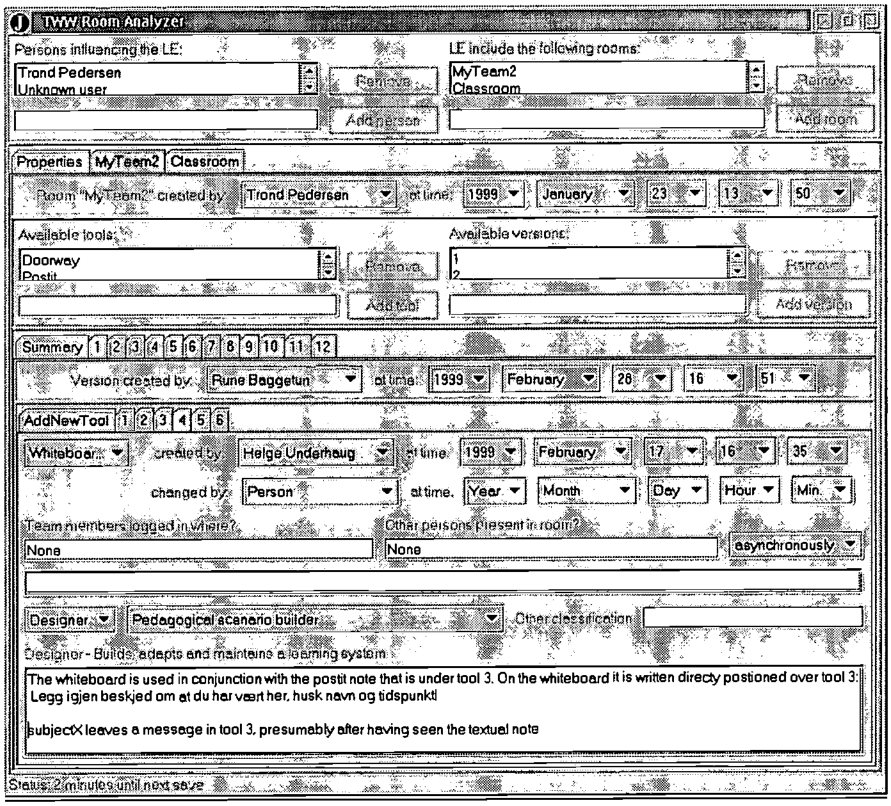


Figure 2 One of many possible views of TRA

In order to use TRA, the researcher first uses SLA to obtain information about the times when, places where, and the team members who were logged in (i.e., the date, time and room). SLA also generates information about the people that visited a particular room during the scenario. For example in figure 2 the rooms MyTeam2 and Classroom have been entered, and MyTeam2 room is active. One can also see that MyTeam2 was originally created by Trond Pedersen on January 23, 1999 at 13:59. There have been 12 versions of MyTeam2 entered into TRA. In figure 2, version 10, created by Rune Baggetun, is active. TW's version control is then used to retrieve the active version of the room and the researcher can see which tools are present in the room. This information is entered into TRA along with the number of versions of each tool. In figure 2, version 4 of the Whiteboard tool, created by Helge Underhaug on February 17, 1999 at 16:35 is visible. The researcher also classifies the use of the particular version of the tool indicating information such as if the current use has changed compared to previous uses, if the tool was used synchronously or asynchronously (menu selection), the role of the actor who made or changed the tool, etc. In figure 2, the researcher who classified the use of the Whiteboard believes that the Norwegian phrase written on the Whiteboard, shown in figure 3, meaning "Leave a note that you have been here, remember name and time!" must be seen in conjunction with the Postit also shown in figure 3 (the Postit is refered to as tool 3 in the classification of the use of the Whiteboard shown in figure 2).

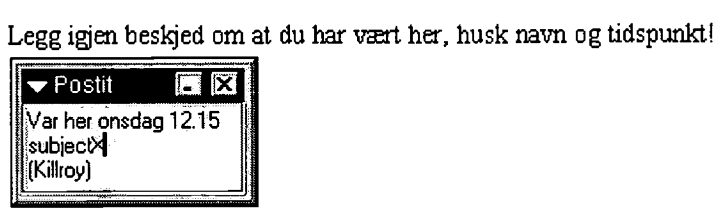


Figure 3 Part of the Whiteboard and a PostIt from version 10 of MyTeam2 room

Conclusions

This paper has described two tools developed for the ongoing analysis of collaborative telelearning scenarios using TW. The tools take automatically generated data as their input. SLA does so as a fairly automated process, whereas TRA depends on a great deal of interaction with the researcher. Information produced by SLA is useful for identifying the times at which a team had the potential to collaborate asynchronously or synchronously. To say that it is possible to collaborate is, however, not to say that collaboration occurred. Thus, SLA's output can be used to focus other methods that are being used to interpret the interaction between users of TW through its various tools.

TRA was developed as aid for studying the learning environment of a team (e.g., the rooms involved, the persons influencing the environment, the available tools, etc.). Incorporating Téle-université's tool classification model for a virtual campus environment (Paquette et. al., 1995) in TRA, enables TRA to suggest how the particular uses of the tools found in the team's rooms may be classified. Using these tools in conjunction with other data gathering methods such as interviews or video observation, the researcher will be able to develop a richer picture of collaboration patterns.

References

Badre, A. N., Guzdial, M., Hudson, S. E. and Santos, P. J. (1995). *A user interface evaluation environment using synchronized video, visualizations and event trace data.* Software Quality Journal 4, pp 101-113.

Fjeld, M., Schluep, S., Rauterberg, M. (1998). Automatic, action driven classification of user problem solving strategies by statistical and analytical methods: a comparative study. In F. E. Ritter and R. M. Young (eds.) *Proceedings of the Second European Conference on Cognitive Modelling*, 98-103. Nottingham: Nottingham University Press.

Garton, L., Haythorntwaite, C. & Wellman, B. (1999). Studying on-line social networks. In S. Jones (Ed.) *Doing Internet research: Critical issues and methods for examining the net*, 75-106. London: Sage Publicaions, Inc.

Guribye, F. & Wasson, B. (1999). Evaluating collaborative telelearning scenarios: A sociocultural perspective. In B. Collis & R. Oliver (Eds.) *Proceedings of Educational Multimedia '99*, 1264-1265. Charlottesville, VA: AACE.

Gutwin, C., Stark, G. and Greenberg, S. (1995). Support for Workspace Awareness in Educational Groupware. *in Proceedings of the ACM Conference on Computer Supported Collaborative Learning* 147-156. Hillsdale NJ: Lawrence Erlbaum Associates.

Guzdial, M. (1993). Deriving software usage patterns from log files. *Technical Report #GIT-GVU-93-41.* Graphics, Visualization, and Usability Center, College of Computing, Georgia Insitute of Technology.

Meistad, Ø. (in preparation). Collaborative telelearning: Using log-files to identify collaboration patterns. *Masters dissertation*, Dept. of Information Science, University of Bergen.

Mørch, A. & Wasson, B. (1999). Dynamics of groupware use in a collaborative telelearning scenario. Position paper at the workshop on "Evolving use of groupware" at ECSCW'99 Copenhagen DK, 12/9-99.

Newhagen, J. E., and Rafaeli, S. (1997). Why communication researchers should study the Internet: A dialogue [On-line]. Journal of Computer-Mediated Communication, 1(4). Available: http://www.ascusc.org/jcmc/vol1/issue4/rafaeli.html.

Nurmela, K, Lehtinen, E., Palonen, T. (1999). *Evaluating CSCL Log Files by Social Network Analysis.* Proceedings of Computer Support For Collaborative Learning 1999, 434-442.

Okada, H., Asahi, T. (1999). *GUITESTER: A log-based usability testing tool for Graphical User Interfaces. IEICE Transactions on information and systems. Volume E82.*

Paquette, G, Ricciardi-Rigault, C., Bourdeau, J., Paquin, C. & Liegeois, S. (1995) Modelling a Virtual Campus Environment for Interactive Distance Learning. *Proceeding of EdMedia'95.*

Wasson, B. (1999). Design and evaluation of a collaborative telelearning activity. In C. Hoadley (Ed) *Proceedings of CSCL99 Designing new media for a new millennium: Collaborative Technology for Learning,Education, and Training, 659-666.* ACM Press.

Wasson, B., Guribye, F. & Mørch, A. (2000). Project DoCTA: Design and use of Collaborative Telelearning Artefacts. *ITU Research Report*, 5, Oslo

Wasson, B. & Mørch, A. (1999). DoCTA: Design and Use of Collaborative Telelearning Artefacts. In B. Collis & R. Oliver (Eds.) *Proceedings of Educational Multimedia & Educational Telecom '99*, 534-539.

Acknowlegements

DoCTA is funded by The Norwegian Ministry of Education, Research and Church Affairs (KUF) under their Information Technology in Education (ITU) programme. The first author has been supported by an ITU graduate scholarship. In addition, the authors would like to thank the anonymous reviewer for their helpful comments.

How adequate are Hypermedia Systems, Models and Methodologies to Education?

Emilia Mendes
Computer Science Department
The University of Auckland
Private Bag 92019
Auckland, New Zealand
emilia@cs.auckland.ac.nz

Abstract: This paper describes the results of a feature analysis aimed at evaluating how adequate hypermedia models, methodologies and systems are when applied to authoring for education.

The requirements used in our work were identified by educational hypermedia authors and also by existing literature in the field of hypermedia authoring. Our objective was to assess whether or not hypermedia models, methodologies and systems offered features corresponding to the requirements identified by educational hypermedia authors/existing literature.

The results obtained showed that none of the hypermedia models and methodologies used in our evaluation had features corresponding to the essential requirements that have been identified. Among the hypermedia systems, only three presented features which corresponded to requirements considered essential by hypermedia authors.

Introduction

The aim of a feature analysis (Kitchenham and Jones 1997a; 1997b;1997c) is to identify which of several methods/systems/methodologies best fits the requirements of potential users. The requirements are translated into a list of desired features, which later on will be compared against the features offered by the candidate methods/systems/methodologies.

The feature analysis presented in this paper was used to identify: i) which models, methodologies and systems would fit the requirements of potential users; ii) potential areas of research that would improve hypermedia authoring by improving either the models/methods, methodologies or systems selected in the evaluation.

The depth of investigation for the candidate hypermedia models, methodologies and systems was based on published literature. Hypermedia models are, in general, used for the conceptual design of hypermedia applications whereas hypermedia methodologies are used for the development of hypermedia applications. The models and methodologies considered in our work are presented in Table 1:

Hypermedia Models	Hypermedia Methodologies
HDM (Garzotto et al. 1995)	**RMM** (Isakowitz et al. 1997)
HDM2 (Garzotto et al. 1996b)	**PHD** (Schuler and Thüring 1994)
OOHDM (Schwabe and Rossi 1995)	**Thüring's framework** (Thüring 1994)
EORM (Lange 1996)	

Table 1: Hypermedia models and methodologies used in the feature analysis evaluation.

Hypermedia systems are tools used to develop hypermedia applications. The hypermedia systems used in the feature analysis are presented in table 2:

Hypermedia Systems

Conclusions

This paper has described two tools developed for the ongoing analysis of collaborative telelearning scenarios using TW. The tools take automatically generated data as their input. SLA does so as a fairly automated process, whereas TRA depends on a great deal of interaction with the researcher. Information produced by SLA is useful for identifying the times at which a team had the potential to collaborate asynchronously or synchronously. To say that it is possible to collaborate is, however, not to say that collaboration occurred. Thus, SLA's output can be used to focus other methods that are being used to interpret the interaction between users of TW through its various tools.

TRA was developed as aid for studying the learning environment of a team (e.g., the rooms involved, the persons influencing the environment, the available tools, etc.). Incorporating Téle-université's tool classification model for a virtual campus environment (Paquette et. al., 1995) in TRA, enables TRA to suggest how the particular uses of the tools found in the team's rooms may be classified. Using these tools in conjunction with other data gathering methods such as interviews or video observation, the researcher will be able to develop a richer picture of collaboration patterns.

References

Badre, A. N., Guzdial, M., Hudson, S. E. and Santos, P. J. (1995). *A user interface evaluation environment using synchronized video, visualizations and event trace data.* Software Quality Journal 4, pp 101-113.

Fjeld, M., Schluep, S., Rauterberg, M. (1998). Automatic, action driven classification of user problem solving strategies by statistical and analytical methods: a comparative study. In F. E. Ritter and R. M. Young (eds.) *Proceedings of the Second European Conference on Cognitive Modelling*, 98-103. Nottingham: Nottingham University Press.

Garton, L., Haythorntwaite, C. & Wellman, B. (1999). Studying on-line social networks. In S. Jones (Ed.) *Doing Internet research: Critical issues and methods for examining the net*, 75-106. London: Sage Publicaions, Inc.

Guribye, F. & Wasson, B. (1999). Evaluating collaborative telelearning scenarios: A sociocultural perspective. In B. Collis & R. Oliver (Eds.) *Proceedings of Educational Multimedia '99*, 1264-1265. Charlottesville, VA: AACE.

Gutwin, C., Stark, G. and Greenberg, S. (1995). Support for Workspace Awareness in Educational Groupware. *in Proceedings of the ACM Conference on Computer Supported Collaborative Learning* 147-156. Hillsdale NJ: Lawrence Erlbaum Associates.

Guzdial, M. (1993). Deriving software usage patterns from log files. *Technical Report #GIT-GVU-93-41.* Graphics, Visualization, and Usability Center, College of Computing, Georgia Insitute of Technology.

Meistad, Ø. (in preparation). Collaborative telelearning: Using log-files to identify collaboration patterns. *Masters dissertation*, Dept. of Information Science, University of Bergen.

Mørch, A. & Wasson, B. (1999). Dynamics of groupware use in a collaborative telelearning scenario. Position paper at the workshop on "Evolving use of groupware" at ECSCW'99 Copenhagen DK, 12/9-99.

Newhagen, J. E., and Rafaeli, S. (1997). Why communication researchers should study the Internet: A dialogue [On-line]. Journal of Computer-Mediated Communication, 1(4). Available: http://www.ascusc.org/jcmc/vol1/issue4/rafaeli.html.

Nurmela, K, Lehtinen, E., Palonen, T. (1999). *Evaluating CSCL Log Files by Social Network Analysis.* Proceedings of Computer Support For Collaborative Learning 1999, 434-442.

Okada, H., Asahi, T. (1999). *GUITESTER: A log-based usability testing tool for Graphical User Interfaces. IEICE Transactions on information and systems. Volume E82.*

Paquette, G, Ricciardi-Rigault, C., Bourdeau, J., Paquin, C. & Liegeois, S. (1995) Modelling a Virtual Campus Environment for Interactive Distance Learning. *Proceeding of EdMedia'95.*

Wasson, B. (1999). Design and evaluation of a collaborative telelearning activity. In C. Hoadley (Ed) *Proceedings of CSCL99 Designing new media for a new millennium: Collaborative Technology for Learning,Education, and Training, 659-666.* ACM Press.

Wasson, B., Guribye, F. & Mørch, A. (2000). Project DoCTA: Design and use of Collaborative Telelearning Artefacts. *ITU Research Report*, 5, Oslo

Wasson, B. & Mørch, A. (1999). DoCTA: Design and Use of Collaborative Telelearning Artefacts. In B. Collis & R. Oliver (Eds.) *Proceedings of Educational Multimedia & Educational Telecom '99*, 534-539.

Acknowlegements

DoCTA is funded by The Norwegian Ministry of Education, Research and Church Affairs (KUF) under their Information Technology in Education (ITU) programme. The first author has been supported by an ITU graduate scholarship. In addition, the authors would like to thank the anonymous reviewer for their helpful comments.

How adequate are Hypermedia Systems, Models and Methodologies to Education?

Emilia Mendes
Computer Science Department
The University of Auckland
Private Bag 92019
Auckland, New Zealand
emilia@cs.auckland.ac.nz

Abstract: This paper describes the results of a feature analysis aimed at evaluating how adequate hypermedia models, methodologies and systems are when applied to authoring for education.
The requirements used in our work were identified by educational hypermedia authors and also by existing literature in the field of hypermedia authoring. Our objective was to assess whether or not hypermedia models, methodologies and systems offered features corresponding to the requirements identified by educational hypermedia authors/existing literature.
The results obtained showed that none of the hypermedia models and methodologies used in our evaluation had features corresponding to the essential requirements that have been identified. Among the hypermedia systems, only three presented features which corresponded to requirements considered essential by hypermedia authors.

Introduction

The aim of a feature analysis (Kitchenham and Jones 1997a; 1997b;1997c) is to identify which of several methods/systems/methodologies best fits the requirements of potential users. The requirements are translated into a list of desired features, which later on will be compared against the features offered by the candidate methods/systems/methodologies.

The feature analysis presented in this paper was used to identify: i) which models, methodologies and systems would fit the requirements of potential users; ii) potential areas of research that would improve hypermedia authoring by improving either the models/methods, methodologies or systems selected in the evaluation.

The depth of investigation for the candidate hypermedia models, methodologies and systems was based on published literature. Hypermedia models are, in general, used for the conceptual design of hypermedia applications whereas hypermedia methodologies are used for the development of hypermedia applications. The models and methodologies considered in our work are presented in Table 1:

Hypermedia Models	Hypermedia Methodologies
HDM (Garzotto et al. 1995)	**RMM** (Isakowitz et al. 1997)
HDM2 (Garzotto et al. 1996b)	**PHD** (Schuler and Thüring 1994)
OOHDM (Schwabe and Rossi 1995)	**Thüring's framework** (Thüring 1994)
EORM (Lange 1996)	

Table 1: Hypermedia models and methodologies used in the feature analysis evaluation.

Hypermedia systems are tools used to develop hypermedia applications. The hypermedia systems used in the feature analysis are presented in table 2:

Hypermedia Systems

SEPIA (Thüring et al., 1995)	**Intermedia** (Haan et al. 1992)
MacWeb (Nanard and Nanard 1995)	**StorySpace** (Bernstein et al. 1991b)
IDE (Jordan et al. 1989)	**HyDesign** (Marmann and Schlageter 1992)
the Web (Berners-Lee et al. 1994)	**Webcosm** (Hill 1998)
Aquanet (Marshall et al. 1991)	**HyperWave** (Maurer 1996)
VIKI (Marshall and Shipman 1997)	**ODMTool** (Lange 1996)
RMCase (Díaz and Isakowitz 1995)	**Microcosm** (Hall et al. 1996)

Table 2: Hypermedia systems used in the feature analysis evaluation

The feature analysis evaluation was organised using a screening mode approach (Kitchenham and Jones 1997b) and was performed by one person. The screening mode is the fastest and least costly form of feature analysis and the number of different roles is minimised. On the other hand, the whole evaluation is based on the subjective assessment of one person or team, which may bias the results.

The requirements used in the feature analysis were based on published literature in the fields of hypermedia authoring for education and experimentation and on the results of a qualitative evaluation that analysed the process of authoring hypermedia applications for education (Mendes and Hall, 1999).

The remainder of this paper is organised as follows: Section 2.0 describes the feature analysis evaluation and the results obtained. Section 3.0 gives our conclusions and comments on future work.

The Feature Analysis Evaluation

The Assessment Scales Used for Scoring the Features

The first step of a feature analysis is to prepare a feature list, where each feature is classified into simple (S) or compound (CO). Each feature also has a degree of importance associated, which can be: Mandatory (M), Highly Desirable (HD), Desirable (D) and Nice to have (N). Each degree of importance has also a weighting factor associated, which will be used by compound features. The corresponding weighting factors for M, HD, D and N are, respectively, 10, 6, 3 and 1 (Kitchenham and Jones 1997b). Simple features are scored as five (for Yes) or zero (for No).

The judgement scales that we have used to assess a method/methodology/system support for a particular feature are as follows (see Tables 3 and 4):

Generic Scale Point	Definition Scale Point	Scale Point Mapping
Makes things Worse	Causes confusion. The way the feature is implemented makes it difficult to use and/or encourages its incorrect use	-1
No support	Fails to recognise it. The feature is not supported nor referred to in the published literature available.	0
Little support	The feature is supported indirectly, by the use of other system features in non-standard combinations.	1
Some support	The feature appears explicitly in the system and in the published literature. However, some aspects of the feature use are not catered for.	2
Strong support	The feature appears explicitly in the system and in the published literature. All aspects of the feature are covered, but its use depends on the expertise of the user.	3
Very strong support	The feature appears explicitly in the system and in the published literature. All aspects of the feature are covered, and the system provides tailored dialogue boxes to assist the user.	4
Full support	The feature appears explicitly in the system and in the published literature. All aspects of the feature are covered, and the system provides user scenarios to assist the user.	5

Table 3: Judgement scale to assess hypermedia system support for a feature

Generic Scale Point	Definition Scale Point	Scale Point Mapping
Makes things Worse	Causes confusion. The way the feature is implemented makes it difficult to use and/or encourages its incorrect use.	-1
No support	Fails to recognise it. The feature is not supported nor referred to in the published literature available.	0
Little support	The feature is supported indirectly, by the use of other model/method/methodology features in non-standard combinations.	1
Some support	The feature appears explicitly in the model/method/methodology and in the published literature. However, some aspects of the feature use are not catered for.	2
Strong support	The feature appears explicitly in the model/method/methodology and in the published literature. All aspects of the feature are covered, but its use depends on the expertise of the user.	3
Very strong support	The feature appears explicitly in the model/method/methodology and in the published literature. All aspects of the feature are covered, and the model/method/methodology provides tailored questions and frequently asked questions to assist the user.	4
Full support	The feature appears explicitly in the model/method/methodology and in the published literature. All aspects of the feature are covered, and the model/method/methodology provides user scenarios to assist the user.	5

Table 4: Judgement scale to assess hypermedia model/methodology support for a feature

The List of Features
The Features Obtained from the Qualitative Survey

This section describes a list of features, which was based on the results of a qualitative survey evaluation (Mendes and Hall 1999). The survey aimed at analysing the processes involved in the authoring of hypermedia applications for education. The list of features and the type and degree of importance associated with each one are presented below (see Table 5). A more detailed explanation of each feature is given in Appendix A:

Feature Description	Type	Importance	M, MD, S	N
Supports structural knowledge design	Compound	Mandatory	All three	04
Supports structuring different domains	Simple	Mandatory	All three	05
Supports a top-down approach to structuring the information	Compound	Mandatory	All three	06
Links are not essential in order to structure the knowledge domain	Simple	Mandatory	All three	07
Supports the representation of the author's cognitive map	Compound	Mandatory	Method, methodology	08
Supports the interface design, structural knowledge design and the authoring of the nodes' contents separately	Compound	Mandatory	All three	09
Allows readers to see the author's cognitive map	Compound	Mandatory	System	10
Supports text	Simple	Mandatory	System	11
Supports images	Simple	Mandatory	System	12
Supports typed links	Compound	Mandatory	System	13

Supports contextual links	Compound	Mandatory	System	14
Supports the structuring of information according to a problem-solving approach	Simple	Mandatory	System	15
Supports different levels of information granularity	Compound	Mandatory	System	16
Supports collaboration in the system	Compound	Highly desirable	System	17
M – Method feature MD – Methodology feature S - System feature N – # in the scoring sheet				

Table 5: Feature list obtained from the qualitative survey

General Features

This sub-section presents three general features, taken from the literature in hypermedia authoring for education and empirical evaluation. These were considered relevant for the feature analysis evaluation. Each general feature is described below and a summary is given in the end of this sub-section (see Table 6).

a) Support for ill-structured domains

According to Rand Spiro et al. (1995) all domains which involve the application of knowledge to unconstrained, *naturally occurring situations* (cases) are highly ill-structured. Even those knowledge domains that are well-structured also have aspects of ill-structuredness, especially at more advanced levels of study, e.g. mathematics.

Ill-structuredness is not a serious problem for *introductory learning* as learners are not expected to master complexity or independently transfer their acquired knowledge to new situations. However, when conceptual mastery and flexible knowledge application become paramount, the complexity and across-case diversity characteristic of ill-structured domains needs to be addressed (Carvalho and Dias 1997; Jacobson and Archodidou 1997; Rana and Bieber 1997).

b) Has been validated empirically using formal experimentation

In a random sample of all the papers that the ACM published in 1993, 40 percent of them contained claims that needed empirical support but had none at all (Tichy 1998). In software-related journals, this fraction was 50 percent. Tichy's data shows that computer scientists validate a smaller percentage of their claims than other scientists. He also asserts that a balance between theory and engineering with experimentation would have the following benefits:

- Experimentation can help build a reliable base of knowledge and thus reduce uncertainty about which theories, methods and tools are adequate.
- Observation and experimentation can lead to new, useful, and unexpected insights and open whole new areas of investigation. Experimentation can push into unknown areas where engineering progresses slowly, if at all.
- Experimentation can accelerate progress by quickly eliminating fruitless approaches, erroneous assumptions, and fads. It also helps orient engineering and theory in promising directions.
- Demonstrations can provide proof of concepts or incentives to study a question further. Too often, however, these demonstrations merely illustrate a potential. To obtain evidence, careful analysis involving experiments, data, and replication is necessary.

According to Fenton et al. (1994) much of what is believed about which approaches are best is based on anecdotes, gut feelings, expert opinions, and flawed research, rather than on careful, rigorous software experimentation.

c) Was proposed using a scientific method of research

Glass (1994) gives a classification of possible research models:

- The scientific method - Observe the world, propose a model or theory of behaviour, measure and analyse, validate hypotheses of the model or theory, and if possible repeat.
- The engineering method - Observe existing solutions, propose better solutions, build or develop, measure and analyse, repeat until no further improvements are possible.
- The empirical method - Propose a model, develop statistical or other methods, apply to case studies,

measure and analyse, validate the model, repeat.

- The analytical method - Propose a formal theory or set of axioms, develop a theory, derive results, and if possible compare with empirical observations.

Most of the research to date in hypermedia authoring uses an analytical advocacy model of research without further empirical justification, transforming the process of authoring into art, rather than into science (Isakowitz et al.1995).

As engineering involves the analysis of measurements (Pfleeger et al. 1997), hypermedia engineering will only become a true engineering discipline when a solid foundation of measurement-based theories is build.

The general feature list and the corresponding type and degree of importance are presented below (see Table 6):

Feature Description	Type	Importance	M, MD, S	N
Supports ill-structured domains	Simple	Mandatory	All three	1
Has been validated empirically using formal experimentation	Simple	Highly desirable	All three	2
Was proposed according to a scientific method of research	Simple	Highly desirable	All three	3
M – Method feature MD – Methodology feature S - System feature N – # in the scoring sheet				

Table 6: General feature list

The Evaluation Profiles

The Evaluation Profile for Hypermedia Models, Methods and Methodologies

None of the hypermedia models, methods and methodologies evaluated supports the structuring of ill-structured domains, which is one of the mandatory features. Consequently, they were all eliminated from the list of candidates. Isakowitz and Türing (1994) corroborate this result:

> "These methodologies are apt for *structured domains* where economies of scale can apply, i.e., there are many objects of the same kind. The key difference between the approaches is that Schwabe and Rossi is object-oriented, while Balasubramanian, Isakowitz and Stohr's is based on an entity-relationship approach.".

The Evaluation Profile for Hypermedia Systems

None of the hypermedia systems, except Microcosm, HyDesign and Webcosm support contextual links. Consequently, apart from those 3, all the others were eliminated from the list of candidates. The evaluation profiles for the three hypermedia systems are presented below (see Table 7):

		Conformance Score		
#Feature Number	Importance	Microcosm	HyDesign	Webcosm
01	M	5	5	5
02	HD	0	0	0
03	HD	0	0	0
05	M	1 x 10	2 x 10	1 x 10
06	M	5	5	5
07	M	3 x 10	3 x 10	3 x 10
08	M	5	5	5
10	M	2 x 10	1 x 10	2 x 10
11	M	3 x 10	3 x 10	3 x 10
12	M	5	5	5
13	M	5	5	5
14	M	2 x 10	1 x 10	1 x 10
15	M	3 x 10	3 x 10	3 x 10
16	M	5	5	5
17	M	2 x 10	1 x 10	3 x 10

20	HD	0	0	2 x 6
Total score		190	170	202
M – Mandatory	HD – Highly desirable			

Table 7: Evaluation profile for the hypermedia systems

Conclusions and Future Work

All the models, methods and the methodologies and nearly all the hypermedia systems were eliminated. The two main requirements that have contributed to these results were 'support for ill-structured domains' and 'support for contextual links'. The scores obtained by Microcosm and Webcosm were quite similar and higher than the score obtained for HyDesign.

The results of the feature analysis evaluation showed that in practice authors' requirements are not being mapped by state-of-the-art methods and methodologies, corroborating Fenton's affirmation that:

> "best projects do not necessarily have *state-of-the-art methodologies or extensive automation and tooling*. They rely on basic principles such as *strong team work, project communication, and project controls. Good organisation* and *management* appears to be far more of a critical success factor than technology or methodology." (Fenton 1993).

The feature analysis evaluation also showed that none of the hypermedia system candidates has scored points for the general features 'being validated empirically using a formal experimentation', and 'being proposed according to a scientific method of research'.

Our next step is to apply a scientific approach to the evaluation and proposal of several metrics that will measure the authoring quality of educational hypermedia applications developed using either Microcosm or Webcosm. By applying measurement principles we hope to generate quantitative descriptions of hypermedia authoring processes and applications that will enable us to control and improve the authoring process as a whole.

References

Balasubramanian, V., Bashian, A., & Porcher, D., (1998). A large-scale Hypermedia Application using Document Management and Web Technologies,*ACM Conference on Hypertext and Hypermedia*, Pittsburgh, 134-144.

Berners-Lee, T., Cailliau, R., Luotonen, A., Nielsen, H. F., & Secret, A., (1994). The World Wide Web, *Communications of the ACM*, 37(8), 76-82, August.

Bernstein, M., Bolter, J. D., Joyce, M., & Mylonas, E., (1991b). Architectures for Volatile Hypertext, *Proceedings of Hypertext'91*, ACM Press, , San Antonio, Texas, December, 241-260.

Carvalho, A. A. A., & DIAS, P., (1997). Hypermedia Environment using a Case-Based Approach to Foster the Acquisition of Complex Knowledge, *ED-MEDIA'97*, Calgary, Canada, June.

Díaz, A., & Isakowitz, T., (1995), RMCase: Computer-Aided Support for Hypermedia Design and Development, S*ubmitted to the International Workshop on Hypermedia Design*.

Fenton, N., (1993), How Effective are Software Engineering Methods?, *J. Systems Software*, 22, 141-146.

Fenton, N., Pfleeger, S. L., & GLASS, R. L., (1994), Science and Substance: A challenge to Software Engineers. *IEEE Software*, July, 86-95.

Garzotto, F., Mainetti, L., and Paolini, P., (1995). Hypermedia Design, Analysis, and Evaluation Issues. *Communications of the ACM*, Special Issue on Hypermedia Design, August.

Garzotto, F., Mainetti, L., and Paolini, P., (1996b). Navigation in Hypermedia Applications: Modelling and Semantics, *Journal of Organisational Computing and Electronic Commerce*, 6(3), 211-238.

Glass, R. L., (1994). The Software-Research Crisis. *IEEE Software*, November, 42-47.

Haan, B. J., Kahn, P., Riley, V. A., Coombs, J. H, & Meyrowitz, N. K., 1992. IRIS Hypermedia Services. *Communications of the ACM*, 35(1), 36-51.

Hall, W., Davis, H., & Hutchings, G., (1996). *Rethinking Hypermedia – The Microcosm Approach.* Kluwer Academic Publs.

Hill, G., (1998), Webcosm Technical Overview, Multicosm Ltd., *Technical manual*,
http://www.multicosm.com.

Isakowitz, T., & Türing, M., (1994), *Methodologies for Designing and Developing Hypermedia Applications*,

Tomas Isakowitz and Manfred Thüring, Eds., Centre for Research in Information Systems, New York University, Department of Information Systems, Leonard N. Stern School of Business, December.
Isakowitz, T., Stohr, E. A., and Balasubramanian, P., (1995). RMM: A Methodology for Structured Hypermedia Design, *Communications of the ACM*, Special Issue on Hypermedia Design, August.
Isakowitz, T., Kamis, A. & Koufaris, M., (1997). Reconciling Top-Down and Bottom-Up Design Approaches in RMM, *WITS-97*, Atlanta, GA, USA, December.
Jacobson, M. J., & Archodidou, A., (1997). Case-based hypermedia and learning neo-Darwinian evolutionary biology: Promoting conceptual change of complex scientific knowledge, Manuscript submitted for publication.
Jordan, D. S., Russell, D. M., Jensen, A. S., & Rogers, R. A., (1989). Facilitating the Development of representations in Hypertext with IDE. *Hypertext'89*, 93-104, ACM Press, Pittsburgh, Pennsylvania, November.
Kitchenham, B., & L. Jones, (1997a). Evaluating Software Engineering Methods and Tool, Part 6: Identifying and Scoring Features. *Software Engineering Notes*, 22(2), 16-18, March.
Kitchenham, B., & L. Jones, (1997b). Evaluating Software Engineering Methods and Tool, Part 7: Planning Feature Analysis Evaluation. *Software Engineering Notes*, 22(4), 21-24, July.
Kitchenham, B., & L. Jones, (1997c). Evaluating Software Engineering Methods and Tool, Part 8: Analysing a Feature Analysis Evaluation. *Software Engineering Notes*, 22(5), 10-12, September.
Lange, D. B., (1996). An Object-Oriented Design Approach for Developing Hypermedia Information Systems. *Journal of Organisational Computing*, October.
Marmann, M., & Schlageter, G., (1992). Towards a Better Support for the Hypermedia Structuring: The HYDESIGN Model, *ACM European Conference on Hypertext*, 11-22, ACM Press, Milan, December.
Marshall, C. C., Halasz, F. G., Rogers, R. A., & Janssen, W. C. Jr., (1991). Aquanet: a hypertext tool to hold your knowledge in place, *Hypertext'91*, 261-275, ACM Press, San Antonio, Texas, December.
Marshall, C. C., & Shipman, F. M. III, (1997). Spatial Hypertext and the Practice of Information Triage, *Hypertext'97*, Southampton, UK, April.
Maurer, H., (1996). *Hyper-G now HyperWave – The next generation web solution*, Addison-Wesley Publ.
Mendes, M. E. X., & Hall, W., (1999). Hyper-Authoring for Education: a qualitative evaluation, *Computers and Education*, 32, 51-64.
Nanard, J., & Nanard, M., (1995). Hypertext Design Environments and the Hypertext Design Process, *Communications of the ACM,*, Special Issue on Hypermedia Design, August, 49-56.
Pfleeger, S. L., Jeffery, R., Curtis, B., & Kitchenham, B., 1997. Status Report on Software Measurement. *IEEE Software*, March/April.
Rana, A. R., & Bieber, M., (1997). Towards a Collaborative Hypermedia Educational Framework, *Thirtieth Annual Hawaii International Conference on System Science* (HICSS), 610-619, Maui, January.
Schuler, W., & Thüring, M., (1994). Pragmatical Hypertext Design (PHD), *Technical Report*, GMD Institute, Germany, 3-58.
Schwabe, D., & G. Rossi, 1995, Building Hypermedia Applications as Navigational Views of Information Models, *28th Annual Hawaii International Conference on System Sciences,* 231-240.
Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L., (1995). Cognitive Flexibility, Constructivism, and Hypertext: Random Access Instruction for Advanced Knowledge Acquisition in Ill-Structured Domains. *In:* L. Steffe & J. Gale, eds., *Constructivism*, Hillsdale, N.J.:Erlbaum.
Thüring, M., (1994), A Conceptual Framework for Hypermedia Design Methodologies, *Workshop on Hypermedia Design and development*, Edinburgh, September 18.
Thüring, M., HANNEMANN, J., & HAAKE, J., (1995). Hypermedia and Cognition: Designing for Comprehension, *Communications of the ACM*, Special Issue on Hypermedia Design, August.
Tichy, W. F., (1998). Should Computer Scientists Experiment More?, *IEEE Computer*, May, p: 32-40.

Appendix A

Supports structural knowledge design - Does the hypermedia system allow the author to structure the application according to the structural knowledge corresponding to a particular domain? The structural knowledge is the knowledge of how concepts within a domain are interrelated.
Supports structuring different domains - Does the hypermedia system allow the author to structure the applications in different ways, corresponding to which subjects (domain) is being taught?

Supports a top-down approach to structuring the information - Does the hypermedia system allow the author to structure the contents using a hierarchy?
Links are not essential in order to structure the knowledge domain - Does the author need to define the links in the application at the same time as (s)he structures the knowledge domain?
Supports the representation of the author's cognitive map - A cognitive map is the graphical representation of the author's structural knowledge. Does the hypermedia system support any graphical representation of the structural knowledge?
Supports the interface design, structural knowledge design and the authoring of the nodes' contents separately - Does the hypermedia system allow authors to design the application's interface, design the structural knowledge and author the contents of each node separately? Or does everything need to be done "at the same time"?
Allows readers to see the author's cognitive map - Does the hypermedia system allow readers to see the graphical representation of the structural knowledge that represents the application's content?
Supports typed links - A typed link is a link that has a description (label) attached to it. In general, types explain what kind of information readers will find when they follow that particular link. Examples of types are 'example', 'definition', 'more information', etc.
Supports contextual links - Context-dependent links are links that are recognised by the hypermedia system within certain boundaries established by the author. A boundary can be a document, the whole hypermedia application, an anchor, a set of documents (nodes).
Supports different levels of information granularity - Does the system support the structuring of information using different levels of abstraction (granularity)?
Supports collaboration in the system - Does the system allow authors to collaborate in the authoring process? Can authors develop the same application at the same time?

The Price a Distance Education Student Pays When Using Electronic Learning Resources

Dr John Messing
School of Information Studies, Charles Sturt University, Australia
jmessing@csu.edu.au

Abstract: While it may be quite usual for proponents of some cause to enthusiastically portray their case in the best possible light, when it comes to changes in education, there is no excuse for not considering the true impact on the final target of those changes, the students. In the push for electronic delivery, distance education students have been found to carry a significant number of costs which rarely find their way into cost-benefit analyses carried out by the institution or its staff. Wasted time and effort, decreased learning access and a variety of social costs are all part of the real price that a distance student often pays.

The Changing Scene

It appears inevitable that more and more education is going to be delivered in the distance mode (National Center for Education Statistics 1998) and that an active debate exists in the move to electronic delivery of education. One only has to look at any of the reports into higher education such as that of the Kellog Commission on the future of state and land grant universities (Stukel 1998) to appreciate how determined university administrators are to take advantage of the use of Information and Communications Technology (ICT). Given all the rhetoric and posturing, one could be forgiven for thinking that this is revolutionary rather than evolutionary. It is significant to note that the advent of another communication technology, public postage, was instrumental in the establishment of early Distance Education (DE) and that while the Internet has challenged the current notions of what DE means and how it is to be delivered, public postage and DE did not totally destroy the existing university order in the last 100 years! History suggests that the Internet will not either. ICT provides many new and exciting prospects that will complement and extend, rather than totally supplant, existing education.

These changes to education make it imperative that the impact of this mode and medium on students be understood and taken into account. Literature such as Twigg (1999) is heavily skewed in favour of the institutional effects and the impact on the instructors. An analysis of the costs and benefits for students such as that carried out for instructors by Collis, Winnips & Moonen (1999) is not easily found. Sibillin et al. (1996 p205) admit that determinations about the future of higher education are *"a discourse in which students appear all too irregularly."* Hara and Kling (1999) while broaching the topic of student frustrations with using web-based education conclude that the predominantly positive literature emphasizes potential and understates the problems students face. Even more difficult to find is reliable data about the impact on DE students who are not at all like full-time students. DE students are much more heavily influenced by external factors associated with the many different roles that they have to undertake. This alters the learning process for each in a wide variety of ways resulting in a more andragogical rather than pedagogical way of learning. (Roberts 1984, Woodley 1987, Garland 1993)

Determining how electronic forms of learning are to feature in the DE environment cannot be done using just pedagogical, technological or economic criteria. These are necessary and may ultimately limit thc scope of what is feasible at any time, but they are certainly not sufficient. The effects that such strategies have on the end user, the learner, are equally important. Key components of DE are learner choice over what, how, where and when to study. Electronic materials have the potential to alter these choices. Whether this changes as learners' exposure to the use of ICT increases, must also be considered. The philosophical changes to educational practice, which are moving to more learner participation in activities and the social impact of such changes are additional concerns.

Costs

It is frequently the case (cf CAUT 1993; Western Governors Association 1996; Bates 1997, Stukel 1998, Sakamoto 1999) that decisions to use technology to deliver education make mention of improved access to higher quality learning materials and better cost-effectiveness of the process. The relationship between costs and quality are not simple, nor clear (Bates 1995, Moonen 1999). Justifications for the use of educational technology sometimes incorporate assumptions that this will result in a better learning environment for the student and suggestions of possibly greater success (Reushle 1995). Such assumptions are not easily challenged because they appear plausible and the collection of reliable data is difficult. There are many factors involved in the quality of the education that a learner receives and improvements in one area with degradation in another may prove inconclusive. Russell's (1999) collection of reports resulting in the 'No significant difference phenomenon' is testament to that.

Better quality learning materials which place greater restrictions on the 'how, when and where' of the learning process may result in a decrease in satisfaction or performance. The interaction of many other variables such as the effect of peer support and face to face context, are difficult to quantify and even more difficult to control. Add in new variables associated with life long learning and flexible 'education on demand' and the ability to accurately predict improvement in educational quality, regardless of the technology, becomes exceedingly difficult.

Changing the focus from the policies of the institution to the needs of the students is exceptionally difficult. While the technology referred to may have altered considerably, the words of Sewart (1981 p172) are no less relevant in the current circumstances.

> *"...there is an overwhelming tendency within the field of teaching at a distance to offer systems from the standpoint of the institution teaching at a distance, rather than from the standpoint of the student learning at a distance. The response to the individual needs of the student has often become lost in the over-riding requirement to produce a grandiose package of materials."*

It is impossible to imagine that the many projects and studies reported in the literature are all genuine responses to student needs. An examination of over 100 successful applications for funding under the National Teaching Development Projects (CAUT 1993) for example, revealed that even though there were expected to be improved learning outcomes in some, all but three were teacher centered. The predominant focus was still on the teaching or institutional standpoint.

The complete costs to the student of the use of these new approaches need to be identified and quantified as accurately as possible. Not all of these may be expressed in financial terms. Additional time and effort, inconvenience and the effects of frustration or poor system performance are very real costs for which it is not always possible to attach some numerical value much less a dollar equivalent. Conversely, as Geasler (1992) pointed out, the failure to develop and use more effective learning environments also represents a cost, for both students and academics, in lost opportunities.

Wasted time

Many current initiatives involve the use of the Internet without even basic consideration of the cost of doing so for the student. Even common IT practices such as estimates of system performance are being ignored in the rush to be seen to be at the cutting edge. Rccciving a 100 kilobyte file on an average academic network may not incur any substantial delays but for a DE student, the whole process of starting the computer, making the connection and then reading or printing the file after transfer may add 5 or 10 minutes to the process. The time, effort and financial cost incurred must bc considered a burden that the student has to bear. When the network slows down, the cost increases substantially. On economic grounds alone, this is not a good situation. The wasted time and the uncertainty factor which increases anxiety, makes it less than acceptable. What may work exceedingly well in campus laboratories supported by high speed optic fibre networks, may turn out to be a nightmare for students using a modem from home at peak times. Some stories such as that of a class required to download a large file, which repeatedly failed to download in the connection time limit, are beginning to approach legend status. The current joke of WWW standing for World Wide Wait is sadly funny because of its proximity to the truth.

Similar difficulties may arise in the use of electronic learning materials, regardless of the method of distribution. A book has obvious advantages in that it requires no additional hardware, is exceptionally portable, may be quickly accessed and may be used in a diverse range of environments. When access sessions with electronic learning materials are relatively brief, the time taken to start up represents a sizeable proportion of the time involved. On the other hand, for extended sessions, it would be negligible. This either changes the way that students use the materials or disadvantages those who do not want to, or are not able to, adjust to such strategies of extended use.

Inconvenience

Models of the teaching-learning process such as that proposed by Laurillard (1993) emphasize the discussion and interaction between the teacher and the learner. Such models may be appropriate for face to face environments but provide a poorer fit for most DE situations. Attempts to synchronize what is basically an asynchronous paradigm cause some friction. The ultimate challenge of future education is to completely remove synchronization events. Such events include fixed enrolment dates, due dates for assessment items and even expectations by the teachers that students will be "up to topic x" by any particular date. This is especially true if notions of life long learning and flexibility as espoused by many such as Cheng (1999) or Jones (1997, 1999) are also taken into account. Education using ICT also has a different set of protocols to 'traditional' education. Many students have yet to master these and the effort required to cope may be asking too much of the student.

Experience with DE students (Roberts 1984, McLachlan 1999) has shown that most would be characterized by Newble and Clarke (1986) as having a 'strategic' approach. This is supported by studies such as the navigation behaviours of students using an electronic study guide (Messing 1997). For such students, electronic learning materials would have to possess identifiable advantages over traditional resources or they would be rejected.

What is often overlooked in this discussion is the role that the scale of the operation plays in encouraging or discouraging learner engagement. Van der Veen et al (1999) report a situation where the numbers of contributions by students actually discouraged deep reading of the contributions by fellow students. As with face to face teaching, there may be natural limits within which, strategies involving the use of electronic resources may be effective but outside of which, they have little chance of success. The old cliché of "horses for courses" does not appear to have been recognised by many of the grand plans.

Research on product outcomes such as higher performance has been extensive but far from conclusive (Russell 1999) while studies on the costs associated with 'learning access' are scarce. Martens et al. (1997) describe learning access as the extent to which students are able to efficiently achieve their learning goals by means of the affordances available in the electronic materials. The learning access needs to be considered at the level of general principles as well as how these are applied to each case of electronic learning materials.

Perceived problems of not being able to find the desired information or achieve desired learning outcomes may be the product of students not fully understanding the features that are available to them or being aware of the protocols required to engage in the materials. Teachers using electronic learning materials are often closely involved in their design thus giving them a biased perspective which sometimes fails to appreciate the difficulties of novices. Evidence in studies such as Messing (1997, 1999) illustrates the fact that students are not always completely conversant with the features at their disposal. This is manifested in 'wandering' behaviour resulting in wasteful transitions from node to node with very short intervening times, often too short for any purposeful learning. Such situations can easily lead to frustration (Hara and Kling 1999).

The Preference for Paper

The issue of printing is one of the most fundamental in the discussion of the viability of electronic study materials. It is common to find (for example, Mason 1996; Bates 1997) that the reduction of printed material and its associated costs is given as one of the principal justifications for the development of electronic materials. However, that represents only the institutional perspective and may simply transfer the cost of printing in both financial and production senses, from the institution to the student. It has also been pointed out (Mason 1996) that the student printed material is vastly inferior in quality and presentation to the standard that the institution would normally provide. Such reduction in standard is another cost that the student must bear. In circumstances such as those described by Benson and Vincent (1997) where there was very little functional difference between the electronic and printed versions of the materials, the result was an overwhelming student preference for the printed versions. The 'added value' that electronic materials supposedly provide needs to be objectively evaluated to determine if it is sufficient compensation for the inconvenience of being electronic.

Examining only the functionality of electronic materials would not provide a sufficiently detailed and accurate evaluation. As well as understanding the nature of the printing that takes place, it is important to understand why it is taking place. For DE students this involves issues of learning style, access, portability and social factors which need to be considered as part of the evaluation.

Mason (1996) in a study of 160 UK Open University students and Messing (1997) in a study of 69 Australian DE students both reported approximately half of the students printing extensive sections of the electronic learning materials. Printing large numbers of pages requires the expenditure of considerable money, time and effort over the course of the semester. Other studies (Martens et al. 1997, Benson & Vincent 1997) reported students wanting to have both print and electronic versions of their materials. Given organizations' efficiencies with print production, it is likely that they would be able to provide a printed copy for all the students at a much lower unit cost than any student's personal printing efforts. When only electronic materials are provided, transferring printing responsibility to the student is a cost that needs to be acknowledged.

Access

The question of access to electronic learning materials often arises in the context of a policy question about requiring students to own a computer. Bates (1997 p94) raises the equity issue that: *"... a university requiring all students to have access to the Internet can at an administrator's stroke, deny access to all students who cannot afford a computer, who are not skilled or confident in using a computer, or who cannot get Internet access where they live."* The issue of ownership of suitable hardware is often not a real consideration as many students often have suitable systems. Organizations such as the University Grants Committee (French 1999) are very good at building infrastructure and redressing inequity when it comes to hardware. Many universities have similar programs to that of Acadia (MacDougall, Muldner and Tomek 1998) in which they provide an appropriate level of equipment to all incoming students. However, other factors which could also be termed access are every bit as important in determining how any electronic learning materials are to be used. In an environment of electronic learning, the definition of access will need to be extended beyond traditional ownership of hardware. Indeed, for distance education students, access needs to consider issues of where and when students study, as well as the physical and logistical requirements for the use of electronic media.

DE students study in quite an amazingly diverse range of circumstances. Apart from the obvious environment of a set time in a dedicated area of the home, the circumstances in which students in both Australia and Hong Kong (Messing 1997) carried out their study included:

- at work (during breaks, before and after work, on business trips)
- in transit (bus, train, plane, car - presumably as a passenger)
- during 'dead' times (waiting for children, airport and hotel lobbies)
- in bed

While electronic learning materials sometimes confer advantages such as searchability, editability (particularly copy and paste when the system is not locked) and ease of duplication they also severely restrict the physical access that some learners require. Apart from the lack of portability, limitations which have been reported include:

- not being able to spread the materials out on the desk
- not being able to see enough information on the screen at a time
- not having multiple 'pages' open at the same time (without overlap)
- 'overhead' time incurred in starting up
- being restricted to the location of the telephone line (ICT applications)

Screen size represents a cost in the form of an inconvenience. Not only are large screens prohibitively expensive but their bulk would further restrict the physical access in the cramped environments that many students work in.

Some such as Catenazzi (1993), design systems for larger screens but one has to question whether such designs are applicable to any but the most well resourced campus, let alone DE situations.

The central importance of the telephone line, especially in materials that require the use of communications technology, is rarely recognized. The many proposals for delivering electronic learning materials over the Internet (Harasim 1995; Western Governors Association 1996; Daniel 1996; Twigg 1999) all rely on access to a telephone. In most DE situations, the single telephone line into the home both determines the location of the computer (and hence the place of study) as well as the times when it may be used. While in recent times, additional telephone lines, especially in the form of mobile phones, have become more frequent, use of a telephone as part of the study process causes the student to incur a cost in monetary, time and inconvenience terms.

Social costs

Garland (1993) reported that the student's learning environment was a key situational variable in the success of a DE student. The learning process was very heavily influenced by what happened all around the student as well as the multiple roles that the learner was expected to fulfil. Woodley (1987), in examining the causes of adult student drop-out, identified an extensive list of study environment factors that adversely affect the learning process. They included:

- Little time or energy given to other domestic, work or leisure commitments
- Lack of encouragement by spouse or employer
- Personal / domestic changes
- Loss of a quiet place to study
- Work changes

While such influences are often studied, they are seldom, if ever, taken into consideration in decisions regarding the design and delivery of educational materials. Studying in the distance mode affects almost everyone that forms part of the student's social network. At the very least it is a disruption to the established order. Imposing restrictions by tying the student to a computer creates added pressures. Decreasing portability reduces the student's opportunities to participate in social activities that are removed from the computer. Tensions created by demands for resources such as the telephone or the only desk in the home create an extra level of anxiety about the study process. This is exacerbated in situations where such demands result in additional sacrifices by other members of the social network. Examples include the relegation of children to do home work at the kitchen table or loss of social communication ability because the telephone line is in use for long periods.

Such social costs are ones that both the student and those affected must bear. The consequences of electronic delivery of education extend beyond the learning process far more than conventional technologies. Increasing these social costs reduces the likelihood of electronic delivery being a judged a success by the student.

Conclusion

Ellul (1990 p39), in analyzing the ambivalence of technical progress in a technological society set out four propositions which he suggested applied in varying degrees to all technical developments. They were that:

"all technical progress has its price
at each stage it raises more and greater problems than it solves
its harmful effects are inseparable from its beneficial effects
it has a great number of unforeseen effects. "

These form an important backdrop for the debate about the future of electronic delivery of education. There is a significant price that students have to pay for such technical 'progress'. The questions raised do not have simple solutions. In the grand scheme of things however, students are rarely asked if they are prepared, or able, to pay that price. It is up to the administrators and educators to consider all the costs in a balanced and fair way, from not just their personal or institutional perspective, but also that of their students.

References

Bates, A.W. (1995). *Technology, open learning and distance education*, Thomas Nelson Australia: Melbourne.

Bates, A.W. (1997). The impact of technological change on open and distance learning. In *Distance education*, 18(1), 93-109.

Benson, R. and Vincent, M. (1997). Electronic delivery of study materials: the students' response. In *Open, flexible and distance learning: Education and training in the 21st century. Proceedings of 13th biennial forum of Open and Distance Learning Association of Australia*, 37-41.

Catenazzi, N. (1993). A study into electronic book design and production: Hyper-book and the hyper-book builder. PhD thesis, University of Strathclyde.

CAUT (1993). *Improving university teaching 1994.* Committee for the Advancement of University Teaching, Department of Employment, Education and Training.

Cheng, K.M. (1999). Information era, lifelong learning and education reform. Keynote address to Fifth Hong Kong Web Symposium, Oct 4-6

Collis, B., Winnips, K. & Moonen, J. (1999). Scaffolding and the use of the WWW: Does it pay off?, submitted to Journal for Interactive Learning Research.

Daniel, J. (1996), New kids on the box: Distance education enters its third generation. In C. McBeath and R. Atkinson (eds), *Proceedings of the 3rd International Interactive Multimedia Symposium*, PROMACO Conventions: Perth, 1-9.

Ellul, J. (1990). *The technological bluff.* trans. G.W. Bromiley, Eerdemans Publishing: Grand Rapids, Michigan.

French, N. (1999). e-Education: Are Hong Kong's higher education institutions rising to the challenge? in F. Castro, R. Lai and M. Wong (eds) e-Education, challenges and opportunities, Social Sciences Research Centre, University of Hong Kong, 345-355.

Garland, M.R. (1993). Student perceptions of the situational, institutional, dispositional and epistomological barriers to persistence. In *Distance education*, 14(2), 181-198.

Geasler, S. (1992). CD-ROM: A cost-effective alternative. In *Instructional delivery systems*, Jan./Feb., 21-23.

Hara, N. and Kling, R. (1999). Students' frustrations with a web-based distance education course: A taboo topic in the discourse. [On-line] Available: http://www.slis.indiana.edu/CSI/up99_01.html

Harasim, L. (1995). The virtual university: New approaches to higher education in the 21st century. In J.M. Pearce and A. Ellis (eds), *Learning with Technology*, Australian Society for Computers in Learning in Tertiary Education: Melbourne, K5-K6

Jones, G.R. (1997). Cyberschools: An educational renaissance. Jones Digital Century Inc, Colorado

Jones, G.R. (1999). e-Education: Opportunities and challenges - The human face of electronic education in F. Castro, R. Lai and M. Wong (eds) e-Education, challenges and opportunities, Social Sciences Research Centre, University of Hong Kong, 83-104

Laurillard, D.M.(1993). *Rethinking university teaching*, Routledge: London

MacDougall, G., Muldner, T. and Tomek, I. (1998) Acadia Advantage- Computerizing a campus in T. Ottman and I. Tomek (eds) *Proceedings of ED-MEDIA and ED-TELECOM 98*, AACE, 41-46.

Martens, R.L., Valcke, M.M.A., Portier, S.J., Weges, H.G. and Poelmans, P.H.A.G. (1997). Research with interactive learning environments in three content domains: Descriptive statistics, continuous mathematics and substantive criminal law. In *Distance education*, 18(1), 44-58.

Mason, R. (1996). Large scale distance teaching and the convergence of telecommunications and multimedia. In C. McBeath and R. Atkinson (eds), *Proceedings of the 3rd International Interactive Multimedia Symposium*, PROMACO Conventions: Perth, 260-266.

McLachlan, R. (1999). DE learning culture - a barrier??Online Teaching forum [On-line (restricted site)] Accessed September 1999

Messing, J. (1990). *The use of content and teaching strategy control features in computer assisted learning courseware*, MEd thesis, Charles Sturt University.

Messing, J. (1997). *Learning computing concepts from electronic books*, PhD thesis, Charles Sturt University.

Messing, J. (1999). A study of the use of online supported learning facilities at Charles Sturt University, Internal Report, Charles Sturt University.

Moonen, J, (1999). Costs or effectiveness? Seminar presented at Charles Sturt University, Oct 1999

National Center for Education Statistics (1998). Issue brief: Distance education in higher education institutions: Incidences, audiences, and plans to expand. [On-line] Available: http://nces.ed.gov/pubs98/98132.html

Newble, D.I. and Clarke, R.M. (1986). Learning styles and approaches: Some empirical evidence and its implications for medical education. In J.A. Bowden (ed), *Student Learning: Research into Practice, The Marysville Symposium,* University of Melbourne, 61-94.

Reushle, S.E. (1995). Design considerations and features in the development of hypermedia courseware. In *Distance education*, 16(1), 140-156.

Roberts, D. (1984). An analysis of distance education study patterns at Riverina College of Advanced Education. Graduate Diploma in Distance Education dissertation, South Australian College of Advanced Education.

Russell, T. L. (1999). The no significant difference phenomenon. [On-line] Available: http://cuda.teleeducation.nb.ca/nosignificantdifference/

Sakamoto, T. (1999). Educational reform by Information and Communications Technology:ICT strategies for educational improvement-A Japanese perspective in B. Collis and R. Oliver (eds) *Proceedings of ED-MEDIA-99 World Conference on Educational Multimedia, Hypermedia and Telecommunications*, AACE, 2-14.

Sewart, D. (1981). Distance teaching: A contradiction in terms. In *Teaching at a distance*, 19(Summer), 171-187.

Sibillin, A., O'Sullivan, K., Letch, J., Churches, P., Higgins, D. and Heywood, K. (1996). Between classes: A student perspective. In G. Hart and J. Mason, *Symposium proceedings & case studies of the virtual university symposium*, Melbourne University, 199-206.

Stukel, J.J. (1998). The Future of Land Grant Universities. Address to the National Association of State Universities and Land-Grant Colleges Extension Directors' Meeting [On-line] Available: http://www.nasulgc.org/Kellog/STATEMENTS/future.htm

Twigg, C.A. (1999). Improving learning & reducing costs: Redesigning large-enrollment courses. The Pew learning and technology symposium. [On-line] Available at : http://www.center.rpi.edu/PewSym/mono1.html

van der Veen, J. , van Riemsdijk, M. , Slabbekoorn, H. and van de Kamp, I. (1999). Stimulating reflection on theory using a web-repository of student reviews in B. Collis and R. Oliver (eds) *Proceedings of ED-MEDIA-99 World Conference on Educational Multimedia, Hypermedia and Telecommunications*, AACE, 172-177.

Western Governors Association. (1996). *The Western Governors University: A proposed implementation plan* [On-line]. Available http://www.westgov.org/smart/vu/imp.htm

Woodley, A. (1987). Understanding adult student drop-out. In M. Thorpe and D. Grugeon (eds), *Open learning for adults*, Longman: Essex, 54-70.

A Study of the Use of Online Supported Learning Facilities at Charles Sturt University

Dr John Messing
School of Information Studies, Charles Sturt University, Australia
jmessing@csu.edu.au

Abstract: This paper reports on a study of student use of various online learning facilities using comprehensive log data that was collected within Charles Sturt University. Analysis of the data verified that many students were silent users of the system as well as revealing some surprising results regarding features that were not used at all and preferred patterns of access. These results have implications for the design of online learning facilities for other distance education ventures.

Background

Various studies such as OECD (1994), Jones (1997, 1999) predict that future university students will be drawn from wider populations with more varied backgrounds and needs. The higher education system in many parts of the world is changing. Macknight (1996) attributes most of these changes to powerful economic forces; a transition from the current teacher centred instructional model to a learner centred one and the global nature of digital interactions which is changing the scale with which the world is viewed.

Technology has for many years been cited (Goldsworthy 1980; Godfrey 1996; Bates 1997; Sakamoto 1999) as offering the promise of greater learning effectiveness, more learner centred approaches and a better quality of interaction. However, the driving force for change does not come from some technological imperative that many such as Tiffin (1996) would have us believe. The pressures for change derive, as Luke (1996) or Margolis (1998) suggest, from political, social and economic roots. Even though the causes are debatable, one thing is certain. They have been building for some time as governments cut higher education budgets while society expects progressively more and more of its school leavers to aspire to post secondary education. These pressures are complicated by falling entry standards and a perception of anachronistic university practices (Jones 1999).

'Distance Education' (DE) or 'Open Learning' as it is sometimes referred to, is one of the methods by which the high cost of face to face teaching may be reduced. There are also serious doubts about the intrinsic value of some of the traditional face to face methods such as the lecture, that most universities continue to use (Ramsden 1992, Laurillard 1993, Ramsden, Margetson, Martin and Clarke 1995). The appropriate use of technology is a significant component in many DE ventures. Computer technology has been used in education for many years but what is surprising, is the relatively superficial effect that it has had. For more than a quarter of a century, computers were seen as an important tool to be used in the educational process. Society was promised (Suppes 1968) the ultimate in individualized instruction, an infinitely patient tutor, a system that would revolutionize both the educational processes at schools and in the home. Bork (1980), in attempting to predict the future use of technology in education claimed that:

> *" - the computer as a learning device in current classes is, compared with all other learning modes, almost nonexistent - the pace will pick up rapidly over the next 15 years. By the year 2000 the major way of learning at all levels, and in almost all subject areas will be through the interactive use of computers. p53"*

While his predictions were clearly well short of the mark, the widespread adoption in recent years, of the Internet and the World Wide Web (WWW) by academic as well as business and private interests around the world has led to suggestions (Daniel 1996) that this is the means by which cost effective delivery of quality education may be achieved. The current social pressures on the education system noted by Voss (1995) make a good case for the rapid development of educational delivery systems which are more flexible in time, space and the type of technology used. The real effect of such radical changes to the role of educational institutions will be felt more by the consumers, the students, than the educational institutions themselves. Some such as Feather

(1995), fear that just as printing divided societies on the basis of literacy, this will lead to a further subdivision based on wealth, privilege and an electronic imperialism.

The nature of the electronic learning materials provided by educational institutions is only just being addressed. While there is literature available on many aspects of Computer Based Learning (CBL), current technology requires a re-assessment of what features and functions such learning materials might contain.

Charles Sturt University (CSU) is one of the major providers of distance education in Australia with over 24,000 students, three quarters of whom, study in the DE mode. The Technology Strategy Report (Rebbechi and Barnard 1994) mapped out a comprehensive set of alternatives for the development of technology used in the teaching and administration of CSU students. One of its key recommendations involved the conversion of as many as 1200 subjects from print into electronic form by the year 2000. What has evolved is a system which migrates the existing print based version of the teaching materials into electronic form at the same time as adding hyperlink features that connect different parts of the document to other resources that CSU has placed online. Fundamental to this decision to move to electronic format for teaching materials was the belief that in doing so, students would not be disadvantaged and indeed the provision of 'added value' features such as hyperlinks, would actually make this method of delivery more attractive to students.

CSU has for various compelling reasons such as being a rural university; having three main campuses spread over 400 kilometers as well as a number of smaller campuses even more remote from the main ones; teaching students who predominantly study in the DE mode; and having a significant presence in many Asian countries, made a concerted effort to provide effective communications technology. The problems of isolation are, in theory, ameliorated by developing information technology strategies to compensate.

Online support at CSU

Distance education has always placed more of an emphasis on the student taking charge of their own learning than the traditional face to face mode. DE students are given the necessary materials as well as study guides and whatever other help the university deems appropriate and expected to take it from there. The currently popular term, "Resource Based Learning" is an expression that encompasses the concept of students controlling their learning. Without wanting to enter into the debate about the meaning of resource based learning, it is clear that there are two different types of resources that are involved in the process. For want of a better set of terminology, these are referred to as "static" and "dynamic" resources. Failure to differentiate between these types and the role that they play is an all too common cause of misunderstanding of the way that electronic communications technologies might assist the teaching and learning process.

The "static" resources have traditionally been provided in print or some other physical format (videotape, slides, audio cassettes and computer disks). Note that the most important characteristic of these resources is not the medium by which they are delivered but the nature of the material itself. A lecture can be static whether it is delivered en masse to 600 students, comes printed in a book of lecture notes, is read as a word processing file on the student's computer or is downloaded off the network as an HTML document.

"Dynamic" resources involve interactions between student - teacher or student - student. The main characteristic of these is that they are ad hoc and cannot be planned for in advance. They include styles of 'real-time' delivery from the mass lecture, seminars, tutorials where questioning and dialogue are encouraged down to one to one conversations in person, on the phone or via e-mail. What conventional DE students often report is a lack of dynamic resources. They feel isolated and that the concepts of a class, fellow students, peer support and general interaction are not very strong.

Online supported subjects at CSU consist of both the static and dynamic resources. While there are numerous exceptions, static resources, in the main, are material converted from Open Learning Institute (OLI) maintained documents. This material is organized as a subject site on a secure information server. Dynamic resources are provided via e-mail, list servers and the centrepiece of the university's strategy, the subject forum.

Figure 1 shows a typical subject page in a web browser. The left-hand frame serves as a navigation menu for the documents that appear in the right hand frame. On entry, the initial document displayed is always the overview. A great deal of redundancy, seen as a positive factor in human-computer interface design guidelines, is built into the design so that students may access components from a number of locations. For example, hyperlinks to the subject coordinator may be found in the overview, communications and index pages.

Most of the links in the menu are self-explanatory. While some such as 'library' link to the standard CSU library page, others such as communicate, overview etc. are customized with the information that is specific to that subject.

Typical online supported subject page

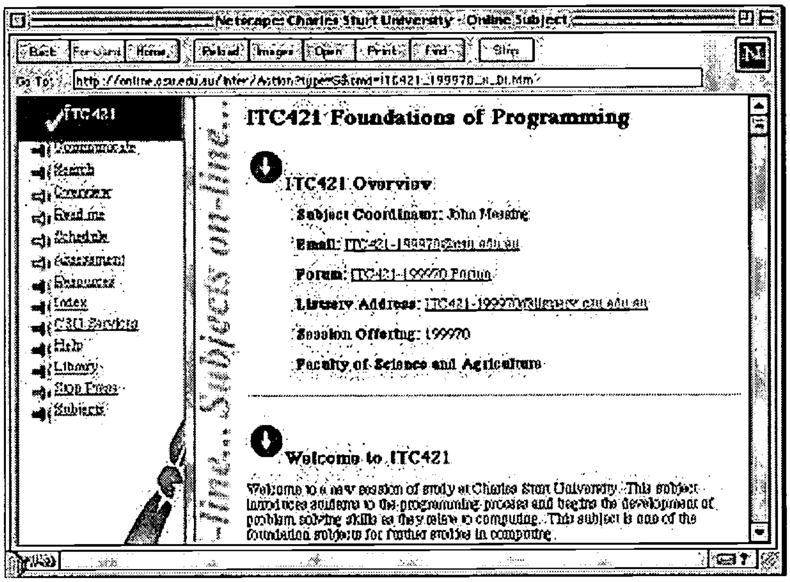


Figure 1

The forum is a discussion area where everyone may post questions, items of interest, general notes or responses to previous postings. It is typical of this type of communication tool but has the added feature that forums are restricted to students and staff assigned to that subject. The postings are 'threaded' and give the user a considerable amount of control in managing their own interface features. The list of postings and any special attributes of each are displayed. Again, a degree of redundancy has been built into the interface to make it easier to use. For example, a user can initiate the act of reading a message by clicking on the hypertext link, the window icon next to the message or the view all button. The forum software was purpose built at CSU and the current version is a greatly enhanced form of what was used prior to July 1999. Even so, additions are still being made to increase the functionality even further. The investment in developing this system can be viewed as a measure of conviction that this was an important dynamic resource in the delivery of the education of the future.

The study

Despite all the consultation that went into the design and the effort that is involved in producing these subject sites and subject forums, little empirical evidence had been collected to date which analyzed how these features were being used. Answers to basic questions such as:

How much time do students spend using these resources?
What effect does the academic involvement have in the usage time of these resources?
What is the relative frequency of use of various features in these resources?
What improvements may be made to the design of the resources?

are valuable from both a pedagogical as well as a system design perspective.

System log data is collected for security purposes on all actions that users carry out. This collection of data provided a previously untapped source of information. Based on a rough activity index which was calculated by dividing the number of 'sessions' by the number of students enrolled in the subject, three subjects were chosen:

one with a high activity index (Sub-A), one with medium (Sub-B) and one at the lower end but which still indicated a significant level of activity (Sub-C).

The records from the log files between June 30, 1999 and September 7, 1999 were extracted from the database and processed by custom written programs that discarded superfluous details and coded certain actions. Since this time frame represented a significant proportion of the teaching time during the semester, any trends in usage of the resources should have been evident by that point. This is even truer when one considers the fact that for some of these resources, the initial use might be the only use and one would expect that to occur very early in the semester.

The important components of the records from the log files include the user, the date, time to the nearest second and the command which was executed by the system as a consequence of the user's action. From these records it was possible to reconstruct a particular user's interaction with the online system. By comparing times of successive events for a particular user it was possible to calculate time intervals between events, correct to the nearest second.

Inspection of the usage logs and initial attempts to analyze the data revealed the presence of large time intervals where no action was monitored as part of the online system. Some students in the initial tabulation of data had average use times that were extraordinarily high, but showed very little activity. In the absence of any direct observation notes, some procedure was necessary to account for the possibility that the time logged at the computer was not actually being used as time on task. This phenomenon had been observed in previous studies (Messing 1997) and even in laboratory studies (Messing 1990) in which there was a limited time for the activity. When conducted in the diverse DE environments of this study, it was likely that there may have been tasks unrelated to the use of online facilities, which affected the logged event time.

In order to reduce the impact of such suspect times, all entries in the log that had a time difference from the previously logged event of 15 minutes or more were assigned a value of 15 minutes. This was in line with a similar technique reported in the literature (Chen, Horney and Anderson-Inman 1995). All documents in either the online subjects page or forum could be read within that time period, most of them several times. Students most likely read what they had to and then performed some other activity such as sending e-mail, opening a word-processing document or even leaving the online session with the intention of resuming at a later time but not actually quitting the system. The data were adjusted so that these large, likely to be inactive time intervals, were replaced as indicated.

Results

Time on task

It is quite reasonable to assume that there are many factors which affect the amount time that students spend in online related learning activities. The nature of the subject, the level of integration of the online resources with the teaching process, the teaching style used by the academic as well as a host of personal factors such as the level of access to suitable equipment, confidence in using the technology or even simply the time available for study are all potential variables which affect usage. The influence of these was not able to be determined. However, from a quantitative perspective, one important factor, the impact of the academics' usage was able to be isolated.

Usage time

	Total time (hrs)	Avg time (hrs)	Avg time minutes/week
Sub-A-all	247.63	4.27	26
Sub-A-students only	239.71	4.44	27
Sub-B-all	93.81	1.71	11
Sub-B-students only	90.37	1.74	12
Sub-C-all	38.04	0.63	4
Sub-C-students only	36.53	0.65	4

Table 1

Table 1 shows both the total time on task as defined above, as well as the average time on task for each of the subjects as well as an adjusted value for the number of weeks since first usage was recorded. An additional set of values was determined by removing data that was able to be attributed to non-student entries. This included log records contributed by academics and other CSU personnel. The trend across the three subjects reflected the original basis for their selection in terms of activity ratio. Note however, that in all three subjects, even in Sub-C which has quite a low average usage, when the non-student use is removed, the average increases slightly. The conclusion to be drawn from this is that academic contributions do not markedly dominate the overall usage in terms of time on task. Indeed, the suggestion is that academics access these resources slightly less than the average student does.

Of course, the nature and purpose of an academic's access is quite different from that of a student but there does not appear to be any support in this study for the proposition that the academics dominate the usage. One might even question why the values for academic usage are not higher than they are.

Static versus Dynamic Resources

Reference was made above to the distinction between static and dynamic resources. Since the online material represented a static resource and the forum a dynamic one, the data were analyzed on the basis of the number of 'sessions' of each. A session being defined as the existence of an initialization event for either the online subject pages or the forum. This does not represent 'terminal sessions' i.e. how many times the user logged on to the CSU site but how many times the user 'switched into' the online material or forum. The results are shown in Table 2.

Numbers of sessions

	Sub-A	Sub-B	Sub-C
Total sessions	710	436	330
Online only	48	16	25
Forum only	70	158	68
Both	592	262	237

Table 2

The overwhelming number of sessions involved access to first the online subjects page and then shortly after, to the forum. This is not surprising since the online subjects page acts as a 'gateway' to the CSU online resources. The relatively high proportion of direct access to the forum in the case of Sub-B is explained by the use of bookmarks to avoid going through the gateway. It appears that most non Sub-B students were either unaware of how to use this feature or chose to follow the normal entry method.

Use of Online Subject Components

Analysis of the data was carried out to determine the number of times various subsections of the online pages were accessed both from the hypertext menu in the left hand frame (see Figure 1) as well as through links embedded in the various documents. The data were reported as the number of accesses per student but made no adjustment for 'transient' actions which are simply navigation actions.

Access to the overview page, both as an introduction or a subsequent selection, accounted for 83.5% of access. No other feature selected was more than 5% of all actions. Five features, Search, CSU Services, Help, Library and the Subjects pages were not accessed even once in the total of 8267 accesses recorded. While this does not mean that students did not use these features from other parts of the CSU site, it does indicate that students did not need to access them from the online subjects pages.

What is more surprising though is the fact that in most cases, less than half of the students engaged in a deliberate action to use a particular feature even once. The averages were calculated on the number of actual users rather than the number of students enrolled in the class. Using the number of students in the class would have reduced the average values even further. The low average usage was somewhat surprising since one would expect that even from the perspective of curiosity, each student would enter these pages at least once to see what was there.

The most likely explanation lies in the fact that a great deal of what exists in the online subject site is a duplication of the printed subject outline that students also receive. Indeed, this printed subject outline would probably be read before entering the online subject site. If this were the case, there would consequently be little need for students to access many of the sections. While verification of such an explanation by more direct means would be necessary before reaching a reliable conclusion, it does raise the question of the merit of providing the same static material in two media.

Use of Forum Components

In a similar manner to that of the online subject pages, the access commands related to the use of forums were tabulated. The 'posts' that is, the creation of a new message or a reply to an existing message, were separated into those performed by students and those by the subject coordinator while all other data is combined. One complication was that the forum was designed with a number of function buttons representing tasks such as changing the way that the forum index is displayed, setting topics to be 'watched' by sending e-mail notification of new postings and a number of other tasks. These function buttons did not generate a log file entry and consequently could not be included in the analysis.

More than 80% of students in all three subjects, used the forum at least once. The most significant point that these data highlight is the fact that by far the most frequent operation is the reading of posted messages. This action comprised 66.3% of all the actions performed and when compared to postings (1.7%) gives a ratio of almost 40 reads to every post. This high ratio confirms the long held suspicion that there are many 'lurkers' who make use of the forums but predominantly as a means of receiving information rather than contributing. This suspicion is further confirmed by calculating the ratio of the number of students who were 'writers' and 'readers'. These ratios, expressed as a percentage for each of the subjects in the study were calculated as 77.1%, 11.5% and 16.0% respectively.

The result for Sub-A is surprisingly high but this is able to be explained by the nature of the subject and the way that the forum was integrated into the learning process. Students were required to submit contributions for assessment purposes. The data also reinforced the critical role that the subject coordinator has in making postings. The contributions by the subject coordinator far outweighed that of any other student. Even in Sub-A where there was a very high level of posting activity that was student initiated, the subject coordinator was responsible for more postings than the three most prolific students combined. In the context of overall low staff usage, one can only conclude that staff, unlike students, often posted responses to what they read.

Conclusions

The three subjects chosen were not a random sample, nor were they representative of the full range of subjects offering online support. If anything, they were chosen to highlight more extensive use of the online support facilities than the average CSU subject. They each had over 50 students enrolled in the subject and made use of the online facilities in different ways as part of the teaching/learning process. Given the limitations of the way that the sample was selected, the following conclusions are suggested by the data.

* Students did make significant use of the forums as one avenue of receiving 'dynamic' resources.
* The high ratio of reading to writing in the forums was confirmation of the belief that there are many more students who benefit from the postings than one would suspect. Even so, there were still considerable numbers of students who made no use of the system at all.
* The important role of the subject coordinator in contributing to the material in the forum was verified, even in forums where there was a very high level of student activity.
* The access to 'static' resources which were largely the same as the printed subject outline material was extremely limited.
* Little or no use was made from within the online subject pages of links to standard CSU resources such as the search facility or access to the library.

As a consequence of these, a number of recommendations relating to the design of the online subjects pages and a re-evaluation of their usefulness were made. The evidence from this study suggested that the strategy of providing static resources as a set of related HTML documents is not viable, even with the inclusion of a substantial number of cross-linked hypertext links. Other avenues will need to be explored that meet the policy as well as pedagogical requirements.

With respect to the provision of dynamic resources as evidenced by the forums, there appears to be qualified support for the continuation of that strategy. However, the role of the subject coordinator is critical if the forum is to be used effectively. Designing functional systems is clearly not sufficient. All the participants need to be made aware of the strategies available in working more effectively with such tools.

References

Bates, A.W. (1997). The impact of technological change on open and distance learning. In *Distance education*, 18(1), 93-109.

Bork, A. (1980). Interactive learning. In R.P. Taylor, (ed), *The Computer in the School : Tool, Tutor, Tutee* , Teacher's College Press: New York.

Chen, D., Horney, M.A. and Anderson-Inman, L. (1995). The standardized states technique: A cluster analysis in analyzing students' hypertext processing patterns. In *Journal of educational multimedia and hypermedia,* 4(1), 53-73.

Daniel, J. (1996), New kids on the box: Distance education enters its third generation. In C. McBeath and R. Atkinson (eds), *Proceedings of the 3rd International Interactive Multimedia Symposium*, PROMACO Conventions: Perth, 1-9.

Feather, J. (1995). *The information society: A study of continuity and change*, Library Association Publishing, London,

Goldsworthy, A.W. (1980), *Technological change- The impact of information technology*, Australian Government Publishing Service, Canberra

Jones, G.R. (1997), *Cyberschools: An educational renaissance*, Jones Digital Century Inc., Colorado

Jones, G.R. (1999), The human face of electronic education, in F. Castro, R. Lai, and M.Wong, *e-Education: Challenges and opportunities*, Social Science Research Centre, The University of Hong Kong, 83-104.

Laurillard, D.M.(1993). *Rethinking university teaching*, Routledge: London

Luke, T. (1996). The politics of cyberschooling at the virtual university. In G. Hart and J. Mason, *Symposium proceedings & case studies of the virtual university symposium*, Melbourne University, 23-47.

Margolis, M. (1998), Brave new universities in *First Monday*, 3(5), (http:www.firstmonday.dk/issues/issye3_5/margolis/index.html)

Messing, J. (1990). *The use of content and teaching strategy control features in computer assisted learning courseware*, MEd thesis, Charles Sturt University.

Messing, J. (1997). *Learning computing concepts from electronic books*, PhD thesis, Charles Sturt University.

OECD (1994). *Background report: The international conference on learning beyond schooling: New forms of supply and new demands.* Centre for Educational Research and Innovation, Organisation for Economic Cooperation and Development: Paris.

Ramsden, P., Margetson, D., Martin, E. and Clarke, S. (1995). *Recognising and rewarding good teaching in Australian higher education,* Australian Government Publishing Service: Canberra.

Rebbechi, M. and Barnard, I. (1994), *Technology Strategy Report*, Internal report, Charles Sturt University: Wagga Wagga.

Sakamoto, T. (1999), Educational reform by information and communications technology: ICT strategies for educational improvement- A Japanese perspective, in In *Proceedings of ED-MEDIA-99 World Conference on Educational Multimedia, Hypermedia amd Telecommunications*, Association for the Advancement of Computing in Education, 2.

Suppes, P. (1968). Computer technology and the future of education. In *Phi Delta Kappan*, 49, 420-423.

Tiffin, J. (1996). In search of the virtual class. In G. Hart and J. Mason, *Symposium proceedings & case studies of the virtual university symposium*, Melbourne University, 49-54.

Voss, L. (1995). Technology supported learning: Education on the edge of transition. *Keynote address, ED-MEDIA-95 World Conference on Educational Multimedia and Hypermedia*, Association for the Advancement of Computing in Education.

One teacher, one text, four lessons: a case study of collaboration and innovation in a multilingual New Zealand classroom.

Duncan Meyer
Long Bay College
Ashley Ave, Torbay
Auckland, New Zealand
duncan@chalksoft.com

Glenda Jacobs
UNITEC
P Bag 92025
Auckland
gjacobs@unitec.ac.nz

Abstract: New Zealand is a multi-lingual society, and this is reflected in classrooms across the country. Since most instruction (with the exception of some Maori-language instruction) is in English, the large Chinese, Japanese, and Korean (CJK) student population is placed at a distinct disadvantage. Many of these students arrive in the country with the most rudimentary English skills, and it is not uncommon for most CJK students to fare poorly in English medium classes.

This is a case study of collaboration between a K-12 school, a local university, professional translators, and ethnic community groups to address the challenges faced by CJK students in an almost exclusively English medium classroom.

Some background

In 1998, the entire year 12 Computer Studies course as taught at Long Bay College was rewritten for web-based delivery. Students logged in to the school Intranet, ran their Browser, and accessed all course materials online (Meyer & Jacobs, 1998). Until this time, course materials consisted of various text books, journal articles and tutor-written notes. Since effective web-based materials differ substantially from their paper-based counterparts, the materials could not be adapted without being stilted. The opportunity was taken to rewrite the course completely.

While web-based delivery proved extremely effective in:

- accommodating the widely divergent computer skills of the 120 students in the study
- encouraging self-paced study
- providing valuable insights into which technologies were optimal in the K-12 online context

the problems facing CJK (Chinese, Japanese & Korean) students immersed into an English-medium class (which required good English-reading skills) remained unaddressed, since although the course was extremely practical by nature, the students were now expected to <u>read</u> their lessons rather than <u>listen</u> to them. This placed a heavy burden on these students.

This problem is partially dealt with by (Faulkner & Chen, 1999) in a study trialling dual-medium course content. While a step in the right direction, their reproducing the entire course content in an Asian language was (we felt)

1. too labour intensive
2. did not lend itself to regular updates
3. and ignored the students' own expressed desire to become more familiar with English as their teaching medium.

Our approach – a four-tier system:

We opted instead for a four-tier system, as follows:

1. Glossary Overlays
2. Tapping into the local Asian community for online "mentors" for each student.
3. Eliciting the aid of a local university to host our course on their "Web Shell" server.
4. Using the "Web Discussion" feature embedded in Office 2000 server extensions.

1. Glossary Overlays:

Since the original web-based course materials were constructed using NetObjects Fusion, it was a simple matter to identify key words and concepts which appeared in the English text, and to provide (on every page) a Chinese, Japanese and Korean "button" which when clicked popped up a new window which displayed explanatory notes in the appropriate language.

There is an in-built problem with using this technique: if one opens a "child" window, and then moves to another page on the website, that child window simply becomes minimized – it doesn't go away. After a very short time, one can have a profusion of very confusing minimized windows crowding up the task bar.

Plug-ins:

NetObjects Fusion has the ability to install "plug-in" components, to extend the functionality of the original application. A Fusion component (also available for Macromedia's Dreamweaver) was sourced which enabled us to create Java-based popup windows in which contained a glossary of the terms used in the main page. These glossary windows are activated by clicking on a button which appears on the main page. Unlike most popup browser windows, however, they automatically close themselves when either another language is selected or the user moves to another web page. Without this automatic closing of "child" windows, this system would soon have sunk under its own weight, since neither Netscape nor Internet Explorer do this by default – leaving in their navigation trail an ever-growing number of orphaned popup help windows.

2. Community Involvement:

In order to establish the viability of the concept, use was made of senior Asian students within the school to translate the glossaries for a single module. This module was published without comment to the school's intranet, and student reactions to it observed. Encouraged by the ready acceptance of the new feature, we approached members of the Asian communities who were eager to become involved in the project.

Pilot Testing and adjustment:

To test the effectiveness and suitability of the glossaries (as well as the user interface), we had two Chinese, two Japanese and two Korean students work through the course in pairs. The students were asked to vocalise their thoughts as they progressed through the material, so that their comments could be taped, and subsequently played back to a Language professional for translation. Armed with these student comments, final editing was done, and the site published.

Online Mentors

Computer-literate "mentors" were sought in the local Asian communities who agreed to "adopt" one or more students, and to follow their progress through the online lessons. Since the course materials were completely online, their task was (1) to become familiar with these materials, and (2) to be available both to answer emails from their student(s), and to show regular interest in their progress.

Asian (CJK) characters:

It was imperative that the CJK students be able to communicate in their own language with their mentors. To this end, all student computers, as well as those of the mentors, were configured to run Global IME, allowing them to type Asian characters directly into email messages. Most of the CJK students were already familiar with this method of entering Asian characters, and this proved not to be a problem at all.

Orientation:

We arranged an initial orientation meeting at which the mentors, parents, homestay parents, and members of the wider Asian communities could meet both the students and the staff involved in the project. This personal encounter helped put a face to the email communication which was to be fundamental to the student/mentor relationship. This was followed up with regular reviews to renew the personal contacts. In some cases, the mentors were known to the students already; however, these meetings "formalized" their new relationship.

3. Using a "Web Shell"

Secondly, a local university agreed to host the course on one of their servers running "Courseinfo", so that all administration could be handled online. Students were thus able to continue their lessons from home (if they had Internet access).

Web shells offer many features not available on a simple website - like student drop-boxes (enabling students to submit assignments), secure and private pages displaying each student's marks, personal student web-pages, online chat, daily notices, a course calendar and so on. While these features certainly could be written into any website, the time involved in doing so would be prohibitive. With a web shell, they are almost "incidental", significantly enhanced the effectiveness of the online course delivery.

One feature not well implemented in "Courseinfo" was online testing. After a few attempts at getting a class to do tests online within Courseinfo, we elected to use computer-based testing software developed by ourselves (Jacobs & Meyer, 1998) instead. This software is now mature, and able to handle local as well as distance testing in a secure, robust and feature-rich manner.

Fortunately, Courseinfo allows a teacher to manually enter marks in the online gradebook, so that even though tests were conducted using our own testing engine, results could still be entered into the Courseinfo system, where students could access them securely.

4. Web Discussions

Office 2000 comes equipped with a very useful feature called "Web Discussions". Once these extensions are installed on an NT Server, any IE5 browser with access to this Server is able to add comments to any web page anywhere on the Internet. These comments appear to be part of the target web page, but in reality exist as files on the NT Server, and are dynamically added to the target web page when viewed by IE5.

Using this feature, our staff were able to add extra comments to our already published web-based course materials as the need arose – customizing these materials to the needs of their particular students. Both our students and their mentors were able to see these comments, and to add comments of their own at any stage - creating instant context-sensitive discussions - visible only to those involved in the project.

A valuable feature of these web discussions is that any addition (ie follow-on comment) to a comment already on the web page would trigger an email notification to the author of the comment, alerting him/her to the fact that someone had responded to their posting.

As an additional bonus, these impromptu discussions became rich sources of ideas to be incorporated in the next version of the published course materials.

Challenges faced in implementing the project.

Workload

1. The year 12 Computer Studies course consists of twelve separate modules. This represented a considerable number of individual web pages which needed to be enhanced with three language-specific glossaries. Each page had to be supported by three independent language popup screens. For some of the larger courses, this ran into hundreds of extra pages which needed to be translated, and published.
2. In addition, to ensure that the popup glossaries displayed the Asian fonts consistently across all browsers and on all computers, we elected to represent the CJK text as a graphic. This required each CJK glossary to be created in a word processor, and copy/pasted into a graphics package before it could be embedded into the glossary pages.

Language expertise

Initially, we prepared a single course (Intro to Win9x) using three senior Asian students at the school. However, since staff had little way of gauging the accuracy of the translations, and little or no additional funding to enlist the skills of independent experts, we resorted to a "round-robin" approach. We presented the CJK texts to other CJK native speakers, and asked them to translate them back into English. We used any marked discrepancies identified in this manner to more accurately translate the original texts.

With this course as a "working model", we were able to approach local interested parties for funding to complete the translation using qualified translators.

Results/Findings

We would love to report that this experiment was an unqualified success. However, since we were only able to translate three of the twelve modules in the course, our results are less than conclusive.

Glossary Overlays:

Even though only three modules sported the CJK popup windows, students found this feature helpful. Students were interviewed, and asked if they would like future courses to continue to offer this feature. Of the 20 students interviewed 4 thought that the translations were too abbreviated, and should be expanded into full translations of the English text; 14 considered the help "just right", and 2 thought that although the translations were a good idea generally, they did not personally benefit from them, since their English was already of an adequate standard.

Community Involvement

Although the communities met the idea of mentoring with great enthusiasm and interest, and although offers to translate the help pages were many, it soon became apparent that relying on the goodwill of busy people was not a workable solution for a project which was bound by the inexorable march of the school calendar. Deadlines came and went, and students progressed to modules for which there was no CJK popup help available. Since the mentoring program relied heavily on mentors being familiar with the online course content, when this familiarity was not apparent, the helpfulness of their replies was (as some students confessed) sometimes of little value. While the students were unequivocal as the value of being able to email a native speaker of their language with problems encountered in the course, one of the singular challenges facing us next year, is to identify outside mentors with the time and expertise to play this role more effectively.

Web Shell

As far as staff were concerned, the Web Shell was a solid success. It streamlined the administration of the course, allowed them to post regular notices, publish grades on secure student-only pages, facilitate the submission of student work, and to return the graded assignments both from home and at school. Some of the features provided by Courseinfo proved to be less than useful in a high school context, and were soon deactivated. One such feature was the online chat – or virtual classroom feature. Teachers rapidly came to the conclusion that 16 or 17 year old students were simply too tempted by the technology, and were too easily lured off-task into endless personal messaging.

Web Discussions

Again, the temptation of students to write fatuous comments rather than to either ask questions related to the text, or to offer suggestions germane to the task at hand, became immediately apparent. So much so, in fact, that staff were forced to limit student participation in the web discussions to read-only. Several attempts were made to re-open the discussions, but with the same results. Even though students knew that every posting carried their login name, they persisted, claiming that they never wrote the message, but that someone must have discovered their password.

However, even as a tool used by staff only, the web discussions proved invaluable, in that it facilitated the ongoing comment by staff on the body of the text – sometimes in amplification, sometimes in alternative points of view. These comments provided rich and useful material for incorporating into future versions of the course.

Funding

One of the rather unexpected outcomes of our search for sponsors, was the discovery that schools enjoy a low profile in the academic community, and as a result can call on few, if any, research grants. Local private enterprise saw little to be gained by allocating funds for this academic research, and the school Board of Trustees, while they thought the idea very interesting, the fact remained that there was little enough money available for other, more substantial, projects. In short, the project had to be funded on a shoestring, with almost all of the work being done by teachers in their free time. This was a major reason for not being able to translate the entire course into CJK.

Bibliography:

Jacobs, G.A. (1997) *Test Authoring for Techno Cynics*, Proceedings , Ed-Media97, Calgary, Canada

Meyer D. (1997) QuizMaster: *A Software Solution to a National Problem.* Proceedings , Ed-Media97, Calgary, Canada

Meyer D.G. & Jacobs G. A. (1998) *At Arm's Length: Distance Delivery within the Classroom*, Proceedings, ICCE98, Beijing, China

Faulkner E.G. & Chen Y. (1999) *Towards a Time-Efficient Methodology for Asynchrnonous Mixed-Language Presentations*, IEEE Learning Technology Taskforce, Vol 1 Issue 2, http://lttf.ieee.org/learn_tech/ , Oct '99

Montgomerie C et al (1999) *Scaling Web-Based Instruction*, Proceedings, Ed-Media99 Seattle Washington, USA

Sakamoto T (1999) *Educational Reform by Information and Communications Technology: ICT Strategies for Educational Improvement - A Japanese Perspective*, Proceedings, Ed-Media99 Seattle Washington, USA

Australian National Training Authority (ANTA) (Feb 1998) *Teaching and Learning Styles that Facilitate Online Learning*, (WWW document) http://www.tafe.sa.edu.au/isrsc/one/natproj/tal

Leubke S.M. et al (1999) *Annotating the World-Wide Web*, Proceedings, Ed-Media99 Seattle Washington, USA

Description of a web-based program suitable for easy adaptation for on-line delivery of many educational resources.

Geoffrey T. Meyer
Department of Anatomy and Human Biology
The University of Western Australia
Nedlands, 6907, Perth, Western Australia
gmeyer@anhb.uwa.edu.au

Abstract: This paper reports the creation of a web-based computer program now used successfully to teach "histology" in our Medical School. Unlike any other similar histology computer program now available, the "template" of this program can be made available to individual course coordinators in their own institutions to create their own "on-line histology course" that reflects the specific and unique learning objectives of an educator's individual histology course. A further objective of this paper is to emphasis that the "program template" is easily adapted for the "flexible, on-line delivery" of many other subject areas in High School and University Curricula.

The "Histology Practical Assistant"

The presentation of this paper will be simultaneously accompanied by an "on-line" demonstration of this teaching resource but a website demonstrating the features of this resource is also available (see below).

The program is called the Histology Practical Assistant" ("HPA") and was created initially to save money! Teaching any histology course has always been an expensive exercise due to:

(a) large numbers of staff required to assist students in the practical sessions.
(b) the need for expensive teaching resources such as high quality microscopes and class slide collections for each student.
(c) the constant maintenance of these resources by staff, or the replacement of these resources due to "wear and tear".

Increases in student numbers in our histology courses over the past few years has meant that we do not have sufficient numbers of quality microscopes or slide collections for each student. We have reluctantly shared these items amongst the students, but sharing is not an ideal teaching and learning exercise. So this dilemma was another reason to develop the "HPA".

The "HPA" was also designed for "flexible delivery"

This program was also created to enhance the effectiveness of teaching and learning. Many students of histology have difficulty visualising a three-dimensional structure from the study of a two-dimensional tissue scction. Images in a computer program can be labeled to show important histological features. Diagrams can be added so students can see the plane of section of the image through the organ, and the location of the image in relation to the whole organ.

The "HPA" was also designed for "flexible delivery"

The "HPA" was also designed to allow students to examine histological sections of tissues and organs outside of normal teaching hours and at their own pace in a non-threatening environment. This has reduced the need for large numbers of microscopes and slide collections (and reduced maintenance) to be available at any one time during the academic teaching week. It also replaces the need for academic staffing in the practical classes by incorporating into the program the "tutor" i.e. a "computerised microscope" which details how to examine each histological section to identify the necessary histological features. This has led to substantial savings in teaching costs. Another feature of the "HPA" is that it provides images of a variety of demonstration material, limited preparations etc. that are not in sufficient numbers to provide in slide collections. This no longer requires staff time and room space to "set up" each week and this material is stored within the computer and hence readily available throughout the course for revision purposes.

The "HPA" provides a comprehensive self-assessment module. This enables students to test their skill in identifying histological structures, or their knowledge of the theory of histology, by answering an extensive quiz following each topic to enhance and not compromise effectiveness in teaching and learning.

Why is the "HPA" so unique?

(a) It is web-based so easy to maintain.

(b) It is interactive in that if students cannot identify features then they can link to extensive use of pointers/labels etc. to indicate relevant histological components to them.

(c) It is written in a language that reflects the personality /sense of humour of the lecturer and so personalises the interface between the computer program and the student.

(d) It is a versatile program and so can be immediately adapted to any changes in teaching emphasis. Additional topics, images, quiz question etc. can be inserted (or deleted) very easily. This is particularly useful so teaching Departments from other Universities can substitute their images - particularly in the "tutor" component of this program.

Because of (d) above, anatomical, plant, insect specimens, etc. can replace the histological content of this program so it can be utilised within any University by a group of educators from many different disciplines. It is designed to be "user friendly". Students can navigate their way through the program very easily. An independent survey has indicated that when students have used this program it has made a very positive impact on student learning.

The major features of the "HPA" will be demonstrated during the presentation of this paper.

There is an On-line demonstration website!

Most features can be seen by visiting the following website:

http://www.anhb.uwa.edu.au/hpa/hpademo.html

The "Histology Practical Assistant" is written in javascript and word documents. On opening the program a list including each major topic on the histology curriculum appears within a narrow frame on the left hand side of an 800X600-pixel screen frame - this list of topics is called the "labmap". A welcoming "splash" page also appears on the remainder of the screen.

A "Noticeboard" is available as a link to convey messages to students about any aspect of the study program.

The 1st level of the "labmap"" lists major topics of a typical histology curriculum in a medical, dental, or a biological science course. The " "labmap"" begins with the basic tissues leading down to the major organ systems. Any topic can easily be deleted if it doesn't suit the objectives (or time restraints) of a particular histology course. Conversely, it is easy to add further topics to this " "labmap"".

By clicking on the + icon, each topic on the 1st level of the "labmap" expands to include the many tissues/organ components of that topic. Many components on this 2nd level, can be further expanded to a 3rd level by once again clicking on the + icon. Clicking the icon again can contract topics.

Each topic generally depicts images at the gross anatomy level; then low to high magnification, light microscope images, and finally electronmicrographs for relevant ultrastructural details. Thus, the computer is imitating student use of their microscope to examine the particular tissue or organ. This feature alone may be sufficient for histology courses where the constant use of the microscope, class slide collections, and associated costs may not be of major emphasis in the course objectives.

The "HPA" is interactive

Students need to interact with the program! By clicking on a topic at any level, an image appears in the middle frame. At the same time, concise text (the "guide") appears in narrower right hand frame, with all the major histological features hypertexted. Students can work individually, or in small groups, to identify each feature and are only tempted to click on the hypertexted feature if they have doubts or wish to test themselves. Once the student clicks on any one hypertexted feature it is immediately labeled and indicated by an arrow or circle, etc. The concise text is written in a language that reflects the personality/sense of humour of the lecturer and so personalises the interface between the computer-aided teaching program and the student. Like all components of this program the text can be easily amended. At the base of the text for each feature are two links;-the "more info" link and the "tutor" link.

The "more info" link

This link can have a variety of uses. For instance, it can contain diagrams, information and questions for the student to research in their recommended texts, lecture notes, etc. There is no limit to the length of the material, or method of presentation of the material, inserted into this link. The "labmap" on the left-hand side remains visible at all times which enables the user to open any topic in any order. This is particularly useful when students wish to review a topic before investigating another topic.

The "tutor" link

The other link is the "tutor". The innovation of the "tutor" link has two unique features:

(1) The microscope objective lenses on the computer screen link images (taken at different magnifications) of the student's class tissue section and so simulates the student's use of a typical class microscope. This unique feature has eliminated use of the microscope in most of our practical classes except to reinforce the skill of microscopy in the histological study of body tissues and organs.

(2) Accompanying each image is text to direct the student to locate (on high-resolution images of their class slide) the specific histological feature/s opened on the "labmap". This feature promotes an independent, self-paced learning opportunity for the student and eliminates the need for teaching staff to be present in practical sessions.

Self-assessment is available on-line

After studying each topic a quiz is available. Questions are MCQ, "roll-down" questions, identification of structures on labeled diagrams, or histological images (often requiring a written answer), or requests for functional descriptions of tissues/organs. At the completion of the quiz a student submits his/her answers and receives immediate feedback of his/her success. It is easy to utilise a link that transfers the performances of each student to a secure result sheet where it can be stored and count towards the final grade for each student.

A brief section on clinical considerations and research is included following at the end of each topic of the curriculum. The main purpose of these two features is to impress upon students:

(1) the close relationship of histology to pathology/disease processes.
(2) the variety of current research investigations at the histological level of many tissues.
(3) the use of histological techniques as research tools.

The program "template" is versatile

In the presentation a demonstration will be performed explaining how versatile the "program template" is to access via any major HTML editor and make amendments to the components of the study subject. This will include a demonstration of how easy other subject disciplines eg. botany, geography, many biological science subjects including anatomy, anthropology, genetics; geology and many High School subjects can be included in this "Flexible Delivery" format by a teacher who need not be computer literate!

Acknowledgments

The author wishes to thank the expert programming skills of Mr. Werner Hennig and the financial assistance from the Faculty of Science, and The Department of Anatomy and Human Biology, The University of Western Australia.

A Rule-based Method to Shift between Learning Protocols

Yongwu Miao, Jörg M. Haake, & Ralf Steinmetz
GMD - German National Research Center for Information Technology,
Integrated Publication and Information Systems Institute (IPSI)
{miao, haake, rst}@darmstadt.gmd.de

Abstract: Learning protocols are computational descriptions of collaborative learning policies (strategies). They can help geographically distributed people to overcome the difficulty of coordination by guiding and controlling social interactions in virtual learning environments. To perform a certain collaborative learning activity, a number of strategies can be used to achieve the same goal. However, no one strategy can be effective in all situations, because learning groups are different in group size and group structure, and group members vary in knowledge, skills, interests, learning style, and so on. Furthermore, in learning processes the situation changes over time. Learning groups may want to shift from the currently used strategy to another strategy to fit some changes. In this paper, a rule-based method to switch learning protocols is proposed. This method is implemented and demonstrated in our virtual learning environment CROCODILE.

Introduction

In education a revolution is taking place, in which we see a shift from the teacher-centered approach to the learner-centered approach. The underlying philosophy is that people learn best when they actively engage in learning to acquire knowledge and skills, which they need to solve the problem at hand (Norman96). The advance of technologies accelerates this change and enables many ideas of the philosophy of constructivism to be carried out. In the past decade, many systems have been developed to support learner-centered learning in virtual learning environments, such as CSILE (Scardamalia94), CNB (Edelson95), Web-SMILE (Guzdial97), and Belvedere (Suthers97).

In the same line we developed a virtual learning environment (VLE) based on principles from constructivism and situation theory. We suggest that losing physical contact in a VLE makes it difficult for learners to understand and interact with learning environment, to construct shard knowledge, and to coordinate their contribution. In order to solve these problems, we adopted a development approach that can be characterized as 1) using a *virtual institute metaphor* to structure shared workspace (Miao99), 2) using *learning nets* to facilitate collaborative construction of shared knowledge (Miao00a), 3) using *learning protocols* to mediate social interaction (Wessner99, Miao00b), 4) using *learning plan* to coordinate tasks performed by different people.

In this paper, we focus on discussing an open issue of learning protocols. A *learning protocol* is a scripted collaborative learning strategy in computational form that helps people to coordinate a collaborative learning activity in a VLE. In different situations, learning groups may adopt different strategies to perform learning activities. For example, to perform problem-based learning different process models are proposed in the literature (Stepien93). Therefore, a set of pre-defined learning protocols should be available for learning groups, so that they can choose one of them to guide and control their collaborative learning activity in a VLE when needed. However, to shift from the learning protocol currently used at run-time to another learning protocol is an open problem. This paper addresses this problem. First of all, we introduce learning protocols in detail. The main part of the paper discusses the problem of shifting between learning protocols and presents a rule-based method to solve this problem. Then we briefly discussing the implementation of a protocol control tool. Finally, we summarize our work and discuss related research.

Learning Protocols and Protocol Instances

In this section, we briefly present the concept of learning protocols, how a learning protocol is defined and executed.

Learning Protocols

Learning protocols are theoretically based on psychological script theory (Wessner99). According to the script theory, generalized knowledge about a sequential list of the characteristic events involved in a common routine is called a script (Schank77). Scripts can be used to organize knowledge, to assist recall, to guide behavior, to predict likely happenings and to help us to make sense of our current experiences. Learning protocols are computational scripts to guide and control social interaction in collaborative learning processes in a VLE.

A learning protocol is described as an extended state-transition-diagram. A node in the protocol diagram represents a *state of collaboration* within the learning protocol. In problem based learning (PBL), for instance, the possible states are "identifying problem", "identifying learning issue", "applying knowledge", etc. Each node is labeled by a unique name within a learning protocol. Each state of collaboration is bound to a set of *behavior rules*. A behavior rule specifies which *protocol-role* is permitted to perform which operation on which type of object. A protocol-role is protocol specific (e.g., tutor, learner, and expert in PBL protocols). Protocol-roles are assigned to participants of the collaborative learning activity. There are two types of objects in a learning protocol. The first type of object are *artifacts* that can be manipulated collaboratively in learning processes. Examples of types of artifacts in PBL are "problem", "learning issue", "hypothesis", "solution", "hint". Operations on artifacts such as "learning issue" objects, are "create", "delete", "modify", "refer_to", "I_know", etc. Such artifact objects carry the knowledge constructed and exchanged in learning processes. The second type of objects are so called *coordination objects,* which are used to coordinate group interaction (e.g., floor token, state of collaboration, etc). Operations on such objects include, for example, "request", "drop", "start", "finish", and so on. A link in a protocol diagram represents an event. The occurrence of an event causes a transition between the departure state and the arrival state connected by the link. A link is also bound to a behavior rule in which the object is a coordination object. An event occurs when an allowed operation is performed. Now, we formally describe a learning protocol.

First of all, we define the behavior rule. A behavior rule can be defined as a tuple element of $B = (R \times Op \times O)$, where R is a finite set of protocol-roles; O is a finite set of objects; and Op is a finite set of operations. Hence, a set of behavior rules can be defined to specify all possible behaviors to support a certain collaborative learning activity. We use B^* to denote the set of all subsets of set B. Then, we formally define a learning protocol. A learning protocol is defined as a tuple $P = \langle S, T, lab, bind, L, B^* \rangle$ where:

- S is a finite set of states of collaboration. Within S, there is a *start state* denoted as s_0 that is the access point of a learning protocol.
- $T \subseteq S \times S$ is a subset of relation on S that is called as transitions.
- L is a finite set of names that are represented as strings.
- lab: $(S \cup T) \rightarrow L$ is a labeling function. Notice that the label of each state of collaboration is unique, while a label can be carried by more than one transition. A label of a state $s \in S$ is represented as lab(s) and a label of a transition $t \in T$ is represented as lab(t).
- bind: $(S \cup T) \rightarrow B^*$ is a binding function. The set of behavior rules bound to a state $s \in S$ is represented as bind(s).

Protocol Instances

When group members perform a collaborative learning activity, they can use a pre-defined learning protocol to guide and control the group interaction. A learning protocol can be executed as a *protocol instance.* One learning protocol can have more than one protocol instance at the same time. Each protocol instance is executed independently following the definition of the chosen learning protocol.

Before or during execution of a protocol instance, the initiator of the protocol instance needs to assign protocol-roles to the potential participants of the collaborative learning activity. When the execution of a protocol instance is initiated, it will begin execution at the start state of the learning protocol. That is, the current state of the instance is the start state. When participants with appropriate protocol-roles perform an operation that is bound to a transition, the corresponding event occurs, which triggers a state transition according to the definition of learning protocol. The destination state of the transition then becomes the *current state* of the protocol instance. In the current state, participants are guided and controlled to perform operations on the shared artifact according to the behavior rules bound to this state. In this way, step by step, all participants carry out their collaborative learning activities coordinated by following the learning protocol.

Shifting between Learning Protocols

As discussed above, group interaction is supported at run time by the execution of a protocol instance of a pre-defined learning protocol. However, to support a certain collaborative learning activity (e.g., problem based learning), a family of learning protocols can be defined. As we known, learning groups are different in group size and group structure, and group members vary in knowledge, skills, interests, learning style, and so on. Different learning groups may exploit different learning protocols to carry out their collaborative learning activity, because of the characteristics of the groups or their customs. There is no single learning protocol that is suitable to every type of group and to every problem. Furthermore, as groups conduct a collaborative learning activity, some factors may change over time such as group size, structure of group, the understanding and expertise of learners, etc. Therefore, groups may want to shift from the currently used learning protocol to another learning protocol to fit the changes.

A simple approach to shift between protocols is to terminate the currently executed protocol instance first and then to initiate a new protocol instance based on the target learning protocol. However, in such a way, some data recorded in the current protocol instance will be lost upon terminating the current protocol instance. The participants then have to repeat efforts to reach the equivalent state in the new protocol instance. For example, when a group uses the "first-request-first-take" floor token control protocol, the learners' requests for the floor are recorded in the request queue of the current protocol instance. If the group wants to change the floor token control protocol by stopping the current protocol instance and initiating a new protocol instance of another floor token control protocol (e.g., the "teacher-assigning" floor token control protocol), the request queue of the current protocol instance will be lost. Learners need to request the new floor token in the new protocol instance again.

An alternative approach is to enable end-users to modify the definition of the learning protocol in use at run time. However, our experiences reveal that it is a difficult and time-consume task for end-users to change learning protocol dynamically.

Therefore, we adopted an approach where end-users are enabled to shift between learning protocols by simply choosing another protocol from a family of pre-defined learning protocols for a certain learning activity. Because all learning protocols in a family are carefully defined to support the same collaborative learning activity, they use identical sets of objects, such as the types of objects and their associated operations, and identical protocol-roles. Learning protocols within the same family vary in the definition of the state of collaboration and transitions, and in the binding relation. An analysis of learning protocols in the same family showed that some states of collaboration defined in different learning protocols are bound to the same set of behavior rules, and that some states of collaboration defined in different learning protocols are refined to different degrees. Manually, for any state of any learning protocol from which to shift we can find an appropriate state in any target learning protocol from where to continue execution after shifting. Therefore, a family of learning protocols can be defined by a protocol diagram in which all learning protocols are contained as sub-diagrams. A new *shift relation* is defined by edges that connect each state in any sub-diagram to a state in any other sub-diagram. This diagram becomes very complex when the number of learning protocols and the numbers of states in these protocols are large. It is also difficult to maintain the diagram when adding or removing or modifying learning protocols.

A Rule-based Method to Shift between Learning Protocols

In order to shift between learning protocols in a systematic manner, we defined a rule-based method.

Readers should remember that a state within a learning protocol is distinguished from other states, because a certain sub set of behavior rules is bound to this state. Within a learning protocol, two different states are bound to two different sub sets of behavior rules. Given there are two states s_1 and s_2 ($s_1 \neq s_2$) in a learning protocol P, then (bind(s_1) ≡ bind(s_2)) is equivalent to true.

Different learning protocols are defined to support the same collaborative learning activity. That is, the set of protocol-roles, objects and their associated operations are the same. Learning protocols are different from each other because the states in different protocols are defined in different way. That is, in different learning protocols, states are refined or specialized in different degree by binding to different sub sets of behavior rules. According to the sub set of behavior rules bound to states, the relation between two states within two different learning protocols can be fall into one of four categories. Given s is a state of a learning protocol P and s' is a state of a learning protocol P' ($P \neq P'$), the relation between bind(s) and bind(s') leads to one of the situations:
equal: $\mathrm{bind}(s) = \mathrm{bind}(s')$;
contained: $\mathrm{bind}(s) \subset \mathrm{bind}(s') \vee \mathrm{bind}(s) \supset \mathrm{bind}(s')$;
intersected: $\mathrm{bind}(s) \not\subset \mathrm{bind}(s') \wedge \mathrm{bind}(s') \not\subset \mathrm{bind}(s) \wedge (\mathrm{bind}(s) \cap \mathrm{bind}(s') \neq \varnothing)$;
separated: $\mathrm{bind}(s) \cap \mathrm{bind}(s') = \varnothing$.

According to these four situations we can establish a shift relation between labels of states instead of establishing a shift relation between states of two learning protocols. For all learning protocols in the same family, we define a unified set of labels and a unique labeling function that is denoted as Lab. In the first case, we label two states by the same name. In the rest of three cases, we have to use different names for these two states.

Generally speaking, given there are m learning protocols in a family $P_1, P_2, \ldots P_m$, while $S_1, S_2, \ldots S_m$, denote the sets of state of collaboration of the respective learning protocols. $\forall\, s \in S_i, s' \in S_j \mid i \neq j \bullet \mathrm{bind}(s) = \mathrm{bind}(s')$ iff $\mathrm{Lab}(s) = \mathrm{Lab}(s')$, that is, these two states will be labeled by the same name. Otherwise, if $\mathrm{bind}(s) \neq \mathrm{bind}(s')$, then $\mathrm{Lab}(s) \neq \mathrm{Lab}(s')$. Now, we define a *label relation graph* as a directed graph $G = \langle L, U, B \rangle$ where:
L is a finite set of nodes that represent the unified set of labels of states for all protocols in the family. $U \subseteq (L \times L)$ is a set of uni-directional edges $U = \{ (l, l') \mid l = \mathrm{Lab}(s) \wedge l' = \mathrm{Lab}(s') \wedge \mathrm{bind}(s) \supset \mathrm{bind}(s') \}$. If $(l, l') \in U$, then l is called a father of l', while l' is called a child of l. $B \subseteq (L \times L)$ is a set of bi-directional edges $B \subseteq \{ (l, l') \mid l = \mathrm{Lab}(s) \wedge l' = \mathrm{Lab}(s') \wedge \mathrm{bind}(s) \not\subset \mathrm{bind}(s') \wedge \mathrm{bind}(s') \not\subset \mathrm{bind}(s) \wedge (\mathrm{bind}(s) \cap \mathrm{bind}(s') \neq \varnothing)\}$. It is important to notice that not all intersected states can lead to drawing such bi-directional edges between their labels. In some cases, the behavior rules bound to two states are almost the same but they have subtle difference because they are defined to emphasize or ignore intentionally some details more or less. They can be regarded as mutually shiftable states and a bi-directional edge can be defined between the labels. In other cases, no shift should be possible between two states although the behavior rules bound to the two states are associated to more or less common behavior rules. Thus, the bi-directional edges need to be designed carefully by protocol designers.

After defining the label relation graph, we can shift between protocols by using the algorithm described below. Let P be the currently used protocol and s be the current state ($s \in S$) of a protocol instance of P. If it is desired to shift from the current learning protocol to another learning protocol P' ($P \neq P'$) we need to find a state in the new protocol. This state $s' \in S'$ can replace the current state in the new protocol while maintaining the current protocol instance by using the following algorithm:

1. Try to find a state in S': If $\exists\, s' \in S' \mid \mathrm{Lab}(s) = \mathrm{Lab}(s')$, then return s'
2. Try to find a state in S': If $\exists\, s' \in S' \mid (\mathrm{Lab}(s), \mathrm{Lab}(s')) \in B$, then return s'
3. Try to find a state in the set of children of Lab(s): $C = \{c \mid c \in L \wedge ((\mathrm{Lab}(s), c) \in U\}$
   - If $\exists!\, c \in C \mid s' \in S' \wedge c = \mathrm{Lab}(s')$, then return s'
   - If there are k labels c_i ($i = 1, 2, \ldots, k$) $((c_i = \mathrm{Lab}(s_i') \wedge s_i' \in S')$ $(i = 1, 2, \ldots, k))$, search a path in which $s_1', s_2', \ldots, s_k'$ are points.
     - If the path is not a loop and s' is the start-point of the path, then return s';
     - If the path is a loop and s' is the nearest point to the start state of the protocol P', then return s'
   - If there is no such $c \in C \mid s' \in S' \wedge c = \mathrm{Lab}(s')$, then recursively search children of elements of C and repeat step 3.
4. Try to find a state in the set of fathers of Lab(s): $F = \{f \mid f \in L \wedge (f, (\mathrm{Lab}(s)) \in U\}$
   - If $\exists!\, f \in F \mid s' \in S' \wedge f = \mathrm{Lab}(s')$, then return s'

- If there are k labels f_i $(i = 1, 2, \ldots, k)$ $((f_i = \mathrm{Lab}(s_i') \wedge s_i' \in S')$ $(i = 1, 2, \ldots, k))$, search a path in which $s_1', s_2', \ldots, s_k'$ are points.
  - If the path is not a loop and s' is the start-point of the path, then return s';
  - If the path is a loop and s' is the nearest point to the start state of the protocol P', then return s'
- If there is no such $f \in F \mid s' \in S' \wedge f = \mathrm{Lab}(s')$, then recursively search fathers of elements of F and repeat step 4.

5. Return the start state of learning protocol P' (i.e. no better matching state in the target protocol could be found).

Implementation

The rule-based method to shift between learning protocols has been implemented in a protocol control tool in our prototype VLE system called CROCODILE (an abbreviation for CReative Open COoperative DIstributed Learning Environment). It is implemented in VisualWorks Smalltalk and available on Window'95, '98, NT and Solaris.

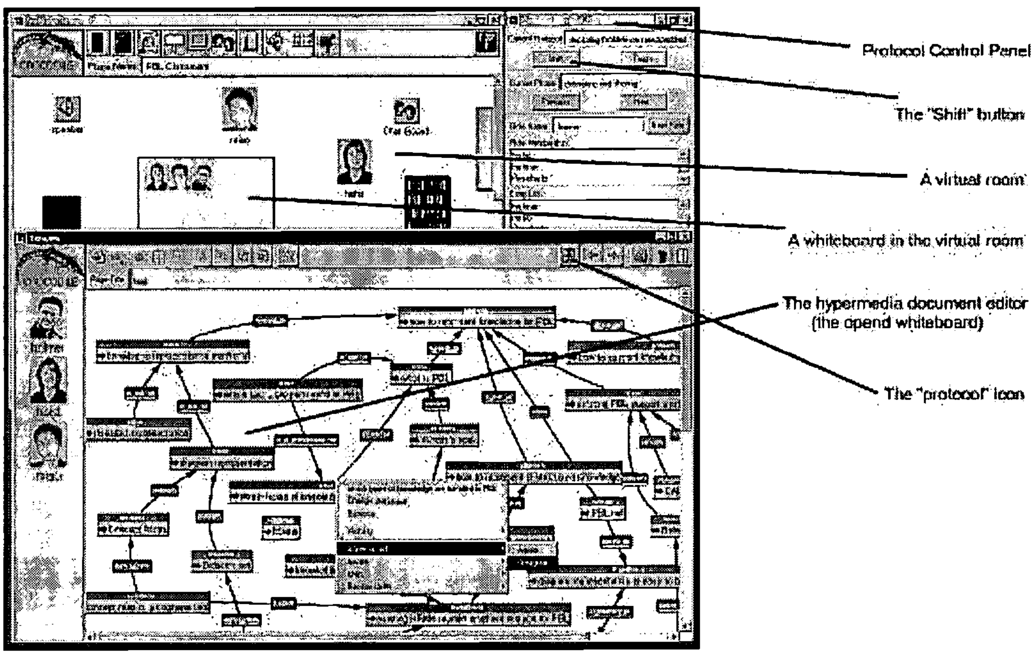


Figure 1: The user interface of CROCODILE

In Fig. 1, we illustrate the three windows that users see. The lower window is the hypermedia document editor in which learners can build their hyperdocument. The upper left window shows a virtual room in which learners are located. The upper right hand window shows the protocol control panel.

A learner can initiate a learning protocol instance by clicking on the "protocol" icon (see Fig. 1) in the editor window. A dialog window will pop up and the protocol initiator can select a learning protocol from a list of pre-defined learning protocols. In the current prototype we prepared three learning protocols for problcm bascd lcarning (*PBL-protocols)*. After choosing a PBL-protocol, users currently working in the editor will see that the protocol control panel pops up. Information about the initiated protocol instance is presented in the panel, such as the name of selected learning protocol, current state of the protocol instance, and assigned role membership (which is assigned by using this panel). Learning groups can construct shared knowledge in the editor window by following the selected PBL-protocol. A detailed description of how a learning group conducts problem-based learning by using our system can be found in (Miao00b). It is important to notice that learning group can shift between PBL-protocols by clicking on the "shift" button in the protocol control panel and choosing another PBL-protocol.

Summary

In this paper, we discussed the concept of learning protocols, their definition, and execution. Then, we identified the problem of shifting between learning protocols. After analyzing and exploring possible approaches to solve this problem, we presented a rule-based method to shift between learning protocols. Finally, we briefly described our virtual learning environment CROCODILE, in which the method has been implemented in a protocol control tool.

In terms of related work, Belvedere and Web-SMILE provide students with guidance for the execution of learning processes. The guidance is implemented as something like a protocol description. However, in both of these systems this protocol description can not be instantiated and shifted. In the Workflow Management Systems area, process models are different and cannot easily be used for our purpose of controlling behavior in collaborative learning processes. Also, in WfMS usually the definition of a process is changed instead of replacing the process definition of a running process. Compared to finite state machines our process model differs with respect to the use of behavior rules in the process definition. Exactly these behavior rules form the basis for our algorithmic computation of transitions between protocols.

Our plans for future work include extensive evaluation of our approach. Furthermore, we will use this method to develop other families of learning protocols to support other types of collaborative learning activities.

References

(Edelson95) Edelson, D., O'Neill, K., Gomez, L., & D'Amico, L. (1995). A design for effective support of inquiry and collaboration. In: *Proceedings of Computer-Supported Collaborative Learning, 1995.* Mahwah, NJ: Lawrence Erlbaum. 107-111.

(Guzdial97) Guzdial, M., Hmelo, C, Hübscher, R., Nagel, K., Newstetter, W., Puntembakar, S., Shabo, A., Turns, J., & Kolodner J.L., (1997). Integrating and Guiding Collaboration: Lessons learned in computer-supported collaboration learning research at Georgia Tech. In R. Hall, N. Miyake, & N. Enyedy (Eds.), In *Proceedings of Computer-Supported Collaborative Learning, 1997*, 91-100.

(Miao99) Miao, Y., Fleschutz, J. M. & Zentel, P., (1999). Enriching Learning Contexts to Support Communities of Practice. In: *Proceedings of Computer-Supported Collaborative Learning, 1999*, 391-397.

(Miao00a) Miao, Y., Holst, S., Holmer, T., Fleschutz, J. M., and Zentel, P. (in press) An Activity-Oriented Approach to Visually Structured Knowledge Representation for Problem-Based Learning in Virtual Learning Environments. To appear in *Proceedings of the Fourth International Conference on the Design of Cooperative Systems*, May 23-26 2000.

(Miao00b) Miao, Y., Holst, S., Haake, J. M., and Steinmetz, R. (in press). PBL-protocols: Guiding and Controlling Problem Based Learning Processes in Virtual Learning Environments. To appear in *Proceedings of the Fourth International Conference on the Learning Sciences*, June 14-17, 2000.

(Norman96) Norman, D.A., & Spohrer, J.C. (1996). Learner-Centered Education. *Communication of ACM*, 39 (4), 24-27.

(Scardamalia94) Scardamalia, M., Bereiter, C., & Lamon, M. (1994). The CSILE project: Trying to bring the classroom into World 3. In K. McGilly (ed.), *Classroom lessons - Integrating cognitive theory and classroom practice*, 201-228. Cambridge, MA: MIT Press.

(Schank77) Schank, R.C. & Abelson, R.P. (1977). *Scripts, plans, goals, and understanding*. Hillsdale, NJ: Erlbaum.

(Stepien93) Stepien, W.J., Gallagher, S.A. & Workman, D. (1993). Problem-Based Learning for traditional and interdisciplinary classrooms. *Journal for the Education of the Gifted*, 4, 338-345.

(Suthers97) Suthers, D., Toth, E., & Weiner, A. (1997). An Integrated Approach to Implementing Collaborative Inquiry in the Classroom. In R.Hall, N.Miyake, & N. Enyedy (Eds.), In: *Proceedings of Computer-Supported Collaborative Learning, 1997*, 272-279.

(Wessner99) Wessner, M., Pfister, H.R., & Miao, Y. (1999). Using Learning Protocols to Structure Computer-Supported Cooperative Learning. In: *Proceedings of the ED-MEDIA'99*, 471-476.

Gender and instructional use of computers

Ananda Mitra, Ph.D.
Wake Forest University
Department of Communication
Winston-Salem, NC 27109
ananda@wfu.edu

Abstract: Based on the findings of this study, it can be claimed that the process of acceptance of computer technology is related to gender where the women are far more cautious about exhibiting a positive attitude than men. However, when the functionality of a technology has been demonstrated within the context of a specific process, in this case the 'learning process,' women tend to embrace the technology and are often more positively pre-disposed, Furthermore, there are no specific categories of use where this process appears to become more significant, and the differences between men and women with regards to computer use categories is unevenly and somewhat randomly distributed suggesting again that it is the practice of technology that is more critical than the specific technology itself.

Introduction

Early studies reveal that males are less anxious, more confident, and like using computers more than females. Despite these findings researchers also conclude the opposite; gender does not directly impact a student's attitude toward computers (Rosen, Sears, & Weil, 1985). These findings are a result of taking into account the variable 'computer experience.' Chen (1985) concludes that overall males show more positive attitudes of interest and confidence with computers than do females. However, when the amount of computer experience is controlled, males and females respond with similar levels of interest. Hunt & Bohlin (1993) reported on a research study designed to measure the entry attitudes of students enrolling in educational computing classes and found that previous experiences were the best predictors of student attitudes. Males indicated having more experience with programming and recreational uses of computers but gender did not significantly correlate with any of the attitude variables. Levin and Gordon (1989) confirm the impact of computer experience on attitudes and add that having an actual computer in the home has a greater affect on attitude toward computers than does gender.

Only when the trend that males and females exhibit similar attitudes toward computers was recognized that researchers began asking if these results were the same for all types of computer use. C.R. Scott & Rockwell (1997) explored the role of computer anxiety, communication apprehension, and writing apprehension in predicting future use of computers as communication tools. They found that past computer use appears to be a strong predictor of future use; however, gender differences are rare: male respondents reported a greater likelihood of joining online services and playing video games. These two instances were exceptions; there were no other differences between the genders regarding likelihood to use new (or more traditional) technologies. Rockwell's research points to a fundamental distinction not made in previous research -- the difference in types of computer use by gender. More importantly, this information can be used to determine if there is a difference in attitude toward computers because of specific use patterns between genders.

As this brief review suggests there is some confusion about the relationship between gender and contemporary attitudes and use of computers. In the educational setting, this confusion leads to doubts about the way in which differences in learning in a computer-enriched environment could be related to gender. We argue that there are two areas that need further exploration: 1) there is an alteration in the relation between gender and different kinds of the computer use as computer enriched environments are emerging, and 2) the emergent environments and the cultures that these environments spawn can lead to new areas of differences between genders when computers are considered as the key technology of the new academic environment. These considerations drive us to advance one broad research question:

What are the relationships between gender, categories of computer use, and attitudes towards computers in the emergent computer enriched environments of academic institutions?

Methodology and Data

Given the breadth of the question, we have utilized the data from an ongoing longitudinal assessment of the impact of computerization at a small liberal arts institution that initiated a process of computer enrichment by entering into collaboration with a major computer industry leader. The study used a survey design to collect self-response data from a sample of students and faculty at the University. The surveys continue on an annual basis and use questionnaires that were developed after extensive focus group interviews with students and faculties.

Results

The results of the analysis point towards several inter-related findings. The results are presented here in a thematic order to capture the various relationships between gender, use and attitudes towards computers.

First, the results indicate that before the computer enrichment was initiated on campus, and before the arrival of the laptop students on campus, the men on campus had a significantly more positive attitude towards the use of computers and were also more frequent users of computers. As illustrated in Table 1, men reported that they felt that computers can make the learning process easier, preferred to be in classes where they could use computers, felt more comfortable with computers than women, were less apprehensive about computers than women and were less concerned that computers in teaching would make the teaching process too impersonal. Finally, men reported that computers enabled them to interact more with teachers using computers.

Table 1: Year 1 comparison

Attitude Item	All Women	All Men	
Increased use of technology makes learning easier	3.39	3.56	*
I prefer classes in which I get to use computers	2.72	3.05	*
I feel comfortable using the computer	3.38	3.78	*
I have a certain apprehension about computer use	3.03	2.55	*
Computers in teaching makes the learning process too impersonal	3.25	3.07	*
Computer use increases the college work load	3.08	3.06	
Computers are effective for communicating with faculty	3.33	3.31	
Communicating with professors by e-mail is generally gratifying	3.38	3.32	
Computers enable me to interact more with professors	2.94	3.07	*

In a similar way, men on campus also reported a more frequent use of computers than women. Computer use was reported as higher by men in all categories of computer use, particularly in the task categories of use ranging from specialized use to the more routine use of the technology. As illustrated in Table 2, this difference disappeared only in the case of the use of electronic mail with teachers.

Table 2: Year 1 comparison

Use	All W	All M	
Spreadsheet	1.50	1.71	*
Database	1.45	1.69	*
Statistical	1.44	1.65	*
Mathematical	1.56	1.78	*
Internet for Info	2.71	2.97	*
E-mail with teachers	2.11	2.20	

This trend, continues in the first year of computer enrichment. At this point, a quarter of the students in the University had access to personal laptop computers, the network system, albeit somewhat unreliable, was in place and the computer labs were being phased out. The data suggests that both the legacy and the laptop-program women became less positive towards computers and their use was less than the men (Table 3 and 4) were.

However, at the same time the overall attitude towards computers among both men and women saw an increase in the positive direction (Tables 5 and 6). Furthermore, there were more significant differences in attitude between the legacy women and the legacy men than the laptop women and the laptop men (Tables 7 and 8).

Table 3: Year 2 comparison (aggregate)

	Men	Women	
Increased use of technology makes learning easier	3.48	3.25	*
I prefer classes in which I get to use computers	3.13	2.75	*
I feel comfortable using the computer	4.04	3.66	*
I have a certain apprehension about computer use	2.16	2.56	*
Computers in teaching makes the learning process too impersonal	2.78	3	*
Computer use increases the college work load	2.92	3.01	
Computers are effective for communicating with faculty	3.57	3.68	
Communicating with professors by e-mail is generally gratifying	3.57	3.74	
Computers enable me to interact more with professors	3.41	3.35	

Table 4: Year 2 comparison (aggregate)

	All M	All W	
Spreadsheet	1.95	1.74	*
Database	1.74	1.52	*
Statistical	1.81	1.76	
Mathematical	1.9	1.73	*
Internet for Info	3.41	3.13	*
E-mail with teachers	2.6	2.61	

Table 5: Changes in women over time

Item	Year 1 W	Year 2 W	Year 3 W	
Increased use of technology makes learning easier	3.39	3.48	3.63	1=2,2=3,1*3
I prefer classes in which I get to use computers	2.72	3.13	3.27	1*2=3
I feel comfortable using the computer	3.38	4.04	4.13	1*2=3
I have a certain apprehension about computer use	3.03	2.16	2.13	1*2=3
Computers in teaching makes the learning process too impersonal	3.25	2.78	2.67	1*2=3
Computer use increases the college work load	3.08	2.92	2.86	1=2=3
Computers are effective for communicating with faculty	3.33	3.57	3.68	1*2=3
Communicating with professors by e-mail is generally gratifying	3.38	3.57	3.65	1=2,2=3.1*3
Computers enable me to interact more with professors	2.94	3.41	4.19	1*2*3

* stands for significant difference between means

Table 6: Changes in men over time

	Year 1 M	Year 2 M	Year 3 M	
Increased use of technology makes learning easier	3.56	3.25	3.38	1=3,2=3,1*2
I prefer classes in which I get to use computers	3.05	2.75	2.77	1*2=3
I feel comfortable using the computer	3.78	3.66	3.9	1=3,2=3,1*2
I have a certain apprehension about computer use	2.55	2.56	2.32	1=2=3
Computers in teaching makes the learning process too impersonal	3.07	3	2/77	1=2*3

Computer use increases the college work load	3.06	3.01	3.04	1=2=3
Computers are effective for communicating with faculty	3.31	3.68	3.86	1*2=3
Communicating with professors by e-mail is generally gratifying	3.32	3.74	4.05	1*2*3
Computers enable me to interact more with professors	3.07	3.35	4.32	1*2*3

*stands for significant difference between means

Table 7: First year of computer enrichment, comparison of legacy and laptop students

	L M	L W		TP M	TP W	
Increased use of technology makes learning easier	3.36	3.1	*	3.72	3.49	
I prefer classes in which I get to use computers	2.98	2.68	*	3.42	2.87	*
I feel comfortable using the computer	3.97	3.6	*	4.17	3.76	*
I have a certain apprehension about computer use	2.23	2.57	*	2.02	2.54	*
Computers in teaching makes the learning process too impersonal	2.94	3.17		2.49	2.72	
Computer use increases the college work load	2.92	3.1		2.89	2.86	
Computers are effective for communicating with faculty	3.48	3.56		3.75	3.86	
Communicating with professors by e-mail is generally gratifying	3.43	3.62		3.84	3.92	
Computers enable me to interact more with professors	3.25	3.17		3.73	3.62	

*stands for significant difference between means

Table 8: First year enrichment comparison

	LM	LW		TP M	TP W	
Spreadsheet	2.02	1.75	*	1.78	1.7	
Database	1.66	1.5		1.89	1.55	*
Statistical	1.85	1.81		1.68	1.69	
Mathematical	1.8	1.68		2.11	1.82	*
Internet for Info	3.35	3.02	*	3.52	3.31	*
E-mail with teachers	2.5	2.52		2.77	2.76	

* stands for significant difference between means

The same trend continued in the second year of the computer enrichment with the single difference being that women agreed significantly more to the notion that communicating with professors by electronic mail was generally more gratifying. In all other respects, the women held a more negative attitude towards computers than men or held attitudes similar to the men. This tendency continued with respect of use of computers as well.

The data suggests that the attitude towards computers of women among the laptop students was somewhat less positive than the men in the same group for both the first and second years of computer enrichment. Finally, the data suggests that the general attitude towards computer has become increasingly positive as the computer enrichment progresses and use of computers has increased as well. This finding is a throwback to the earlier days of computing when research had indicated that men were more positively disposed towards computers than women.

Discussion

First, it is possible to claim that, like members of many other institutions, the University students had displayed little differences in attitudes towards computers and use of computers prior to the introduction of a complex and elaborate technological enrichment program. The few significant differences based on gender tended to suggest that the men were more positively predisposed towards computers and tended to use computers more than women. This finding is consistent with previous research on the relationship between gender and computer attitudes. This finding also has to be placed in the context of a liberal arts institution where the thrust of the education was not on skill-development and professional or technical training but on disciplines that traditionally were not highly computer-use intensive. It can be argued that in such environment men and women do not come in with specific expectations and predisposition about computer use. In such environments, the computer remains a "tool" that can be used to advance the learning goals which would not necessarily be learning how to use a computer or how to program a computer, but more on how the computer can make a pedagogic and learning goal more efficiently achieved. We would thus make the argument that when the computer was not the center of attention and publicity for the University, the actual difference in computer use level and attitudes towards computers were minimal, even if statistically significant.

The second major finding follows from the earlier one in logical progression. Once the environment was altered and the overall "ethos" of the University shifted towards a technological orientation, albeit, in enriching the campus only and not in revamping the curriculum to make it a "technical" institution, the expectations about the education that could be obtained from the University could have shifted. Given, the way the University altered its image in the academic marketplace, there was a specific emphasis placed on the computerization process as the University geared up for the new Millenium. Thus, the plan called, "Plan for Year 2000," was publicized as one that would technically enrich the University. Indeed, many other significant aspects of the plan, such as the reduction of class size, and the addition of new faculty sometimes were made less important given the emphasis that was placed on the technological aspect of the plan. This, as demonstrated in the content analysis, resulted in well-documented displeasure among the legacy students, and that displeasure could have resulted in the extension of some of the more traditional relationships between gender and attitudes towards computers. Thus the women being less favorable towards computers could be based on the fact that the new environment that was perceived to be emerging did not appeal to the women and the blame was placed on technological enrichment and women became more critical of the process than men.

In association with this change, there could have been a third shift in terms of the expectations about the institution. The laptop students also displayed differences between genders with men being more positive towards computers. This phenomenon could be related to two different processes at work in the University. On one hand, the incoming students now had a somewhat different expectation of the environment that they would encounter at the University. While, there was no evidence, particularly in focus groups, that there was any school-choices based on the laptop program the students did enter the environment expecting that computers would play a significant role in their learning process. This expectation, which was different from the traditional perceptions of liberal arts institutions could in itself have led to the fact that women came in greater trepidation than men. Such a conclusion is somewhat congruent with earlier studies about gender and computing where there was some evidence to suggest that men are somewhat more positively predisposed to computing than men. On the other hand, this positive predisposition was also related to the newness of computers, and as other studies have suggested, as the newness disappears and the computer becomes more ubiquitous the gender difference becomes insignificant or switches to a more positive valence for women. In other words, as the computer becomes an expected and standard part of the process of learning, women are likely to embrace it more readily. In many ways, the computer-enrichment phenomenon could be duplicating, in a microcosm, the phenomenon that used to be observed about the relation between gender and computer technology in the past when computers were being introduced into the practice of our everyday life. If that is the case, it can be hypothesized that the differences observed in the first two years of the computer enrichment will begin to disappear with time.

In conclusion it can be claimed that the process of acceptance of computer technology is related to gender where the women are far more cautious about exhibiting a positive attitude than men. However, when the functionality of a technology has been demonstrated within the context of a specific process, in this case the 'learning process,' women tend to embrace the technology and are often more positively pre-disposed, Furthermore, there are no specific categories of use where this process appears to become more significant, and the differences between men and women with regards to computer use categories is unevenly and somewhat randomly distributed suggesting again that it is the practice of technology that is more critical than the specific technology itself.

The prescriptive aspect of these findings is that technology enrichment needs to be accompanied with a clear description of the way in which the technology would be introduced in the primary practice of an institution. In the case of an academic institution this would suggest that there needs to be a clear rationale explicitly stated about the way in which ubiquitous computing would be utilized in the process of teaching. Such explicit definition of the technology practice and its functionality would generate a more positive affect within women, who otherwise would be far more likely to consider the computer-enrichment with a greater degree of criticism. Such criticism can then translate to a negative affect eventually creating undesirable gaps between genders. On the other hand, if the expectations and functionality of the technology-enrichment is made explicit at the onset, or when in time they become explicit, it can be anticipated that the differences between genders could either disappear or the women could exhibit a more positive pre-disposition than men. All of this suggests, that planners of technology-enrichment need to be sensitive of the gender of the users and consequently make adopt specific planning strategies to ensure that unwanted gender-based rifts do not result from the process of technology enrichment.

References

Chen (1985).

Hunt, N.P., & Bohlin, R.M. (1993). Teacher education students' attitudes toward using computers. Journal of Research on Computing in Education, 25, 487-497.

Levin & Gordon (1989)

Scott, C.R., & Rockwell, S.C. (1997). The effect of communication, writing, and technology apprehension on likelihood to use new communication technologies.

From Brawn to Brain: Towards an Emerging Minds-on Approach in Integrated Distributed Learning Environments (IDLEs)

Marja Mononen-Aaltonen
Media Education Center, University of Helsinki
P.O. Box 38 (6A Ratakatu)
FIN-00014 HELSINKI UNIVERSITY, FINLAND
marja.mononen-aaltonen@helsinki.fi

Seppo Tella
Media Education Center, University of Helsinki
P.O. Box 38 (6A Ratakatu)
FIN-00014 HELSINKI UNIVERSITY, FINLAND
seppo.tella@helsinki.fi

Abstract: A growing number of researchers have come to the conclusion that we have moved from an earlier paradigm (computer-based education, CBE) to a new paradigm which will be called network-based learning (NBL) in this article. So far, however, too little attention has been paid to the methodological aspects needed for creating NBL environments. This article aims to analyze these developments by linking them closely to new emerging electronic learning environments and to methodology. As a concrete example we will analyze the use of one integrated distributed learning environment (IDLE) tool called "Future Learning Environments" (FLE). Our focus is on academically oriented university students in a teacher education program at the University of Helsinki, Finland.

Learning Environment as Dialog

Network-based learning relates directly to the concept of learning environments. There are multiple views of a learning environment, each eliciting in our minds different images about teaching, learning and studying. Mononen-Aaltonen (1998) has noted that these are often divided into three categories: learning environments as (i) ecosystems, (ii) places, and as (iii) space. As a novel way of seeing a learning environment, Tella & Mononen-Aaltonen (1998) have suggested that a learning environment should be defined as dialog in its Bakhtinian and Vygotskian sense. In the framework of dialogism (Tella & Mononen-Aaltonen, 1998) and the cultural democracy approach (Appelbaum & Enomoto, 1995), this article argues for dialogic learning environments and dialogic pedagogy. The research focus is based on the concepts of modern media education and social reconstructionism.

Our initial arguments are that

1. Dialog as a learning environment is a social environment, in which knowledge is co-constructed and appropriated.
2. A network-based learning environment is a computer-mediated and technology-enhanced dialog.
3. A prerequisite (or a co-requisite) for empowering NBL environments is the fundamental flexibility of any social environment. An IDLE should be able to enable social interaction between the different communicators.
4. When planning and designing NBL environments, one guiding principle should include the idea of providing the users with structures that they can tailor to best accommodate their own learning needs.
5. Combining NBL environments with undominated dialog contributes to constructing a model of social interaction within an unoppressed and equal study community.

In order to implement these principles, we will have to enlarge the contemporary discussion usually focused on learning into a broader concept of the teaching-studying-learning paradigm (Uljens, 1997) in which theoretical knowledge plays an important role.

The Teaching-Studying-Learning Paradigm

In new electronic environments, the teacher must have a strong and theoretically well justified methodological view of her own. It can be grounded on different theories and conceptions of learning and knowledge, such as constructivism. In the teaching-studying-learning paradigm, we point out the importance of teaching, studying and the emergence of a study community, as demonstrated later in this article.

Admittedly, the teacher will change from a 'sage on the stage' to a 'guide on the side'. In an NBL environment, and in our conception of a dialog, this is not quite enough: the real question is the dual stance (Willis 1995, 14-15) of the learner and the teacher, in which the teacher is still on the center stage as an actor and as a moderator of all activities but at the same time (s)he will be on the side, observing the teaching-learning process with an attentive eye, reviewing the whole situation. The teacher, then, is both an actor and a critic. And so is the student: playing his or her part but also analyzing his or her own studying process at the metacognitive level. The teacher can easily contribute to this process by giving cognitive support, such as scaffolding. Tella (1999, 213) has argued that media educators will need a "media educational" eye in the spirit of Bourdieu's reflexive sociology (Bourdieu & Wacquant, 1992, 248). The question, then, is not only of reciprocity and addressivity between the different actors but also of the changes of the changing roles. One way to express this change is to describe the teacher as the student's cognitive coach and as a motivating and emotional counselor. These will also help her to act as an interpreter of the student's relations with the world. This kind of 'eye' is needed when we think of a dialog as the metaphor of an NBL environment, which contextualizes the process of individual empowerment and raises the awareness of individual actors. This is exactly our link to social reconstructionism and to the cultural democracy approach.

The studying component consists of tools and the context, and the context helps the emergence of a study community, in which, again, different tools, like IDLEs, will be used.

Tools and the Context

In the emergence of a study community, the dual stance of teachers and students will facilitate the adoption of a dialog as a learning environment. In this community, certain tools, media and technologies will be needed to support dialog. At the same time, this community will create an educational context in which these tools will be used.

Tools

Tools can be divided into technological and intellectual ones. While it is necessary to have a fair command of 'technological' tools, it is at least equally important for everyone to cope with intellectual tools. These include methods of creating, organizing, and using information and knowledge. Lin et al. (1995) note the ability to critical and sustained thinking and to reason about important content as well as the ability and motivation to lifelong learning and autonomous study. Rieber's findings (1994; cited in Lin et al. 1995, 59) show that learners' personal discoveries, possibility to explore, feeling of ownership, and construction of knowledge can help optimize not only intrinsic motivation but also learning proper. In this sense, intellectual tools, technological tools, and learning are deeply intertwined and in close interrelationship with one another.

Context

We contend that in addition to the tools component, the TSL paradigm is likely to lead to a new kind of thinking of the learning context, which could best be depicted as an "ideal public space" in the spirit of Habermas (1974). This space is important, as it is the meeting point of all learners at the very heart of the study community. At its best, this thinking leads to contextualism, which, according to Pettigrew (1985; also Poikela 1999, 38), is one of the "world hypotheses", whose mission it is to create order to the chaos. History, time and change are the basic principles of contextualism (Poikela 1999, 38). Therefore, the metaphor of contextualism is a historical event, with a special view to the discussion of the independence of time, place and location, which is often regarded as an intrinsic feature of an IDLE.

Technology can be regarded as context, representing and simulating meaningful real-world problems, situations, beliefs, perspectives, arguments, and stories of others. Technology as context also supports discourse among knowledge-building communities of learners (Jonassen 1995, 62) and could therefore be seen as supportive of our argument of a dialog being the learning environment.

IDLEs (Integrated Distributed Learning Environments)

Above, the dual stance of the teachers and students was derived from the TSL paradigm. At the same time, new emerging study communities will greatly benefit from technological and intellectual tools, as well as from seeing the learning environments as a new context. In our thinking, IDLEs (Integrated Distributed Learning Environments; also called groupware tools) are ideal to be used in the framework of contextualism. IDLEs represent two mainstream cultural theories (see Creswell, 1998, 86-87): first, they represent ideational theories, suggesting that change is a result of mental activities and ideas enabled by language. Second, they represent materialistic theories, holding that material conditions, like resources, money, and modes of production, are prime movers. In IDLEs, we believe, these two theories, merge beneficially. Their use call for mental ideas related to teaching, studying and learning, but they also represent a context or a forum of action, a "center stage", on which different actors interact. What counts from our point of view is that IDLEs can be especially designed for communal modes of inquiry and studying, as in our research project. But once on the "center stage", one needs some principles for "acting" properly. We will discuss these in the following.

The Four Basic Elements of the Dialogic Learning Environment, in relation to IDLEs

In our thinking, the four basic elements of a learning environment are the study community, the zone of proximal development, the We relationship and the dialogic field (Figure 1).

Study Community	**Dialogic Field**
***We* Relationship**	**Zone of Proximal Development**

Figure 1. The basic elements of a learning environment (Mononen-Aaltonen 1998, 195; http://www.helsinki.fi/~tella/montreal4field.html).

In Buber's philosophy, the concept of We is overshadowed by the dominating doctrine of I-Thou, and as a consequence, the We has failed to attract sufficient attention. The Buberian We is animated in the shared speech and finds its beginning when one addresses another on the I-Thou basis. The Buberian We suggests a setting for dialog to realize itself.

It is through a dialogic field that learners discover their ways of thinking, their truths, their belief systems, their fields of vision, which of them they share with others and which are unique to them.

For Vygotsky, the most essential feature of teaching and education is that it creates the zone of proximal development (ZPD). The dynamic movement within the ZPD is a prerequisite for growth and knowledge construction that moves the learner from one stage of development to another. This is done with the help from outside one's mind, with the help of another voice, another mind. Through technological tools, especially when combined with intellectual tools such as cognitive support, coaching, modeling, and scaffolding, we can help elevate learners through their zones of proximal development.

The study community is interpreted in line with Bruner's ideas of the classroom being a subcommunity that specializes in learning among its members-a subcommunity of mutual learning. Mutuality is tangible in the sense that we can feel, notice and see it as well as identify with it.

The Research Project

The Media Education Center of the University of Helsinki has recently launched a research project on dialog, communication and technology in teaching and learning at the university level. The project is carried out in a foreign language methodology research seminar, where the traditional face-to-face mode of studying and learning is complemented with working in an NBL environment by using an IDLE tool called Future Learning Environments (FLE), designed for communal modes of inquiry and studying. The study project is part of the FLE Project, launched in 1998 and co-ordinated by the Medialab of the Helsinki University of Art and Design. The teacher in charge of the research seminar has been Marja Mononen-Aaltonen.

Our aim is two-fold: (i) to create a learning environment that would empower the students to participate in the discourse of educational sciences and to conduct research on foreign language methodology, and (ii) to support each student's research project as a whole within a dialogic frame of reference. We aim at promoting sharing and discussing ideas at all stages of the scientific inquiry process. The research seminar has been chosen for two reasons: First, the students come from other university departments in order to do their teacher education module (one academic year) at the Department of Teacher Education. They start our research seminar only three weeks after they have first entered the world of educational sciences, which is to them a totally new academic culture with its own discourse and traditions, concepts and research problems. Second, the program includes two two-month school placements. The students are expected to continue their research papers also in schools, and complete them by the end of the academic year.

As stated above, our study is based on the notion of a learning environment as dialog in the Bakhtinian and Vygotskian sense. The seminar is conducted in such a way that dialog is likely to become the way to be a seminar member: the way to teach, to study and to learn the culture and the language of the academic community of education, and to participate in its scientific discourse. The study aims at developing general pedagogic principles and teaching practices to support dialog in an academic learning community.

We will now briefly analyze how the four components of the dialogic learning environment (Figure 1) can be worked on as elements of an academic study community.

For instance, when creating the dialogic field, the participants need to be engaged in the dialog from the very first research idea. Then thinking becomes a text and the students as well as the teacher has a 360° field of vision. This might lead to a temporary chaos, which is shown in the unstructured and non-linear nature of the research process.

One more step is to activate the ZPD by making the research process visible and understandable to the learners. More data will be needed, browsed and analyzed during the on-going process than in traditional seminars. Continuous feedback is needed. The target at this stage is *telos*, the cognizance of common and shared educational aims to be achieved through the research project.

At the same time, an interface to the We relationship needs to be created. It means, among other things, that the openness of the relationship becomes an opportunity and a risk. In this process, the teacher's contribution is crucial. However, the teacher needs to remember that participating in a dialog is voluntary, too much control or pushing will destroy the budding dialogic atmosphere.

Research Findings

One of the foci of our research project has been an authentic use of information and communication technologies in the real world and their potential in research-focused teaching in teacher education. The data gathered during the academic year 1998-99 are being analyzed at the moment. Therefore, these findings are preliminary but indicative.

The members of the seminar are interpreted to form a study community. This study community is seen as a 'common obligation' to everybody in the Latin sense of the word: cum (with, together) and munis (duty, obligation), thus, a common obligation, shared by everybody but not imposed on anybody. In this way, the students' minds will be geared towards research and thus the process is more likely to result in a 'minds-on' approach, instead of an earlier more pragmatic hands-on approach. The work is therefore moving from brawn to brain, with a distinctly conceptual character. The many comments by the students indicate that we have succeeded in this.

The support given by an NBL environment to the emergence of a study community and the We relationship is indirect and mediated. In research-focused teaching, NBL appears to be very important as the creator and maintainer of the zone of proximal development and the dialogic field.

We believe that it is through dialog with others that learners discover their ways of thinking, their truths, their belief systems, their visions, all of which they can then share but which will still be unique to them. Their ways of thinking, being, believing and studying open up as a dialogic field. As Bakhtin put it: "What we see can never be what you see, if only because I can see what is behind your head".

Our students participate in a real research project with the aid of an authentic IDLE. From the very beginning, they are aware of belonging to a large research project. They understand that they are not only writing an 'academic piece of paper' but are fully committed to developing a new area of methodology and the tools to be used in it.

The approach we promote also includes a few hazards and threats. The FLE interface consists of each participant's desk, open to everybody else in the same study group. Everybody's documents and other materials are openly accessible by everybody else. Even access to each other's messages is open. In this sense, the FLE functions as a technological and intellectual interface to the We relationship, but, in our case, again in an indirect way: the students knew each other and the teacher before entering the seminar, as they had participated in her other courses before this seminar. The openness of the FLE to all the participants of the seminar with open desks and files is a new opportunity for collaboration and sharing ideas and thoughts. But at the same time the students may find it awkward to go to their co-researchers' desks and open their files. Clearly, more emphasis should be laid on the personality characteristics of learners who find it valuable to use these emerging technologies, such as the IDLEs. We simply refer to Dede's argument (1995, 47) that there might exist a whole new dimension of learning styles orthogonal to the visual/auditory/kinesthetic/symbolic categories now underlying pedagogical approaches to individualization.

One of our conclusions is that the metaphor of a desk is not appropriate; rather, we should speak of a public space, like a virtual library, in which everybody can browse through the documents. If the concept of virtuality represents cultures based on the logical rather than the physical (as argued by Agres, Edberg & Igbaria 1998, 72), it seems that ours is one of the cases in which bringing reality into the virtual world might encounter some unexpected barriers at the conceptual level of the learners.

Lin et al. (1995, 54; as reported in Tella 1997) argue that social considerations belong to the second wave of the cognitive revolution, focusing attention on the social contexts of learning that have pervasive cognitive and motivational effects, while the first wave mainly dealt with individual thinkers and learners, deemphasizing affect, context, culture, and history. In this light, the use of a groupware tool such as FLE is most likely to amplify the relations between the teacher and the students, and between the students themselves, and finally helping construct a study community, in which the second wave cognition and motivation prove indispensable. We would argue that a traditional research seminar is much more likely to point out the first wave emphases, i.e., individual work done without any real co-construction of knowledge.

The teacher's role seems to prove most crucial in creating a dialogic learning environment in the context of FLE. It is the teacher who either creates the We relationship or destroys the opportunity to establish any relationships on a dialogic basis. The teacher's role becomes even more important in creating and maintaining successful mediated learning experiences. Importantly, an IDLE may open up the chaotic and non-linear character of almost any research process, but at the same time it helps to give order to this chaos. In the final analysis, then, the mediated learning experience consists of the individual empowerment properly contextualized within the virtual working concept of a study community, and inducive to fostering a better comprehension of individual participation in a mutually shared research project.

References

Agres, C., Edberg, D. & Igbaria, M. (1998). Transformation to Virtual Societies: Forces and Issues. The Information Society: *An International Journal* 14 (2), 71-82.

Appelbaum, P. M. & Enomoto, E. K. (1995). Computer-Mediated Communication for a Multicultural Experience. *Educational Technology*/November-December, 49-58.

Bourdieu, P. & Wacquant, L. J. D. (1992). *An invitation to Reflexive Sociology*. Chicago: Polity Press.

Creswell, J. W. (1998). *Qualitative Inquiry and Research Design: Choosing Among Five Traditions*. Thousand Oaks: SAGE.

Dede, C. (1995). The Evolution of Constructivist Learning Environments: Immersion in Distributed, Virtual Worlds. *Educational Technology*/September-October, 46-52.

Habermas, J. (1974). The public sphere. *New German Critique* 3.

Jonassen, D. H. (1995). Supporting Communities of Learners with Technology: A Vision for Integrating Technology with Learning in Schools. *Educational Technology*/July-August, 60-63.

Lin, X., Bransford, J. D., Hmelo, C. E., Kantor, R. J., Hickey, D. T., Secules, T., Petrosino, A. J., Goldman, S. R. & The Cognition and Technology Group at Vanderbilt. (1995). Instructional Design and Development of Learning Communities. *Educational Technology*(September-October, 53-63.

Mononen-Aaltonen, M. (1998). *A Learning Environment-A Euphemism for Instruction or a Potential for Dialogue?* In Tella, S. (ed.) Aspects of Media Education: Strategic Imperatives in the Information Age. Media Education Centre. Department of Teacher Education. University of Helsinki. Media Education Publications 8, 163-217.[http://www.helsinki.fi/~mononena/mmamep8.pdf]

Pettigrew, A. M. (1985). *Contextualist Research: A Natural Way to Link Theory and Practice*. In Lawler, A., Mohrman, S., Ledjord & Gummings (eds.) Doing Research That is Useful for Theory and Practice. San Francisco, 222-274.

Poikela, Esa (1999). *Kontekstuaalinen oppiminen: Oppimisen organisoituminen ja vaikuttava koulutus.* (Contextual Learning: Organizing Learning and Impressive Training.) University of Tampere. Acta Universitatis Tamperensis 675. (In Finnish)

Rieber, L. P. (1994). *An instructional design philosophy of interaction based on a blending of microworlds, simulations, and games.* Paper presented at the annual meeting of the Association for Educational Communication and Technology, Nashville.

Tella, S. & Mononen-Aaltonen, M. (1998a). *Developing Dialogic Communication Culture in Media Education: Integrating Dialogism and Technology.* University of Helsinki. Department of Teacher Education. Media Education Centre. Media Education Publications 7. [http://www.helsinki.fi/~tella/mep7.html]

Tella, S. (1997). *An 'Uneasy Alliance' of Media Education and Multiculturalism, with a View to Foreign Language Learning Methodology.* University of Helsinki. Department of Teacher Education. OLE Publications 4. [http://www.helsinki.fi/~tella/ole4preface.html]

Tella, S. (1999). Mediakasvatus – aikamme arvoinen. (Media education for our times.) *Kasvatus* 30 (3), 205-221. (In Finnish)

Uljens, M. (1997). *School Didactics and Learning.* Hove, East Sussex: Psychology Press.

Vygotsky, L. S. (1978). *Mind in Society. The Development of Higher Psychological Processes.* (Edited by Cole, M. et al.) Cambridge, MA: Harvard University Press.

Willis, J. A. (1995). Recursive, Reflective Instructional Design Model Based on Constructivist-Interpretivist Theory. *Educational Technology*/November-December 5-23.

Educational Multimedia Systems for Students with Autism

David Moore, Paul McGrath, John Thorpe, School of Computing, Leeds Metropolitan University, Leeds LS6 3QS, UK. Email: **d.moore@lmu.ac.uk**

Abstract Educational multimedia systems have a potentially important role to play in the education of students with autism. This potential has thus far, however, been largely unexplored. This paper therefore makes a case for the use of multimedia systems for such students, and reviews the current state of the field. It will be argued that a fruitful way of furthering research and development in this area is to develop systems that directly address autism-specific impairments. Proposals for multimedia systems for each of these areas will be put forward, and our current development work outlined.

Introduction – A case for Multimedia Systems for Students with Autism

A commonly held view of the nature of autism is that it involves a "triad of impairments" (Wing 1996). There is a social impairment: the person with autism finds it hard to relate to other people. Secondly, there is a communication impairment: the person with autism finds it hard to understand and use verbal and non-verbal communication. Finally, there is a tendency to rigidity and inflexibility in thinking, language and behaviour. Much current thinking is that this triad is underpinned by a "theory of mind deficit" – people with autism may have a difficulty in understanding mental states and in ascribing them to themselves or to others.

Why might it be thought that multimedia systems could be beneficial in the context of the education of students with autism? First, it has been argued that many people with autism have a natural affinity with computers (Murray 1997) and that pupils with autism tend to enjoy using computers (Swettenham 1992). Indeed, Jordan (1991) has suggested of children with autism that ".. it is often valuable to view their thinking and learning as analogous to computers - you only get out what you put in". Concerning multimedia in particular, it is well known that children with autism are attracted to visual images (Virart 1997) and since it is thought that individuals with autism may not have 3D vision (Grandin 1995) then the world of the flat screen may be more acceptable and less frightening than the real world. Multimedia systems may be beneficial in that they can eliminate the need for reading in order to engage in computer aided learning (CAL) activities (Iacono and Miller 1989) and Murray (1997) suggests that through computer use the student with autism may in fact become motivated to read.

A further advantage is that the computer presents a relatively controlled environment and can eliminate many distractions of the normal classroom (Green 1993); attempting to reduce potentially disturbing stimuli is in line with the "SPELL" approach to teaching (Siddles et al 1997). A further benefit concerns the individualised, one to one tutoring that may be made possible by interactive multimedia systems. Such a teaching mode is often seen as important for students with autism. Peeters (1995), for example, talks of the "unbelievable luxury of individual attention" and Higgins and Boone (1996) see individualisation as "key to appropriate instruction" for students with autism.

Existing Multimedia Systems for Students with Autism

There appears, then, great potential for beneficial multimedia systems for students with autism. And there is a growing body of such applications. Tjus et al (1998) use multimedia for teaching literacy to pupils with autism, allowing the student to construct a sentence in text and receive "immediate multi-channel feedback". Anthony (1992) discusses a non-oral approach for teaching communication skills to severely handicapped "autistic-like" students. The approach involves "picture communication", using dedicated communication devices that can be programmed to reflect the daily activities and choices in the classroom. Anthony claims that the results of the approach include reductions in "non-social behaviours" and increased verbal interactions.

In a related approach, Arora and Goodenough-Trepagnier (1989) adopt a game show format in their visual communication systems. Another system adopting a games-based approach is "Danny's Rooms". This is a "recreational multimedia application for the autistic population" (Eddon 1992) with seven games, such as a photograph game invoking spoken messages from on-screen photographs of the family and the rooms game in which the user is required to navigate a series of increasingly complex rooms. Another room-based application is "AVATAR" (Enyon 1997), in which the user activates objects in the room which respond with an appropriate sound effect, with the word in writing and in Makaton and with the word spoken.

More generally, Higgins and Boone (1996) have provided a set of software design guidelines for use with CAL systems for people with autism, and a group, ASILeSP (Autism Specific Interactive Learning Software Packages) has been set up to look specifically at "effective ways to use technology to empower and to support individuals with autism".

Despite this potential, however, the field remains relatively unexplored. Higgins and Boone see educators as in a position only to "*begin to explore* the possibilities of the new technologies for students with autism" (Higgins and Boone 1996, emphasis added), and the British National Autistic Society (NAS) points to ".... a general lack of computer programs which have been written specifically for children with autism" (NAS 1996). Similarly, Eddon (1992) points to a "void in recreational computer applications for the autistic population" and Enyon (1997) claims a "growing need voiced by parents and professionals for specially developed computer programs".

A Proposal for Research and Development

Given that there is a compelling case for educational multimedia systems for students with autism and that the field is thus far largely un-researched, an important issue concerns delineating areas that might usefully be addressed by such systems. The priority should be, we argue, to develop interactive systems specifically aimed at the core autistic deficiencies. We argue for this in detail elsewhere (Moore et al 2000) but essentially our argument is that such a prioritisation is in line with current pedagogic theory relating to autism. For example, Jordan argues: "of course, it will be a teaching priority to enable the pupil to improve interpersonal and communication skills" (Jordan 1992a).

The importance of targeting autism-specific issues is given greater urgency by the fact that the limited provision of existing software designed for users with autism tends not to directly address the autistic condition as such. Eddon (1992), for example, points out that many applications relate to basic skills such as knowledge of the alphabet, and that these are less appealing to older children who might be slighted by their childish nature. Even Eddon's own Danny's rooms itself, though, seems not to be directly targeted at the autistic condition per se, in that navigating rooms or invoking sounds from farm animals is intuitively unlikely to help autism specific concerns such as a lack of social skills. More generally, Trehin (1996) argues that the attempt to act on "one or several specific deficiencies encountered in autism" is "only in its infancy". This is not of course to deny the worth of the work outlined earlier, far from it, but merely to argue for an urgent need for programs targeted directly at the difficulties characterising the autistic condition.

In the remainder of the paper, therefore, we will consider means by which these difficulties might be addressed by multimedia systems.

Social Skills Education

Direct teaching of social skills to students with autism is widely advocated (e.g. Jordan 1991). Multimedia systems with varying levels of interactivity can be developed to assist in this endeavour. The lowest level of interactivity would involve simply *observing* social events. Even this may be educationally useful. Jordan (1992b) suggests that pupils with autism should be able to observe how non-autistic children play with each other. Jordan points out that the "pupils' observations need to be directed to salient points", and this can be aided by multimedia systems in that they can be paused, speeded up and repeated endlessly, and graphics and animations can be overlaid to highlight the crucial points. Further, the multimedia facilities provide a readily re-usable resource, which may be important in specialist settings where opportunities to observe play may be sparse (Jordan 1992b). This facility can be further enhanced by creating examples of "good" and "bad" social interactions, asking the user to pick out sub-optimal interactions, and allowing the user to invoke displays of the motives and thoughts of the various participants, in the manner of "bubble dialogues" (O'Neill and McMahon 1991).

A higher degree of interactivity can be created in simulated role play activities. Role-play (which may include the use of video) is used to teach social skills to adults and children with autism (e.g. Yates 1993), and simulated versions can be built. Interactive video disks for management training have been available for some time. Social scenarios are introduced and a number of alternatives offered to the user; the user's choice invokes further video and further decision points, so that the user is branched through at least some of the on-line material in line with their answers. Similar work has been carried out in connection with more general social skills (Iacono and Miller 1989).

Much of our current development work is centred around building simulations of a similar kind, involving contexts likely to be found particularly problematic by people with autism, such as the school lunch hour (Cumine et al 1998). As an example, one of our prototypes presents the student with a video clip depicting a dining room queue and asks where the queue should be joined. Different clips of video are then shown, consequent upon the selection made, before the system moves onto other aspects of dining room protocol such as choosing an appropriate place to sit. Evaluation of interactive systems for students with autism is, we argue, particularly problematic (Moore et al 2000), but preliminary formative evaluation of the system has proved very encouraging

To some extent such work involves creating on-line versions of existing practice, and it might be argued that such an approach may diminish the impact of the technology and that it would be better to go beyond what can be done in conventional methods (cf. Green 1990). However, the computer-based simulations do offer the advantages of interactivity, of being repeatable and of offering "safe" experimentation with ideas. Further, they are readily adaptable in that, for example, text can be turned on and off depending on the perceived needs of the user.

Communication Skills Education

Here we follow Iacono and Miller's (1989) suggestion that individuals with poor communication skills "may stand to gain most from computer applications specifically designed to teach or enhance communication skills".

At the level of the individual word, talking word processors may be useful (NCIP 1995). There has been considerable work in automating symbol systems for speech and hearing-impaired people (Sale and Carey 1995, Anthony 1992) and systems such as Makaton are frequently used by people with autism (e.g. Rutherford 1996). At the semantic and syntactic levels, drill and practice may be valuable, e.g. Iacono and Miller (1989) suggest using drill and practice for initial teaching of, for example, verbs, following which "the verbs can be utilised in computer games, exploratory play and simulations of fantasy then real life".

At the pragmatic level, Iacono and Miller (1989) suggest computer or video simulations as a way of encouraging communication. Concerning non-verbal communication, Yates (1993) advocates video for the teaching of body language, and video tapes of differing facial expressions are already used, as are graphically based face games (Jordan 1992b, Yates 1993). Tantam (1993), however, suggests that "systematic training of emotional expressiveness has never been carried out in people with autism" and interactive systems may have an important role here.

Our current prototypes in this area seek to address non-verbal communication by requiring users to identify facial expressions and body language. Users are presented with examples, via a mixture of line drawings, on-line still photographs and videos, and asked to identify the likely messages being given. They are then offered explanations and further examples, dependent upon their progress to date. Preliminary formative evaluation results are again very encouraging. A range of similar scenarios can be created, such that the series of interactions a user might engage in becomes of a drill and practice nature. Drill and practice may be unlikely to generate a deep understanding of the relevant concepts, but may at least enable the associating of, for example, expressions with emotions, which may be very helpful: "[people with autism] will not ... directly perceive someone's joy or despair, although they can come to 'work out' how certain facial expressions and behaviours are associated with certain given labels such as 'sad' or 'happy'" (Powell and Jordan 1997).

Rigidity of Thought

This impairment can generate a number of learning difficulties. Many of these may be amenable to assistance from multimedia systems. The problem of lack of imagination (Green 1990) and lack of creativity and spontaneity (Jordan 1993) may be helped by simulation, by the interactivity and animation of multimedia as opposed to paper based material and by being able to create one's own multimedia. One approach to the difficulty of restricted play is to encourage role-play (Jordan 1993), and multimedia simulations may help here. "Difficulties in sequencing a prediction" (Simmonds 1993) can be helped by multimedia simulations, for example the sequences in a plant's life cycle may be understood more readily if speeded up in a simulation. The adverse affect of rigidity of thought on problem solving (Simmonds 1993) can be addressed by the sort of problem driven interaction to which CAL is well suited.

The autistic tendency to "tunnel vision" (Jordan 1993) and difficulties with enquiry (Simmonds 1993) may be helped by hypermedia systems. A student with autism may have a major interest in a narrow topic area, such as deltic trains (Attwood 1998). A hypermedia page about deltic trains could have links from the initial page to (say) the workings of a diesel engine, and from there into topics from general physics. The student may therefore be encouraged to take a wider perspective.

A further problem caused by rigidity of thought is "difficulties in accepting the essentially open-minded attitude that is a feature of scientific enquiry" (Jordan 1992b). Clearly it is essential, with students with autism and indeed all students, to seek to produce individuals who can think for themselves. Computer programs have been developed to help teach critical thinking skills (Jordan and Powell 1990) and our current research in multimedia-based argumentation systems (Moore 2000) may have a role to play here.

Multimedia to Address the "Other Minds Deficiency"

It has been postulated that people with autism have a cognitive deficit in the development of a "theory of mind" (Swettenham 1996). People with autism, it is held, do not understand mental states and cannot ascribe them either to themselves or to others. They do not understand what people are thinking or feeling or even *that* people are thinking and feeling (Jordan 1993).

Again, multimedia is a potentially powerful teaching medium. Simulations involving predicting people's emotions in and reactions to different situations can be developed. People with autism may for example hit other people without realising it hurts, may stare at people without realising it may make them uncomfortable (Carlton 1993), and such scenarios can readily be modelled in interactive multimedia. One of our current prototypes, for example, plays a number of videos of youngsters interacting in different ways, e.g. stealing sweets from each other or helping each other out. It then asks the user to suggest how the participants in the video might be feeling; this is a preliminary attempt at using multimedia to address the concern of a possible lack of empathy. Tantam (1993) argues that people with autism, "like people who are not autistic, modify their behaviour according to its predicted result" and the use of such simulations may help increase the accuracy of the predictions.

A different but related approach, is to use "bubble dialogues" (O'Neill and McMahon 1991). The essential idea here is that dialogue participants are provided with an on-screen character, in strip cartoon format, together with a "say bubble" and "thought bubble" for their character. Participants participate in dialogue by typing their contributions into the say bubble, and their private reflections into the thought bubble. In all this the aim is to encourage ascription to others of thoughts, emotions, motives and intentionality, in line with claims that, for example, pupils with autism need to be "specifically taught that others have points of view" (Jordan 1991). The ability of students with autism to understand thought bubbles is controversial, but Parsons and Mitchell (1999) argue that "at least some children with autism are capable of understanding thought bubbles as a representational device". Further, there is some evidence of the successful use of bubble dialogues with children with autism (McMahon 1999, Rajendran and Mitchell 2000).

Summary and Further Work

This paper has given a brief overview of our on-going research and development work concerning multimedia for students with autism. Many important research issues are raised and are being investigated (cf. Moore et al 2000). Chief among these are how best, if at all, to utilise the apparent attraction of computer *games*, ways of catering for student differences and deciding a suitable evaluative regime. A particular concern, perhaps, is the danger than computer-based work may itself become a dominant interest of the user with autism and thus fail to ease, or perhaps even exacerbate, the autistic condition. The answer to this, we argue, lies in the successful integration of computer-based work with other aspects of educational provision. How best to manage this integration is an important research question.

Much remains to be done, therefore, but the potential benefits are great. Murray (1997) argues, concerning the education of students with autism, that "the auto didactic possibilities are endless". The hope is that the research discussed in this paper will contribute in some measure to the achievement of these possibilities.

References

Anthony A (1992) Non-Oral Language Approaches for Autistic-Like Students; in Murphy H J (ed.) *Proceedings of the Seventh Annual Conference "Technology and Persons with Disabilities"*, Los Angeles 1992

Arora A, Goodenough-Trepagnier C (1989) Feasibility of VIC for Students with Language Impairments Associated with Autism; *Resna 12th Annual Conference* 9 424-425

Attwood T (1998) *Asperger Syndrome, A Guide for Parents and Professionals*; Jessica Kingsley

Carlton S (1993) *The Other Side of Autism*. Self Publishing Association Ltd.

Cumine V, Leach J, and Stevenson G (1998) *Asperger Syndrome: A Practical Guide for Teachers*. David Fulton

Eddon G (1992) Danny's Rooms; in *Proceedings of the John Hopkins National Search for Computing Applications to Assist Persons with Disabilities*; IEEE Computing Society Press 78-79

Enyon A (1997) Computer Interaction: An Update on the AVATAR Program; in *Communication* Summer 1997 18

Grandin T (1995) *Thinking in Pictures and Other Reports from my Life with Autism*; Doubleday

Green S J (1993) Computer-Based Simulations in the Education and Assessment of Autistic Children; in *Rethinking the Roles of Technology in Education, Tenth International Conference on Technology and Education*, Massachusetts Institute of Technology, March 1993, Volume 1 334-336

Green S J (1990) *A Study of the Application of Microcomputers to Aid Language Development in Children with Autism and Related Communication Difficulties*. PhD Thesis, Sunderland Polytechnic

Higgins K and Boone R (1996) Creating Individualised Computer-Assisted Instruction for Students with Autism Using Multimedia Authoring Software; in *Focus on Autism and Other Developmental Disabilities* 11, 2, summer 1996 69-78

Iacono T A and Miller J F (1989) Can Microcomputers be used to Teach Communication Skills to Students with Mental Retardation? *Education and Training of the Mentally Retarded*, 22, 1, 32-44

Jordan R (1991) *The National Curriculum: Access for Children with Autism. 1. The Special Educational Needs of Pupils with Autism;* Inge Wakehurst Trust

Jordan R (1992a) *The National Curriculum: Access for Children with Autism. 3. Mathematics;* Inge Wakehurst Trust

Jordan R (1992b) *The National Curriculum: Access for Children with Autism. 4. Science;* Inge Wakehurst Trust

Jordan R (1993) The Special Educational Needs of Children with Asperger Syndrome; in *Children with Asperger Syndrome*; Inge Wakehurst Trust, 276 Willesden Lane, London NW2 5RB

Jordan R and Powell S (1990) Improving Thinking in Autistic Children Using Computer Presented Activities; *Communication* 24, 1, 23-25

McMahon H (1999) *Bubble Dialogue for Literacy, Learning, and Life Skills*; http://bestpraceduc.org/Technology/HarryMcMahonPractice.html [accessed May 10 1999]

Moore DJ, McGrath P, Thorpe J (2000) Computer Aided Learning For People With Autism - A Framework for Research and Development. *Innovations in Education and Training International* 37(3) (in press)

Moore D (2000) "A Framework for Using Multimedia within Argumentation Systems" *Journal of Educational Multimedia and Hypermedia* (in press)

Murray D K C (1997) Autism and information technology: therapy with computers; in Powell S and Jordan R (eds.) *Autism and Learning: A Guide to Good Practice*; David Fulton (1997)
NAS (1996) *Autism: The Invisible Children? An Agenda for Action*; NAS, London
NCIP (1995) National Centre to Improve Practice in Special Education - Using an Expanded Keyboard to Help Students with Autism Learn to Write; http://www.edc.org/FSC/NCIP/EC_ExpandedKeyboard.html [accessed June 3 1997]
O'Neill B, McMahon H (1991) Opening New Windows with Bubble Dialogues; in *Computers and Education*, 17, 1, 29 - 35
Parsons S and Mitchell P (1999) What children with autism understand about thoughts and thought bubbles. *autism* 3 (1) 17-38
Peeters T (1995) The Best Treatment for Behaviour Problems is Prevention; in *Communication* Winter 1995 29-30
Powell S and Jordan R (1997) Rationale for the approach. In Powell S and Jordan R eds. (1997) *Autism and Learning - A Guide to Good Practice*; David Fulton
Rajendran G & Mitchell P (2000) Computer mediated interaction in Asperger's syndrome: the Bubble Dialogue Program. Unpublished manuscript, School of Psychology, University of Nottingham, UK.
Rutherford M (1996) Michael's 160 Symbols; *Communication* Summer 1996 13-16
Sale P and Carey D M (1995) Strategies for Infusion of Assistive Technology for Students with Severe Disabilities in Regular Education Classrooms; in *Proceedings of the 12th International Conference on Technology and Education* 53-55
Siddles R, Mills R, Collins M (1997) SPELL - the National Autistic Society Approach to Education; in *Communication* Spring 1997 8-9
Simmonds C (1993) The Asperger Student in a Mainstream Setting; in *Children with Asperger Syndrome;* Inge Wakehurst Trust, 276 Willesden Lane, London NW2 5RB
Swettenham J G (1992) The autistic child's theory of mind: a computer based investigation; Unpublished thesis, University of York
Swettenham J (1996) Can Children with Autism be Taught to Understand False Belief Using Computers? *Journal of Child Psychology and Psychiatry* 37 (2) 157-165
Tantam D (1993) *A Mind of One's Own*; National Autistic Society
Tjus T, Heimann M, Nelson K E (1998) Gains in Literacy Through the use of a Specially Developed Multimedia Computer Strategy; in *autism* 2(2) 139-156
Trehin P (1996) *Computer Technology and Autism;* http://web.syr.edu/~jmwobus/autism/link.htm [accessed May 10 1998]
Virart (1997) *Avatar Software*; http://quoll.maneng.nott.ac.uk/Research/virart/educn/autism.htm [accessed September 11 1998]
Wing L (1996) *Autism Spectrum Disorders*; Constable
Yates P (1993) Social Skills Training; in *Children with Asperger Syndrome*; Inge Wakehurst Trust, 276 Willesden Lane, London NW2 5RB

Life-Like Pedagogical Agents in Constructivist Multimedia Environments: Cognitive Consequences of their Interaction

Roxana Moreno
Psychology Department
University of California
Santa Barbara, CA 93106
moreno@ psych.ucsb.edu

Richard E. Mayer
Psychology Department
University of California
Santa Barbara, CA 93106
mayer@ psych.ucsb.edu

James C. Lester
Department of Computer Science
North Carolina State University
Raleigh, NC 27695-8206
lester@eos.ncsu.edu

Abstract: The goal of this study is to test the hypothesis that animated pedagogical agents can promote constructivist learning in a discovery-based learning environment. We do this by first, comparing the learning outcomes of students who learn in the context of social interaction with a computer-mediated character with the learning outcomes of students who learn in a computer text context. Second, we focus on the relative contributions of pedagogical agents' image, voice, and language style in promoting deeper learning.

The Case for Software Pedagogical Agents

Discovery-based learning environments are intended to facilitate constructivist learning through creative problem-solving experiences. However, the characteristics of discovery-based environments which offer the greatest potential for fostering learning also pose the greatest challenge: the complexity of the learning experience, based on the learner's freedom to explore and design artifacts in microworlds, constantly threatens to overwhelm learners. To combat this complexity, discovery-based learning environments should provide scaffolding in the form of highly contextualized problem-solving advice that is customized to each learner. Perhaps the most intriguing vehicle for providing such dynamically individualized scaffolding is the emerging technology of animated pedagogical agents--lifelike on-screen characters who provide contextualized advice and feedback throughout a learning episode (Lester & Stone 1997, Lester et al. 1997).

A Life-Like Pedagogical Agent Example

The discovery-based learning environment used in this study is a microworld called "Design-A-Plant", developed by the Multimedia Laboratory at the Department of Computer Science of North Carolina State University (Lester & Stone 1997, Lester et al. 1997). In this program, the student travels to an alien planet that has certain environmental conditions (e.g., low rainfall, light sunlight) and must design a plant that would flourish there (e.g., including designing the characteristics of the leaves, stem, and roots). It includes an animated pedagogic agent called Herman--a lovable alien with appealing facial expressions, human-like movements, and an amusing voice, who offers individualized advice concerning the relation between plant features and environmental features, encouragement when students encounter difficulties, and feedback on the choices that students make in the process of designing plants. Herman's actions are dynamically selected and assembled by a behavior sequencing engine that guides the presentation of problem-solving advice to learners, as described more fully in Lester et al. (1997). The program starts with Herman introducing the student to the first set of environmental conditions. Then, he asks the student to choose the appropriate root from the library of roots' names and graphics shown on the computer screen. After the student had chosen a root, Herman gives two explanations: first, a narrated explanation, and second a QuickTime movie that contains a similar explanation for the correct root. The same procedure applies to the stem and leaves, with Herman first asking the student to make a choice, and giving the student feedback afterwards. Once the student was given the last explanation on the leaves for each environment, he is taken to the next environment. The same procedure follows for the rest of the environments.

Issue 1: Agent versus Text-Based Environments

Does learning with an animated pedagogical agent in a discovery environment promote constructivist learning? In order to help answer this question, we conducted a preliminary study where the learning outcomes of students who learned about environmental science in the Design-A-Plant microworld (personal agent or PA group) was compared with the learning outcomes of students who received the identical verbal and visual materials in a computer-based text environment (no personal agent or no-PA group).

Method and Results

The participants were 44 college students from the Psychology Subject Pool at the University of California, Santa Barbara. Twenty-four participants served in the no-PA group and twenty participants served in the PA group. The computerized materials consisted of two multimedia computer programs on how to design a plant. The PA version was the original multimedia program called "Design-a-Plant", where students see a library of plant parts, pick the plant part that they consider appropriate for the respective environment, and receive spoken feedback in a conversational style from the agent (Lester & Stone 1997, Lester et al. 1997). The no-PA version was presented with the same library plant parts and explanations than the PA version, but Herman's image was deleted. In addition, students in the no-PA version were not allowed to design the plant before reading the verbal explanations, but rather received the explanation directly in a monologue style, similar to when science material is read from a text book.

The participants were randomly assigned to a treatment group and seated at an individual cubicle in front of a computer. First, students were given a questionnaire, which solicited participant's demographic information. Second, the respective version of the multimedia program was presented. After the respective program was over, participants were tested on three important measures of learning: retention--in which we assessed memory for the basic factual information that was presented; problem-solving transfer--in which we asked students to solve new problems based on the principles learned in the respective program; and motivation and interest--in which we asked students to rate their level of motivation, interest, understanding, and the perceived difficulty and friendliness of the lesson. We determined whether the groups differed on measures of retention, transfer, and self-ratings.

Do students who learned interactively with a pedagogical agent show deeper understanding from a multimedia science lesson than students who learned in a conventional environment?

Students in the PA and no-PA groups received identical factual information consisting of the same verbal and visual materials. As a retention test, we simply asked students to name as many types of roots, stems, and leaves as they could--highly relevant information that was prominently displayed in both instructional programs. The mean number of correctly recalled items by the PA group was not significantly different than the mean number of correctly recalled items by the no-PA group. The results suggest that when retention of factual information is the goal of instruction, then environments, which allow for interacting with an animated pedagogical agent are not warranted. Although these results demonstrate that both groups learned the basic factual information, the major prediction in this study is that students in the PA group will learn more deeply than no-PA students. As predicted, students in the PA group produced significantly more correct solutions on transfer problems than students in the no-PA group ($\underline{p} < .005$).

The foregoing results are consistent with the idea that students who learn with animated pedagogic agents work harder to make sense of the material than do students who learn in a more conventional text-based environment. Another way to test this idea is to assess students' motivation to continue learning and their interest in the material, so we predicted that the PA group would produce a higher mean program rating than the no-PA group. As predicted, the PA group rated their motivation to continue learning and their interest in the material significantly higher than the no-PA group ($\underline{p} < .01$).

Conclusion

This preliminary study contributes to multimedia learning theory (Mayer 1997) by comparing the cognitive consequences of students' experience with or without the aid of a pedagogical agent. Students in both groups received identical verbal and visual material presented in the context of social interaction with a computer-mediated character (PA group) or in an non-personalized text context (no-PA group). These findings give preliminary evidence in favor of using pedagogical agents as software mentors, and demonstrate a *personal-agent effect* in multimedia learning environments: Students are more motivated, interested, and achieve better transfer when the lesson is imparted by a pedagogic agent rather than by on-screen non-personalized text.

How do agents affect student learning? Reeves and Nass (1996) have provided convincing evidence that students view their contact with computer-based characters as social interactions. Congruent with this approach, students' learning with the pedagogical agent could have been promoted by at least three social-cues: the pedagogical agents' image, voice, and personalized language style. Therefore, we investigated first, the role of pedagogical agents' auditory and visual presence in a discovery-based computer lesson. For this purpose, we varied whether the agent's words were presented as speech or on-screen text and whether or not the agent's image appeared on the screen, both with an animated fictional agent (Experiment 1), and a video of a human face (Experiment 2). Second, we investigated the role of the agents' language style in the computer lesson. For this purpose we varied whether or not the agent's words were presented in conversational style (i. e. as dialogue or monologue) both using speech (Experiment 3), and on-screen text (Experiment 4).

Issue 2: The Role of Life-Like Pedagogical Agents' Visual and Auditory Presence

We tested the predictions arising from two opposing hypothesis: the social-cue hypothesis, and the cognitive load hypothesis. According to the former, students communicate better, become more interested, and therefore learn better and rate more favorably computer lessons that include social cues--such as facial expressions or human voices, than those which do not include social cues (Dewey 1913, Rutter 1984). Three predictions can be made for students who learn a multimedia lesson with the image of an agent. First, they will be more likely to remember the materials of the lesson than students who are not provided with the visual presence of the agent; this we call an image effect on retention. Second, they will be more likely to use what they have learned to solve problems than students who are not provided with the visual presence of the agent; this we call an image effect on transfer. Third, they will rate the lesson more favorably as expressed in the program ratings than students who are not provided with the visual presence of the agent; this we call an image effect on program rating. In contrast, according to a cognitive load of learning (Chandler & Sweller 1991, Moreno & Mayer in press, Sweller 1989), the inclusion of irrelevant adjuncts in a science lesson will divert the limited cognitive resources available for the processing of the relevant materials of the lesson. As a result, learning and problem solving will be impaired.

An additional goal of the present study was to investigate the role of pedagogical agents' auditory presence in a constructivist multimedia lesson. We investigated if prior findings on modality effects in learning--where students learn better from visual and verbal presentations when the verbal information is presented as speech rather than as on-screen text, extend to discovery-based multimedia environments (Mayer & Moreno 1998, Moreno & Mayer 1999, Mousavi, Low, & Sweller 1995). Congruent with past research on modality effects in multimedia learning, two predictions can be made. First, students who learn with the voice of an agent will be more likely to remember the materials of the lesson than students who learn the same verbal materials as on-screen text; this we call a modality effect on retention. Second, students who learn with the voice of an agent will be more likely to use what they have learned to solve problems than students who learn the same verbal materials as on-screen text; this we call a modality effect on transfer. An additional prediction was made based on the social-cue hypothesis (Dewey 1913). Students who learn with the voice of an agent will be more motivated and will rate the lesson more favorably than students who learn the same verbal materials as on-screen text; this we call a modality effect on program rating.

Method and Results

In the first study, 17 students learned by interacting with the image of a life-like fictional agent who spoke to them (Group IN), 16 students learned by interacting without the image of an agent who spoke to them (Group -IN); 15 students learned by interacting with the image of a life-like fictional agent who gave explanations as on-screen text (Group IT); and 16 students learned by interacting without the image of an agent who gave explanations as on-screen text (Group -IT). The second study was identical but the video and voice of a human agent replaced the fictional agent. Nineteen students participated in the IN group, 20 students participated in the -IN group, 19 students participated in the IT group, and 21 students participated in the -IT group. The procedure was identical to that of the preliminary study.

Do students who are presented with the image of a pedagogical agent show deeper understanding from a multimedia science lesson than students who are not presented with the image ?

The findings from Experiments 1 and 2 did not provide evidence in favor or against presenting students with the image of a pedagogical agent, failing to confirm what we have called an *image effect* in program ratings, recall, and transfer: Students who are presented with the image of an agent do not rate the lesson more favorable, recall more, or are better able to use what they have learned to solve problems than students who are not presented with the visual presence of the agent.

Do students who communicate with a pedagogical agent via speech show deeper understanding from a multimedia science lesson than students who communicate with a pedagogical agent via on-screen text?

The findings from Experiments 1 and 2 gave evidence in favor of students' communicating with a pedagogical agent by means of speech by demonstrating what we have called a *modality effect* in program ratings, recall, and transfer: Students who learn with the voice of an agent rate the lesson more favorably, recall more, and are better able to use what they have learned to solve problems than students who learn the same verbal materials as on-screen text. In both experiments, the mean program ratings for the narration groups was significantly higher than the mean program ratings for the text groups ($p < 0.05$ for both experiments); the narration groups recalled significantly more than the text groups ($p < .005$ and $p < 0.005$ for Experiments 1 and 2, respectively); and the narration groups gave significantly more correct answers in the transfer tests than the text groups ($p < .0005$ and $p = .0001$ for Experiments 1 and 2, respectively). These results extend the modality effect in learning from visual and verbal materials to discovery-based multimedia environments and confirm the social-cue prediction according to which students are more motivated and interested in programs, which communicate via speech.

Issue 3: The Role of Life-Like Pedagogical Agents' Language Style

Regarding the language style used by the pedagogical agent, we tested the opposing predictions from the transmission hypothesis and the conversational hypothesis. According to the former, human communication involves encoding an idea into a signal by a sender, transmitting the signal to the receiver, and decoding the signal by the receiver (Reddy 1979). Consequently, as the content material is identical when the language style is changed from a dialogue style to a monologue style, it should not affect students' learning. In contrast, the conversational hypothesis views communication as inherently cooperative and claims that a uni-directional model of communication such as the one supported by the transmission hypothesis, fails to capture the social and individual processes involved in knowledge construction through conversations (Brennan 1990).. This hypothesis predicts that students will learn deeper from instructional conversations rather than from non-personalized monologue-style communications.

Method and Results

In the third study, 18 students learned with a personalized conversation spoken by the human agent used in Experiments 1 and 2, (Group P) and 21 students learned with a non-personalized monologue spoken by the same human agent (Group NP). For the fourth study, 21 students learned with a personalized conversation displayed as text (Group P) and 21 students learned with a non-personalized monologue displayed as text (Group NP). In both studies the image of the agent was not presented. The procedure was identical to that of the prior studies.

Do students who communicate with a pedagogical agent via a personalized dialogue show deeper understanding from a multimedia science lesson than students who communicate with a pedagogical agent via an non-personalized monologue?

The findings from Experiments 3 and 4 gave evidence in favor of students' communicating with a pedagogical agent by means of a personalized conversation by demonstrating what w have called a *dialogue effect* in recall and transfer: Students who learn by communicating with a pedagogic agent via a personalized dialogue recall more and are better able to use what they have learned to solve problems than students who communicate via a non-personalized monologue. The mean number of ideas recalled for dialogue groups was significantly larger than for monologue groups ($p < .005$ and $p < .05$ for Experiments 3 and 4, respectively) and the mean number of correct answers in the transfer test was significantly larger for the dialogue groups than for the monologue groups ($p < .0001$ for both experiments). In addition, Experiment 4 demonstrated a dialogue effect for program ratings. Students who learned by reading dialogue-style text rated more favorably the lesson than students who learned by reading monologue-style text ($p = 0.05$).

General Discussion

The reported results have important theoretical and practical implications.

First, the modality effect found in Experiments 1 and 2 might be explained as a combination of the superiority in recall when words are processed auditorily rather than visually (Penney 1989), the relatively effortless maintenance of the auditory input in comparison to the visual input provided by text (Anderson & Craik 1974), and the extra emotional cues, which voices carry and text lacks. According to communications research, voices are powerful indicators of social presence and its incorporation in the interaction might promote richer processing by the incorporation of the additional attitudes and beliefs that are attached to the agent (Reeves & Nass 1996). These findings extend pioneering demonstrations of modality effects in learning from visual and verbal materials (Mayer & Moreno 1998, Moreno & Mayer 1999, Mousavi, Low, & Sweller 1995) in three ways: (a) by examining a modality effect in an interactive constructivist computer-based multimedia environment rather than a paper-based or non-interactive computer environment, (b) by employing multiple dependent measures including students' rating of the learning materials, and (c) by using fictional and non-fictional pedagogic agents to deliver the verbal materials of the lesson. The finding that students rated the computer program more favorably when it communicates via speech rather than via text is congruent with the social-cue hypothesis according to which the agents' voice may help students feel an emotional connection with the agent therefore promoting interest in the learning task which in turn fosters constructivist learning .

Second, the failure to find an image effect in Experiments 1 and 2 does not support the social cue hypothesis or the cognitive load hypothesis. Several interpretations for this finding can be offered. First, the lack of image effects might have relied on the strength of the auditory cues given by the voice of the agents which in both applications was extremely expressive and clear. When a voice carries these qualities, it is less likely that facial expressions or lip movements will provide extra information, or help disambiguate the message in the lesson. An alternative explanation may reside on the specific content of the computer lesson: The scientific nature of the lesson used in the reported studies is not essentially emotional and facial expressions may not offer any informational advantage.

Cognitive load predicted that the introduction of the agent's image in the computer lesson would be detrimental to students' learning. This prediction was not confirmed. However, in our studies, the agent's image was never presented simultaneously with other visual materials of the lesson. According to cognitive load theory, a detrimental effect in learning occurs in the cases that students need to split their attention between mutually referring materials. Therefore, it is more likely that if the multimedia lesson contained animations of the agent presented simultaneously with graphics or text, his visual presence would have been detrimental rather than neutral to learning (Mayer & Moreno 1998, Moreno & Mayer 1999, Sweller 1989).

The dialogue effects on retention and transfer found in Experiments 3 and 4 support the conversational hypothesis. We attribute these effects to a combination of less cognitive effort and more active processing. First, it might be argued that students who listen to non-personalized explanations need to work harder than students who listen to personalized explanations because they need to map the agent's generalized explanations to their specific choices in the computer lesson. Second, conversations might act as attention enhancers and produce more active processing of the materials (Reeves & Nass 1996) by creating a state of vigilance in which the participant might be asked to intervene in the dialogue at any time.

It is tempting to conclude that the personal agent effect found in our preliminary study resided in the effectiveness of teaching via instructional conversations (Tharp & Gallimore 1991). However, our focus in the present study was solely on the role that the agent's social cues may have in a multimedia constructivist environment. Although speech and language style proved to help students understanding, other factors, such as students' interaction with the computer program, might play an important role in learning as well. More research is needed to determine the contribution of alternative interactive designs in promoting deep learning from constructivist environments.

The most direct practical implication of our studies is that in a constructivist science lesson where students learn with the help of a pedagogical agent, technological advances in education should focus on extending the capabilities of speech recognition and natural language systems to facilitate instructional conversations. Moreover, the reported findings suggest that an agent interface metaphor might already be present once students interact with a computer, and trying to make it more visually apparent, may not necessarily lead to better results.

References

Anderson, C. M. B., & Craik, F. I. M. (1974). The effect of a concurrent task on recall from primary memory. Journal of Verbal Learning & Verbal Behavior, 13, 107-113.

Brennan, S. E. (1990). Conversation as direct manipulation. In Laurel, B. (Ed.)., *The art of human-computer interface design.* Reading, MA: Addison-Wesley.

Chandler, P. & Sweller, J. (1991). Cognitive load theory and the format of instruction. Cognition and Instruction, 8, 293-332.

Dewey, J. (1913). Interest and effort in education. Cambridge, MA: Houghton Mifflin.

Lester, J. C. and Stone, B. A., (1997). Increasing believability in animated pedagogical agents. In Proceedings of The First International Conference on Autonomous Agents (pp. 16-21). New York, NY: ACM Press.

Lester, J. C., Converse, S. A., Kahler, S. E., Barlow, S. T., Stone, B. A., & Bhogal, R. (1997). The persona effect: Affective impact of animated pedagogical agents. In Proceedings of CHI'97 (pp. 359-366). New York, NY: ACM Press.

Mayer, R. E. (1997). Multimedia learning: Are we asking the right questions? Educational Psychologist, 32, 1-19.

Mayer, R. E. & Moreno, R. (1998). A split-attention effect in multimedia learning: Evidence for dual processing systems in working memory. Journal of Educational Psychology, 90, 312-320.

Moreno, R. & Mayer, R. E. (in press). A Coherence Effect in Multimedia Learning: The Case for Minimizing Irrelevant Sounds in the Design of Multimedia Instructional Messages. *Journal of Educational Psychology.*

Moreno, R. & Mayer, R. E. (1999). Cognitive principles of multimedia learning: The role of modality and contiguity effects. *Journal of Educational Psychology, 91*, 1-11.

Mousavi, S., Low, R., & Sweller, J. (1995). Reducing cognitive load by mixing auditory and visual presentation modes. *Journal of Educational Psychology, 87,* 319-334.

Penney, C. G. (1989). Modality effects and the structure of short-term verbal memory. *Memory and Cognition, 17,* 398-422.

Reddy, M. J. (1979). The conduit metaphor: A case of frame conflict in our language about language. In Ortony, A. (Ed.) *Metaphor and Thought*. Cambridge: Cambridge University Press.

Reeves, B. & Nass, C. (1996). The media equation. New York: Cambridge University Press.

Rutter, D. R. (1984). Looking and Seeing: the role of visual communication in social interaction. John Wiley & Sons, Chichester.

Sweller, J. (1989). Cognitive technology: Some procedures for facilitating learning and problem solving in mathematics and science. Journal of Educational Psychology, 81, 457-466.

Tharp, R. G., & Gallimore, R. (1991). *The instructional conversation: Teaching and learning in social activity.* Report from the Office of Educational Research and Improvement. U. S. Department of Education.

Acknowledgments

This research was supported by a grant from the National Science Foundation entitled "Learning and Intelligent Systems: Animated Pedagogical Agents for Constructivist Learning Environments."

Meaningful Design for Meaningful Learning: Applying Cognitive Theory to Multimedia Explanations

Roxana Moreno
Psychology Department
University of California
Santa Barbara, CA 93106
moreno@psych.ucsb.edu

Richard E. Mayer
Psychology Department
University of California
Santa Barbara, CA 93106
mayer@psych.ucsb.edu

Abstract: How can we help students understand scientific systems? One promising approach involves multimedia presentations of explanations in visual and verbal formats, such as presenting a computer-generated animation synchronized with narration or on-screen text. In this paper, we present a cognitive theory of multimedia learning from which principles of instructional design are derived and tested. The split-attention principle states that learning is impaired when the presentation requires the learner to mentally integrate disparate sources of information before the instructional material can be rendered intelligible. The spatial contiguity principle states that it is better to present words and graphics integrated rather than physically separated. The temporal contiguity principle states that students learn better when corresponding words and pictures are presented simultaneously rather than successively. The modality principle states that it is better to present words auditorily as narration than visually as on-screen text The coherence principle states that adding sufficient amounts of entertaining but irrelevant words or sounds to a multimedia instructional message is detrimental to student learning.

Designing a Multimedia Explanation

Humans can integrate information from different sensory modalities into one meaningful experience--such as when they associate the sound of thunder to the visual image of lightning in the sky. They can also integrate information from different modes (verbal or non-verbal) into a mental model--such as when they watch lightning in the sky and listen to an explanation of the event. Therefore, when the process of lightning formation is to be taught with a multimedia explanation, the instructional designer is faced with the need to choose between several combinations of modes and modalities to promote meaningful learning (Mayer & Moreno, 1998). Should the explanation be given auditorily in the form of speech, visually in the form of text, or both? Would entertaining adjuncts in the form of words, environmental sounds, or music help students' learning? Should the visual and auditory materials be presented simultaneously or sequentially? To help answer these questions, we conducted a series of studies where the learning outcomes of students who viewed alternative presentation formats was compared. In particular, we concentrated on three learning measures: retention of the steps in the cause-and-effect chain (retention test), matching of the pictures and names of parts (matching test), and using what they have learned to solve problems (transfer test). By beginning with a cognitive theory of how learners process multimedia information, we have been able to conduct focused research, which has yielded some preliminary principles of instructional design for multimedia explanations.

A Cognitive Theory of Multimedia Learning

Our cognitive theory of multimedia learning draws on dual coding theory, cognitive load theory, and constructivist learning theory. It is based on the following assumptions: (a) working memory includes an auditory working memory and a visual working memory, analogous to the phonological loop and visuo-spatial sketch pad, respectively, in Baddeley's (1986) theory of working memory; (b) each working memory store has a limited capacity, consistent with Sweller's (1988, 1994; Chandler & Sweller, 1992) cognitive load theory; (c) meaningful learning occurs when a learner retains relevant information in each store, organizes the information in each store into a coherent representation, and makes connections between corresponding representations in each store, analogous to the cognitive processes of selecting, organizing, and integrating in Mayer's generative theory of multimedia learning (Mayer, 1997); and (d) connections can be made only if corresponding pictorial and verbal information is in working memory at the same time, corresponding to referential connections in Paivio's (1986) dual-coding theory.

The Split-Attention Principle

How should verbal information be presented to students to enhance learning from animations: auditorily as speech or visually as on-screen text? In order to answer this question, Mayer and Moreno (1998) asked students to view an animation depicting the process of lightning either along with concurrent narration (Group AN) or along with concurrent on-screen text (Group AT).

According to the cognitive theory of multimedia learning, in the AN treatment, students represent the animation in visual working memory and represent the corresponding narration in auditory working memory. Because they can hold corresponding pictorial and verbal representations in working memory at the same time, students in group AN are better able to build referential connections between them.

In the AT treatment, students try to represent both the animation and the on-screen text in visual working memory. Although some of the visually-represented text eventually may be translated into an acoustic modality for auditory working memory, visual working memory is likely to become overloaded. If students pay full attention to on-line text they may miss some of the crucial images in the animation, but if they pay full attention to the animation they may miss some of the on-line text. Because they may not be able to hold corresponding pictorial and verbal representations in working memory at the same time, students in group AT are less able to build connections between these representations. Therefore, our theory predicts that students in group AT perform more poorly than students in group AN on the retention, matching, and transfer tests.

Method and Results

The participants were 78 college students who lacked knowledge of meteorology. They first viewed the animation with either concurrent narration in a male voice describing 8 major steps in lightning formation (Group AN) or concurrent on-screen text involving the same words and presentation timing (Group AT). Then, all students took the retention, transfer and matching tests.

Group AN recalled significantly ($p < .001$) more, correctly matched significantly ($p < .01$) more elements on diagrams, and generated significantly ($p < .001$) more correct solutions than Group AT. These results are consistent with the predictions of the cognitive theory of multimedia learning and allow us to infer the first instructional design principle, called the split-attention principle by the cognitive load theory (Chandler & Sweller, 1992; Mousavi, Low, & Sweller, 1995).

Split-Attention Principle

Students learn better when the instructional material does not require them to split their attention between multiple sources of mutually referring information.

The Modality Principle

Why do students learn better when verbal information is presented auditorily as speech rather than visually as on-screen text? Mayer and Moreno's (1998) study showed that students who learn with concurrent narration and animations outperform those who learn with concurrent on-screen text and animations. However, concurrent multimedia presentations, force the text groups to hold material from one source of information (verbal or non-verbal) in working memory before attending to the other source. Therefore, the narration group might have had the advantage of being able to attend to both sources simultaneously, and the superior performance might disappear by using sequential multimedia presentations, where verbal and non-verbal materials are presented one after the other. The next logical step was to test if the advantage of narration over on-screen text resides in a modality principle (Moreno & Mayer, 1999, Experiment 2). If this is the case, then the advantage for auditory-visual presentations should not disappear when they are made sequential.

Method and Results

The participants were 137 college students who lacked knowledge of meteorology. They first viewed the animation in one of the following six conditions. one group of students viewed concurrently on-screen text while viewing the animation (TT), a second group of students listened concurrently to a narration while viewing the animation (NN), a third group of students listened to a narration preceding the corresponding portion of the animation (NA), a fourth group listened to the narration following the animation (AN), a fifth group read the on-screen text preceding the animation (TA), and the sixth group read the on-screen text following the animation (AT). After viewing the animation, students took the retention, transfer, and matching tests.

The text groups (TT, AT, and TA) scored significantly lower than the narration groups (NN, AN, and NA) in verbal recall ($p < .001$), problem solving transfer ($p < .001$), and matching ($p < .005$). These results reflect a modality effect. Within each modality group, only the simultaneous and sequential text showed a significant difference in their performance for matching tests ($p < .05$), with the sequential text groups outperforming the simultaneous text group. This finding might be interpreted as another example of the split-attention effect, where presenting two competing visual materials simultaneously has negative effects on the matching of verbal and visual materials in a multimedia lesson. The results from this study are consistent with prior studies on text and diagrams (Mousavi, Low, & Sweller, 1995), and allow us to infer a second instructional design principle--the Modality Principle.

Modality Principle

Students learn better when the verbal information is presented auditorily as speech rather than visually as on-screen text both for concurrent and sequential presentations.

The Spatial Contiguity Principle

How does the physical integration of on-screen text and visual materials affect students' learning? Mayer and Moreno's study on split-attention (1998) showed that students who learn with concurrent narration and animations outperform those who learn with concurrent on-screen text and animations. One interpretation for this result is that students might be missing part of the visual information while they are reading the on-screen text (or vice versa). In a review of ten studies concerning whether multimedia instruction is effective, Mayer (1997) concluded that there was a consistent evidence for what was called a spatial-contiguity effect. Students generated a median of over 50% more creative solutions to transfer problems when verbal and visual explanations were integrated than when they were separated (Mayer, 1997). In order to extend these studies to multimedia learning with animations, we conducted a study where the physical proximity of the on-screen text and the animation was manipulated (Moreno & Mayer, 1999, Experiment 1). One group of students had on-screen text that was integrated or physically close to thc animation (IT group) while a second group of students had on-screen text that was separated or physically far from the animation (ST group). A third group of students saw a presentation with concurrent animation and narration (N group). This study allows to interpret performance differences between the text groups (IT and ST) in terms of spatial-contiguity and performance difference between the narration (N) and text groups (IT and ST) in terms of modality.

Method and Results

The participants were 132 college students who lacked knowledge of meteorology. They first viewed the animation in one of the following three conditions: N, ST or IT. One group of students listened to concurrent narration describing each of the major events in words spoken at a slow rate by a male voice (Group N) and the other two groups of students learned by reading concurrent on-screen text using the same words and timing as the narration used in the N group. For the separated text version (Group ST), the text was physically far from the animation and for the integrated text version (Group IT), the text was physically close to the relevant part of the animation. After viewing the animation, all students took the retention, transfer and matching tests.

The N group scored significantly higher than the IT and ST groups in the verbal recall, and transfer tests, with the IT group scoring significantly higher than the ST group ($p < .001$). These results are evidence for both, a modality and a spatial-contiguity effect in recall and transfer. For matching tests, students in group N group scored significantly higher than the IT and ST, which did not differ from each other ($p < .05$). These results are evidence for a modality effect in matching but not for a spatial-contiguity effect. One possible explanation for not finding a significant difference in the matching scores of the IT and ST groups is a ceiling effect in which all groups did very well on this particular measure. Overall, it is possible to infer a third instructional design principle that extends prior findings on text and diagrams to multimedia learning with animations--the Spatial Contiguity Principle.

Spatial Contiguity Principle

Students learn better when on-screen text and visual materials are physically integrated rather than separated.

The Temporal Contiguity Principle

How synchronized in time do the verbal and visual materials have to be for students to learn better from animations? Congruent with a dual-processing model of working memory, constructivist learning is fostered when the learner is able to hold a visual representation in visual working memory and a corresponding verbal representation in verbal working memory at the same time. The model implicates working memory load as a major impediment to learning. Although all learners may receive identical animation and narration in a multimedia environment, the amount of information that they are forced hold in working memory at one time might affect performance. For example, presenting the whole animation preceded or followed by the whole narration successively (which we will call large bites), can overload working memory such that it is not possible to hold all of the narrative in working memory until the animation is presented (or vice versa). However, if we present one chunk of animation--depicting only a short sequence--preceded or followed by one corresponding chunk of narration and so on (which we will call small bites), and if the size of the chunk does not exceed working memory capacity, then the learner should be able to make connections between the corresponding words and pictures--in the same way as when animation and narration are presented concurrently.

Our prior study (Moreno & Mayer, 1999) failed to find performance differences between the simultaneous and sequential narration groups. Similar results were obtained for learning with geometry examples by simultaneous and sequential explanations (Mousavi, Low & Sweller, 1995). In both cases, the successive presentations of the animation and narration were small bites, only a line or two at a time, and thus unlikely to overload working memory. However, in another set of studies (Mayer & Anderson, 1991, 1992), where large bites of animation and narrations were presented successively, students in the simultaneous conditions outperformed students who learned with sequential presentations. In order to reconcile the above findings, we varied the size of the units that were presented sequentially to the learners (Mayer, Moreno, Boire & Vagge, 1999). One group of students saw a presentation with concurrent animation and narration (concurrent group), a second group of students either viewed the whole animation followed or preceded by the whole explanatory narration (large bites group) and a third group of students either viewed small chunks of animation followed or preceded by small chunks of explanatory narration (small bites group).

Method and Results

The participants were 60 college students who lacked knowledge of meteorology. They first viewed the animation in one of the following conditions: concurrent narration and animation, large bites of narration and animation or small bites of narration and animation. As in our prior studies, after viewing the animation, all students took the retention, transfer and matching tests.

The large bites group scored significantly lower than the concurrent and small bites groups in the verbal recall, matching and transfer tests, ($p = .002$, $p < .0001$, and $p < .0001$, respectively). The concurrent and small bites groups did not differ from each other. These results allow all prior studies in temporal contiguity to be reconciled if the length of the cycles in the sequential presentations are taken into account. Therefore, a fourth instructional design principle for multimedia learning with animations can be inferred.

Temporal Contiguity Principle

Students learn better when verbal and visual materials are temporally synchronized rather than separated in time.

The Coherence Principle

Would entertaining adjuncts in the form of sounds, or music help students' learning from a multimedia explanation? According to the cognitive theory of multimedia learning, learners process multimedia messages in their visual and auditory channels--both of which are limited in capacity. In the case of a narrated animation, the animation is processed in the visual channel and the narration is processed in the auditory channel. When additional auditory information is presented, it competes with the narration for limited processing capacity in the auditory channel. When processing capacity is used to process the music and sounds, there is less capacity available for paying attention to the narration, organizing it into a coherent cause-and-effect chain, and linking it with the incoming visual information. Based on this theory, we can predict that adding interesting music and sounds to a multimedia presentation will result in poorer performance on tests of retention, matching, and transfer. In short, the cognitive theory of multimedia learning predicts a coherence effect in which adding interesting material--in the form of music and sounds--hurts student learning. In order to test this prediction, Moreno and Mayer (in press) asked students to view an animation depicting the process of lightning either with concurrent narration (Group N), with concurrent narration and environmental sounds (Group NE), with concurrent narration and music (Group NM), or with concurrent narration, environmental sounds and music (Group NEM).

Method and Results

The participants were 75 college students who lacked knowledge of meteorology. They first viewed the animation in one of the four conditions: narration, narration and sounds, narration and music, or narration, sounds and music. After viewing the animation, all students took the retention, transfer and matching tests.

Students scored significantly lower in both retention and transfer tests when music had been presented than when no music had been presented ($\underline{p} < .0001$); but there was no significant difference between students who received environmental sounds and those who didn't. There was a significant interaction between music and sounds ($\underline{p} < .05$), in which the combination of music and environmental sounds (Group NEM) was particularly detrimental to retention and transfer performance. Supplemental tests indicated that students in Group NEM had retention and transfer scores significantly lower than each of the other groups and that Group NEM had retention and transfer scores significantly lower than Groups N and NE, which did not differ from each other. The mean matching scores for the four groups were no significantly different, with no main effect for music, sounds, and no significant interaction between music and environmental sounds.

This pattern obtained for the retention and transfer tests therefore supports the hypothesis derived from the cognitive model of multimedia learning. Adding extraneous auditory material--in the form of music--tended to hurt students' understanding of the lightning process. Adding relevant and coordinated auditory material--in the form of environmental sounds did not hurt students' understanding of the lightning process. Together with the retention results, these findings suggest that auditory overload can be created by adding auditory material that does not contribute to making the lesson intelligible. The results of this auditory overload are that fewer of the relevant words and sounds may enter the learner's cognitive system and fewer cognitive resources can be allocated to building connections among words, images, and sounds
Therefore, A fifth instructional design principle for multimedia learning with animations can be inferred.

Coherence Principle

Students learn better when extraneous material is excluded rather than included in multimedia explanations.

Conclusion

Multimedia explanations allow students to work easily with verbal and non-verbal representations of complex systems. The present review demonstrates that presenting a verbal explanation of how a system works with an animation does not insure that students will understand the explanation unless research-based principles are applied to the design.

The present studies have important theoretical implications. According to a generative theory of multimedia learning (Mayer, 1997), active learning occurs when a learner engages three cognitive processes--selecting relevant words for verbal processing and selecting relevant images for visual processing, organizing words into a coherent verbal model and organizing images into a coherent visual model, integrating corresponding components of the verbal and visual models. To foster the process of selecting, multimedia presentations should not contain too much extraneous information in the form of words or sounds, and should not present . To foster the process of organizing, multimedia presentations should represent the steps in order and with clear signals for both the verbal and visual information. To foster the process of integrating, multimedia presentations should present words and pictures concurrently using modalities that effectively use available visual and auditory working memory resources. The major advance in our research program is to identify techniques for presentation of verbal and visual information that minimizes working memory load and promotes meaningful learning.

References

Baddeley, A. D. (1986). *Working memory.* Oxford, England: Oxford University Press.

Chandler, P. & Sweller, J. (1992). The split-attention effect as a factor in the design of instruction. *British Journal of Educational Psychology, 62*, 233-246.

Mayer, R. E. (1997). Multimedia learning: Are we asking the right questions? *Educational Psychologist, 32*, 1-19.

Mayer, R. E. & Anderson, R. B. (1991). Animations need narrations: An experimental test of a dual-coding hypothesis. *Journal of Educational Psychology, 83,* 484-490.

Mayer, R. E. & Anderson, R. B. (1992). The instructive animation: Helping students build connections between words and pictures in multimedia learning. *Journal of Educational Psychology, 84*, 444-452.

Mayer, R. E. & Moreno, R. (1998). A split-attention effect in multimedia learning: Evidence for dual processing systems in working memory. *Journal of Educational Psychology, 90*, 312-320.

Mayer, R. E., Moreno, R., Boire M., & Vagge S. (1999). Maximizing constructivist learning from multimedia communications by minimizing cognitive load. *Journal of Educational Psychology , 91*, 638-643.

Moreno, R. & Mayer, R. E. (in press). A coherence effect in multimedia learning: The case for minimizing irrelevant sounds in the design of multimedia instructional messages. *Journal of Educational Psychology.*

Moreno, R. & Mayer, R. E. (1999). Cognitive principles of multimedia learning: The role of modality and contiguity. *Journal of Educational Psychology, 91*, 358-368.

Mousavi, S.Y., Low, R., & Sweller, J. (1995). Reducing cognitive load by mixing auditory and visual presentation modes. *Journal of Educational Psychology, 87*, 319-334.

Paivio, A. (1986). *Mental representation: A dual coding approach.* Oxford, England: Oxford University Press.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science, 12*, 257-285.

Sweller, J., Chandler, P. (1994). Why some material is difficult to learn. *Cognition and Instruction, 12*, 185-233.

Distributed Repository of Programming Examples

Tomasz Müldner
Jodrey School of Computer Science, Acadia University, Wolfville, N.S. B0P 1X0 Canada
email: tomasz.muldner@acadiau.ca

Vicky Shiv
Jodrey School of Computer Science, Acadia University, Wolfville, N.S. B0P 1X0 Canada

Abstract: We present a description of a fully distributed system that can be used to distribute data among any number of authenticated users. The name server is used only for authentication; otherwise the load is evenly distributed. The system has been used to create a distributed repository of programming examples.

0. Introduction

With the increased availability of the Internet, personal computers and fast networks, there are many research efforts directed at various network applications, and in general, distributed software. Another reason for the interest in this research is the growing number of universities, which have built fully computerized campuses. For example, Acadia University, see (MacDougall et al. 1998), has been involved in building such a campus; it provides fast network connections for all students living on the campus as well as electronic classrooms (a setting in which every student and teacher have access to a personal computer, and all the computers are networked allowing for various types of computer-supported interaction, see (Shneiderman et al 1995)). For another example of a computerized campus, see (Holmes 1996). In this paper we tackle the issue of distributing data among a number of networked computers.

We consider both, connected and partially connected computers (the latter are mobile computers that can connect to various networks). This type of arrangement is typical for computerized campuses, but also applies to mobile users who travel with their laptops. There are many applications for which one would wish to distribute information, but here we concentrate on a specific case to support an example-driven learning process; namely a distributed repository of programming examples, for instance examples of programs in C or Java. Examples are useful if they can be easily browsed and searched, and various users can share them. When learning programming, examples are particularly useful because in this case one always learns from examples of small programs.

This paper is organized as follows. In the first section, we provide basic concepts of distributed information systems and discuss various models. The second section presents our system, the Distributed Repository of User-Classified dOcuments, DRUCO; and the final section describes a case study, a repository of programming examples in C.

1. Distributed Information Systems

A distributed information system can be defined as a system where documents containing some information are distributed across multiple machines connected by a network. Therefore, data (or, documents) are accessible as a shared resource, see (Booth 1981). These systems are useful because the collective storage of multiple computers provides a more powerful system. Additionally, with the duplication of resources, the failure of one component does not necessarily imply losing the entire set of data. Thus, distributed systems provide parallelism and fault tolerance, making them potentially much more powerful than their individual components, see (Mullender 1989). In the context of computerized campuses and a wide accessibility of the

Internet, a distributed information system has an additional important task to fulfill; namely to support information sharing. Below, we review various types of information sharing systems.

The most basic thing we want to be able to do is to exchange and share information. From now on, we will assume that the information is stored in a document, which serves as a persistent medium for this information (and therefore, we will use the term "document" interchangeably with the term "information"). A document is not necessarily the same thing as a file; it could be a file, a number of files logically grouped together, or an entry in a database. (Note that this definition of a distributed system is more general than that of a distributed file system, such as Coda, see (Satyanarayanan 1990)). There are three basic considerations when it comes to sharing documents using an information system: operations on the system, security of the system, and the interface to the system. For a system to be useful, it has to provide various operations such as search, browse, compare, export/import from and to the file system, and others. Some systems support only homogenous information, that is force all the users to use the same type of documents. Other systems may support more heterogeneous documents as long as they conform to a certain standard. The system should be secure by allowing each user to specify for every document, who are the users for whom this document is accessible (for example, to view, copy, traverse, etc.). This functionality can be provided by associating with each document the list of users and their passwords; then the user has to be authenticated before they can obtain any information. As an alternative, digital signatures can be used, see (Greenleaf 1997).

The interface to the system determines one of two possible roles the user has to play to obtain documents that belong to other users. These roles roughly correspond to pulling information and pushing information. If a system supports only pulling information, then the user has to play an active role in obtaining required information. A notification system can be added to notify a user for example when new information becomes available (addition notification) or is changed (change notification). An information push system tries to push required information to interested users. These systems may be profile-based, or context- and situation-based; see (Van de Velde at al. 1997). An alternative would be to consider active, autonomous providers, such as software agents, using planning to search for the required information; see (Huhns 1998). A system of intelligent agents, such as Cooperative Information System, CIS, see (Papazoglou 1992) can actively reason about the information it contains and search for these pieces of information by connecting to other systems.

Now, we elaborate on the push and pull models. In order to describe the task of exchanging and sharing information in a pull model, we consider two kinds of applications, here called respectively providers and fetchers. A provider application gives access to available information for authorized users; a fetcher application is designed to fetch or browse information from one or more providers. Typically, a provider is implemented as a server, and a fetcher as a client; for more information about clients and servers, see (Mullender 1989). A single application may be both a provider (server) and a fetcher (client) at the same time. For an application A to communicate with another application B, A has to be able to locate B, using some kind of a naming system. A standard convention used by the Internet, is to use Universal Resource Locators, URLs. When A provides B's URL, the Domain Name Server, DNS finds B's IP address, and now A can use this address to communicate with B. Unfortunately, the above technique does not work if B is currently off-line, or B uses an Internet service Provider, ISP which provides dynamic IP addresses. Therefore, often we assume that there exists additional name server residing at a "well-known" static IP. When the application B goes on-line, it connects to the name server, which at that time retrieves its current IP and associates it with the application's name. When the application A wants to connect to the application B, it does it through the name server, which guarantees that B is on-line and its current IP address is known. (Additionally, the name server can be used to store user names and passwords, and to authenticate users.)

The best known example of the above model is that of a Web server (provider) and a Web browser (fetcher). The user of a browser pulls information provided by the Web server. Recently, Internet Explorer introduced channels, which are lists of web sites that are regularly (with the required frequency) pushed onto the users desktop. However, this is not a real push model; instead it is a "scheduled" pull. As mentioned above, the push model is best implemented using mobile agents (for the description of mobile agents, see (Wong 1999)). The user interested in an operation, such as search, or compare may create an agent to move to various sites and perform this operation on her or his behalf (the agent may perform some action on that site, if allowed, or it may collect the information and carry it to its home site). While it is easy to see how to specify the required information, it is more difficult to decide where the agent should go to perform the required task. Here, there are several possible solutions. First, a solution similar to one described above, i.e. using a central naming server can be used. The server will know of all kinds of information and the corresponding sites. Of course, instead of using a central server, a distributed naming service such as JNDI can be used. The problem is that all sites associated with a single type of information will have to be homogenous; for example the information about technical reports will have be provided in a consistent manner. It would be best, if there is a generally accepted standard for specifying data, and for this reason below we briefly describe XML.

An eXtensible Marking Language, XML, see (David 1999), is a meta-language that allows the user to create a specialized language to define a structure of a document. XML has been used in a variety of applications, for example to define Internet Explorer's channels, see (Microsoft). The main strength of XML is that it provides a domain specific standard, and XML applications support operations such as search, compare and merge. For each XML-generated language there is a Document Type Definition, DTD, which is basically a grammar for this language. Therefore, an XML document can be verified against its DTD. In addition, an XML document can be easily converted to a different XML format, if the conversion is defined by another DTD. XML is accompanied by an eXtensible Style Language, XSL and an eXtensible Link Language, XLL. XSL provides formatting instructions to display an XML document, while XLL supports links that generalize HTML links, to rectify the problem of maintenance of links, and to allow to create links for read-only media. Therefore, these products; XML, XSL and XLL provide three independent ways to collectively define the document's structure, format and links. In the absence of XML, one may want to use an information system, in which the user explicitly provides her or his own structure of the document. In the following section we describe a specific example of a general distributed information system, based on user-defined classifications. This system is called Distributed Repository of User-Classified dOcuments, DRUCO.

2. Distributed Repository of User-Classified Documents

Here we consider a system of documents, in which every user can define her or his classifications. Each document may be stored or classified within one or more classifications, and classifications may be nested. Therefore, in a classical file system, classifications resemble folders, or directories, and documents resemble files. The entire system can be seen as a tree; leaves, however, may have more than one father (classification). The user will be able to make a part of its system available to other users; and pull (download) a classification from another user (this classification corresponds to the node of the tree; and the entire subtree rooted at this node may be pulled). Permissions may be set so that only selected users will have access to some documents. In what follows, we will refer to this specific information system as a distributed repository of user-defined classifications, or briefly as a repository.

DRUCO is a system designed to satisfy the above requirements. In this system, a single unit that resembles a file represents each document. DRUCO documents are stored separately from the file system, but they can be easily imported to, and exported from that system. Now, we briefly describe the design and functionality of DRUCO. It is a program that can operate both, in off-line mode or in on-line mode, and in the latter mode as a server, or as a client. All the operations that can be performed in off-line mode can also be performed in on-line mode. Off-line operations facilitate organizing a repository, that is creating new classifications, modifying and deleting existing classifications, importing and exporting, and browsing and viewing documents; see (Fig. 1). In (Fig. 1) the leftmost pane shows the current state of the repository. Folder icons indicate whether or not they are currently folded, or expanded. The middle pane shows the current state of the DownloadSpace; the outermost folder (Shiv) is a placeholder for all the documents that have been pulled. The rightmost pane can be used to show the contents of the selected file. The user can use menus/right button/drag and drop. Also, in off-line mode, the user may specify "permissions", that is give or revoke the right to access documents. Here, a classification is the smallest unit; that is the user can grant permission to one or more users for a specific classification; then, these users can view and possibly pull all documents in this classification. However, whether or not they will be able to view the contents of any nested classifications, depends on their permissions for these classifications. (Below, we describe how the user can get the list of all registered users.) To manage permissions, the user selects the SecurityManagement pane, see (Fig. 2). The UserList pane shows the list of registered users (see (Fig. 2); the user can select folders and documents in the leftmost pane, and use buttons to assign and revoke permissions.

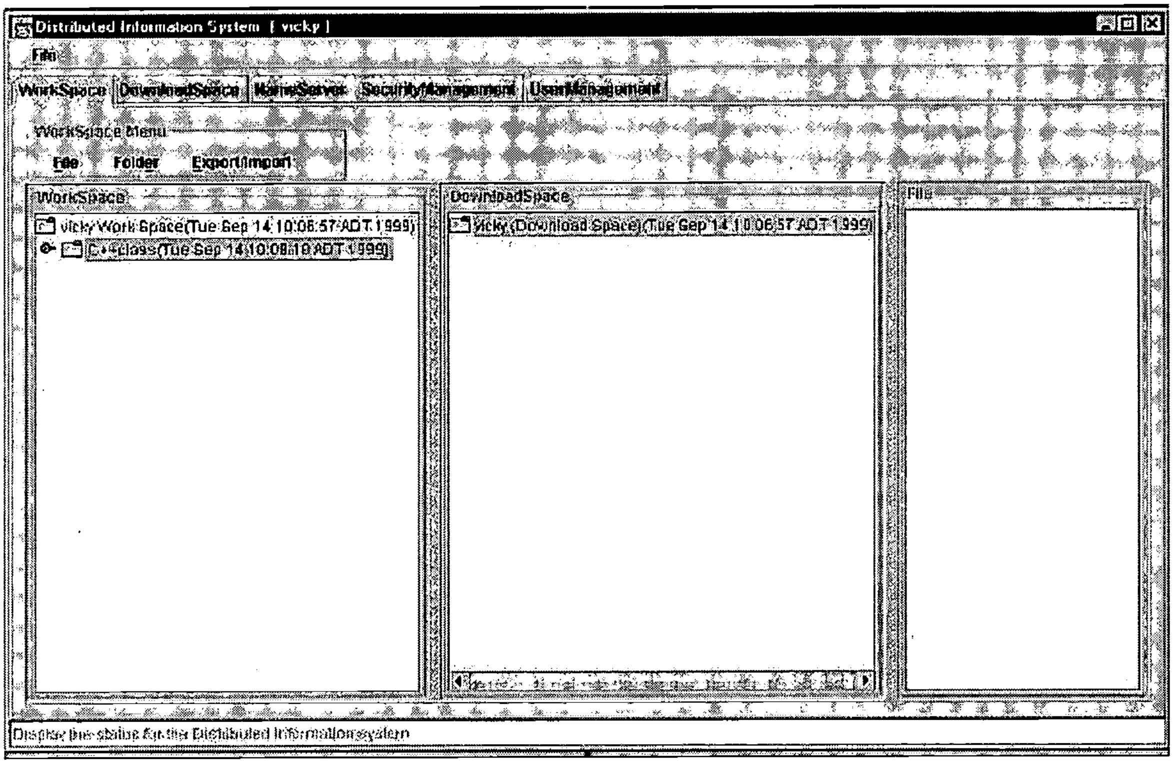


Figure 1: DRUCO in off-line mode).

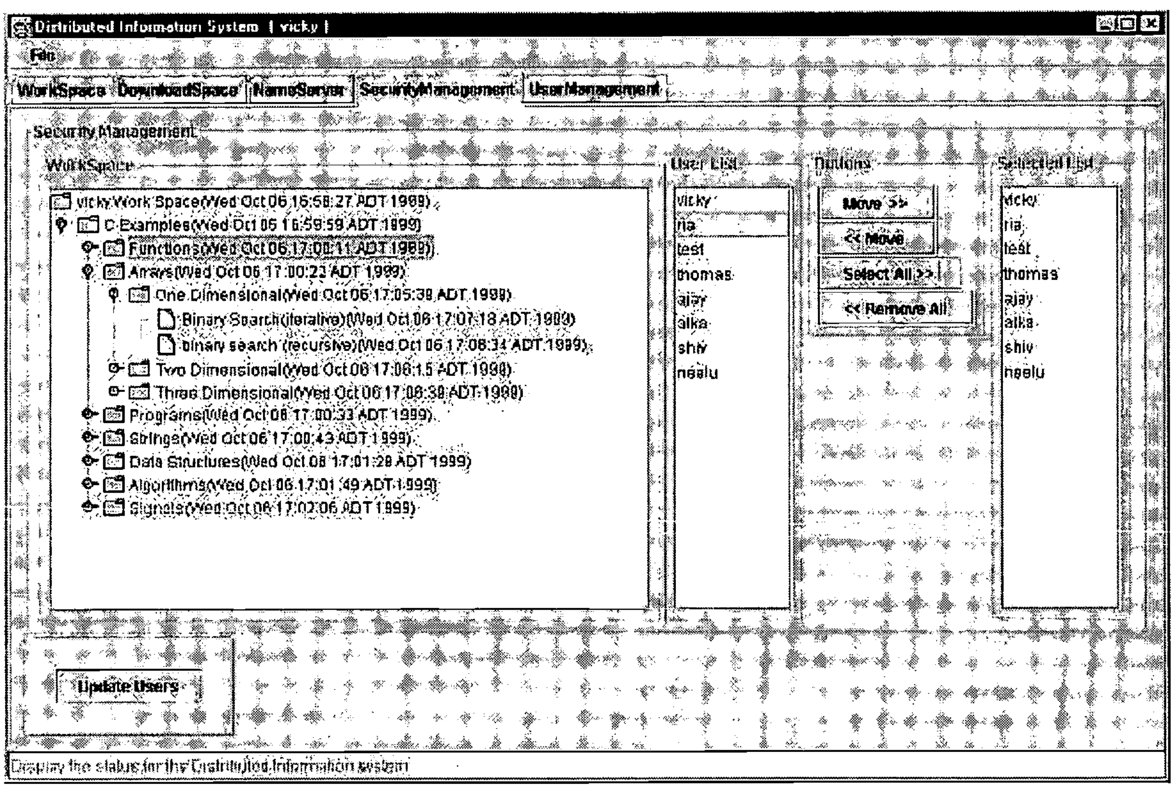


Figure 2: DRUCO in off-line mode

To facilitate the location of other users, especially in the presence of users who use dynamic IP addresses, a central name server has been incorporated into DRUCO. An administrator of this name service manages users, that is registers these users, assigns passwords, etc. The name server is running on a computer with a "well-known" static IP address, which is provided in the configuration file read when the user's application starts. The interface to the name server is shown in (Fig. 3).

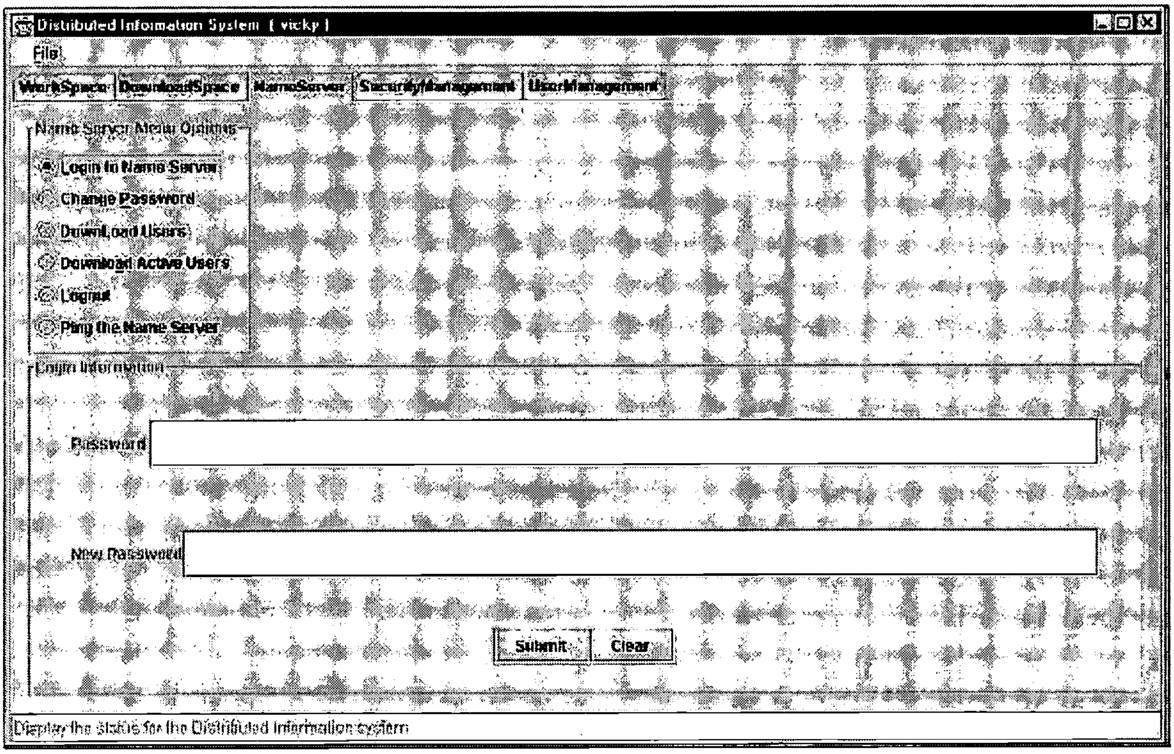


Figure 3: DRUCO's name server

The administrator manages the name server; that is adds and removes users, and sets their passwords. On-line operations can be divided into two types; interactions with the name server and interactions with other users. In order to interact with the name server, the user has to login to the server, by providing the name and password. Upon the successful login, the name server retrieves the current IP of this user, and saves this information; therefore DRUCO supports users who have dynamic IP addresses, for example those using ISPs. The user may perform the following operations that interact with the name server: change the password, retrieve the list of all registered users, and retrieve the list of all active users (i.e. users who are currently on-line). The list of active users is used to start an interaction with another user; to connect to another user it is enough to select this user from the active user list. Note that this connection doesn't require authentication, because both users must be currently connected to the name server, and therefore they have already been authenticated by that server. Also, the name server provides the current, dynamic IP address of all users. The list of all currently active users can be used to select one user and then connect to them. User A, upon connecting to another user B, may browse these classifications for which have been permitted by the user B, and she or he can also download some of these classifications.
DRUCO has been implemented in Java 1.2, see (SUN 1999a), using RMI, see (SUN 1999b).

3. Case Study: Distributed Repository of Programming Examples

Example-based learning, see (Neal 1989) promotes the idea of using numerous examples to help to understand various concepts, and to move these concepts from short-term memory to long term memory. Examples are useful if they can be easily browsed and searched, and they can be shared by various users. When learning programming, examples are particularly useful because in this case one always learns from examples of small programs. Consider as an example a specific class for teaching programming in the C programming language, taking place in an electronic classroom. Before the beginning of the class, the instructor (provider) makes available examples of programs in C to all students in the classroom. (As an alternative, the instructor may divide students into groups by giving each group a different example.) Now, the students can pull these examples to their computers. They can view these examples, export them to their favorite compiler, modify them by creating new versions, and making these versions available to all students, or specific students. The entire process can result in collaborative development of a useful repository that can be used not only for learning, but also for real every-day programming.

DRUCO is an ideal candidate to implement a shared repository of examples with a hierarchical structure. It has been used to implement DRUCOC - a repository of examples of C.

Acknowledgments

The implementation of DRUCO described in this paper has been completed as a part the Masters thesis written by the second author.

References

Booth (1981). Booth, Grayce M. *The Distributed System Environment*. New York: McGraw-Hill.
David (1999). Lessons in EDI, knowledge management, and scalable vector graphics from Interdoc's annual XML conference. http://www.xml.com
Greenleaf (1997). Graham Greenleaf and Roger Clarke, "Privacy Implications of Digital Signatures". at http://www.anu.edu.au/people/Roger.Clarke/DV/DigSig.html
Holmes (1996). Holmes, M., Porter, D.: "Student Notebook Computers in Studio Courses"; *ED-MEDIA'96 Conference*, Boston.
Huhns (1998). M.N. Huhns: Agent Foundations for Cooperative Information Systems. In: *Proceedings of The Third International Conference on The Practical Applications of Intelligent Agents and Multi-Agent Technology; London 1998*; Edited by H.S. Nwana and D.T. Ndumu.
Mullender (1989). Mullender, Sape. *Distributed Systems*. New York: ACM Press.
Neal (1989). L. R. A System for Example-Based Programming. ACM, *Human-Computer Interactions, HCI'89 Proceedings. pp. 63-67.*
Papazoglou (1992). Papazoglou, M.: An Organizational Framework for Intelligent Cooperative IS. *IJICS-1 (1).*
Satyanarayanan, M. (1990). Satyanarayanan, M., Kistler, J.J., Kumar, P., Okasaki, M.E., Siegel, E.H., Steere, D.C. *IEEE Transactions on Computers April 1990, Vol. 39, No. 4.*
Shneiderman et al (1995). Shneiderman, B., Alavi, M., Norman, K, and Borkowski, E. Windows of Opportunity in Electronic Classrooms; *Communications of the ACM, 38, 1.*
Sun Microsystems (1998). Sun Microsystems. The Java Language Environment. On-line. Available: http://www.javasoft.com/docs/white/langenv/
SUN (1999a). Sun Microsystems, Java 2 SDK, Available via http://java.sun.com/jdk/
SUN (1999b). Sun Microsystems. White paper. Available via http://java.sun.com/marketing/collateral/javarmi.html
Van de Velde at al. (1997). Van de Velde, W., Geldof, S. and Schrooten, R.: Competition for Attention. In: *Intelligent Agents IV. Agent Theories, Architectures and Languages. Lecture Notes in Artificial Intelligence 1365; J.G. Carbonell and J. Siekmann (Eds.) Lecture Notes in Computer Science; Springer Verlag.*
Wong (1999). David Wong, Noemi Paciorek, Dana Moore: Java-based Mobile Agents. *CACM 42(3): 92-102.*

Finding out the intention of a user of Educational Hypermedia

D. J. Mullier, D. J. Hobbs, D. J. Moore
Faculty of Information and Engineering Systems
Leeds Metropolitan University
England
[d.mullier][d.hobbs][d.moore]@lmu.ac.uk

Abstract: Hypermedia has been identified as a promising medium for education. However, it is beset with problems concerning the complexity of navigation and meeting the individual needs of the user. This paper is concerned with a domain-independent metric that can be used to extract information about a user of an educational hypermedia system with a view to tailoring the hypermedia to meet the user's individual needs. The metric attempts to discover a user's information seeking goal when they are using a hypermedia system based upon the patterns they make as they navigate the hypermedia. Discussed within are the types of patterns that a hypermedia navigator may use and how they may be used to infer the user's information seeking goal. Experiments, used to demonstrate the validity of this approach are described and discussed.

Introduction

Leeds Metropolitan University has been investigation the possibility of producing a tutoring system that offers aid to the student whilst allowing reuse over a number of domains. The use of a generic system reduces the amount of information that can be collected about the student for the purpose of providing aid. In an attempt to solve this problem a prototype hypermedia tutoring system, called "Hypernet", has been developed to explore issues relating to extracting information about the student in an information sparse environment. A potential candidate for a metric in a generic hypermedia environment has is browsing pattern information. The remainder of this paper is concerned with this metric and describes some experiments that were used to support the contention that browsing patterns are of potential use in this area. Hypernet collect other metrics, these are discussed elsewhere (Mullier et al 1998, 1999, Mullier 1999).

Browsing Patterns and Browsing Strategies

Hypermedia browsing strategies, as outlined by Canter et al (1985) and McAleese (1993), and discussed further in Mullier (1999), are characteristic methods for moving through a network of hypermedia nodes. Canter et al and McAleese are referring to browsing strategies since they are referring to a user undertaking a particular information seeking strategy in order to fulfil some information seeking goal. For example, a user searching for a specific piece of information may induce a "seeking" browsing strategy. Therefore the user may "quickly skip from one node to the next, seldom returning to a previously visited node, seldom spending more than a few seconds at each node and ignoring the associative trails that lead off in varying directions" (Canter et al (1985)'s description of scanning). It is the movements that the user makes as they move through the hypermedia that are termed a "browsing pattern", which can be thought of as a physical manifestation of a browsing strategy. It has been argued previously by Canter et al (1985) and Mullier et al (1999) that browsing patterns offer the potential to extract information about the user's information seeking goal. Research at Leeds Metropolitan University has produced a neural network based system that is capable of recognising browsing patterns and ascribing meaning to them, a description of this system can bee found in Mullier et al (1998, 1999) and a thorough discussion in Mullier (1999). The remainder of this paper is concerned with the potential uses of browsing patterns and some experimental evidence to support the contention that they are of use.

Canter et al (1985) and McAleese (1993) have formally identified five browsing strategies.

1) Scanning - covering a large area without depth.
2) Browsing - following a path until a goal is achieved.
3) Searching - striving to find an explicit goal.
4) Exploring - finding out the extent of the information given.
5) Wandering - purposeless and unstructured "globe trotting".

Uses for Browsing Patterns

Canter et al (1985) suggest that browsing patterns represent some "important psychological information about the user". Since the browsing pattern is a result of the user's information-seeking goal it may be possible to identify this information-seeking goal from the browsing pattern. The information-seeking goal may then be used to tailor the hypermedia system to aid the user. For example, current web agents use keyword matching to aid a user of the World Wide Web, by offering pages with similar content (keywords) (Armstrong et al 1985). Further, offering web pages of similar content is only useful for certain information-seeking strategies, namely those that involve the location of specific information. However, as Cartledge and Pitkow (1995) point out, keyword matching can not take into account the possible dynamic behaviour of the browser, in terms of the potential for the browser to change their goals and strategy at any instant. Similarly, Armstrong et al (1995) note that their browsing support system "Web Watcher" is restricted to being an adviser only because it "might not perfectly understand the user's information seeking goal". Information-seeking strategies, such as general browsing, are not aided, and may be hindered, by keyword matching. The identification of browsing patterns may therefore provide additional information for a web agent (or hypermedia agent) so that keyword matching can be enabled or disabled, as the situation requires.

The Meaning of Browsing Patterns

Once a particular browsing pattern has been identified it is necessary to link the pattern to information that can be used to directly aid the student. It is envisaged that identification of the browsing pattern could be employed to tailor the presentation of information to a user in such a way so as to model their interests more closely. For example, if the student is generally interested in the domain then it may be useful to present them with a selection of different topics from the domain, whereas it would be better to offer more detailed information if they are looking for a specific item of information. The Hypernet system developed at Leeds Metropolitan University to explore issues relating to educational hypermedia (Mullier et al 1998, Mullier 1999) contains a sub-system (the Browsing Pattern Recogniser) which is able to identify browsing patterns. Browsing patterns are then mapped onto a student ability level (obtained by Hypernet is response to a student's interactions with tutorials) and the task the browsing pattern is employed for (as provided by the Hypernet), by a second sub-system termed the Fuzzy Rule Base (FRB). It is an advantage that Hypernet is a tutoring system, since this enables a dialogue with the student, the results of this dialogue can then be used to ascribe meaning to a browsing pattern. For example, if a novice student uses a particular browsing pattern to solve a particular problem (and the type of student and type of task are known) then it may be that this type of browsing pattern is often used in such a way. Obviously it is not desirable to make such a distinction based upon one example, therefore the Hypernet system has been designed to map general trends from a large number of examples. Hypernet achieves this by using a combination of fuzzy logic and neural networks, this is discussed further in Mullier et al (1998 and 1999) and is discussed in detail in Mullier (1999).

Recognising Browsing Patterns

Canter et al (1985) suggest that browsing patterns are formed from lower level browsing structures (constructs); termed "spikes, "rings", "paths" and "loops". These constructs connect together to form higher level browsing patterns (searching, scanning etc.). These browsing patterns may then form part of a user's overall browsing strategy. This presents a problem for automatic recognition, since it is not readily apparent where one construct ends and another construct begins. It could also be argued that constructs merge into each other. For example, a large loop can also be thought of as a path, until the point where it crosses a previously visited node. Further, the diagrammatic representations of browsing patterns are not accurate representations of the actual constructs and browsing patterns. This is because the diagrams are drawn in two-dimensional space, whereas the constructs themselves do not exist in such a space. For example, the ring diagram shows a trail arcing over upon itself until it crosses a previously crossed node. In reality, it is only because one node has been visited twice that this construct becomes a loop. Although Canter et al (1985) do not note this deficiency in representation explicitly they do provide a mechanism for overcoming the problem. They do not attempt to identify constructs individually, instead they describes a user's browsing pattern as being comprised of several indices, namely the path, spike, ring and loop indices, identified on figure 1 as Path PQ, Ring RQ, Loop LQ and Spike SQ. However, they admit that their indices present "calculation problems" since indices can overlap and become fuzzy in nature and there is therefore a requirement for "more complex and subtle algorithms". It can be seen then that the low-level browsing constructs merge into one another to form the complex browsing patterns. The task then, is to identify these constructs and relate them to the overall browsing pattern. The browsing pattern may then be used to infer information about the student's overall browsing strategy.

Automatic recognition of browsing patterns, however, presents several problems and their interpretation several more. Firstly, recognising the high level patterns is made complex because a user may adopt more than one pattern for a particular session and may appear to be utilising different patterns depending upon how many movements are examined (Bates 1989). For example, a student may be involved in an overall "searching" strategy (and thus invoke a searching pattern), i.e. they are looking for a specific piece of information. However, they may become interested in a piece of information that they have discovered whilst engaged upon their "searching". The student may then make a short deviation from their current "searching" strategy and "browse" around the area that has caught their interest, before returning to their original strategy. How then is this to be interpreted? Are there three distinct strategies? Are there two? Or is this to be interpreted as one complex strategy? If a symbolic artificial intelligence (SAI) approach to pattern recognition were to be employed then the answer to such questions must be decided upon before a student uses the system. For the SAI designer must decide beforehand the construction of every browsing pattern (that is invoked by a particular strategy) that the system must recognise and encode appropriate production rules.

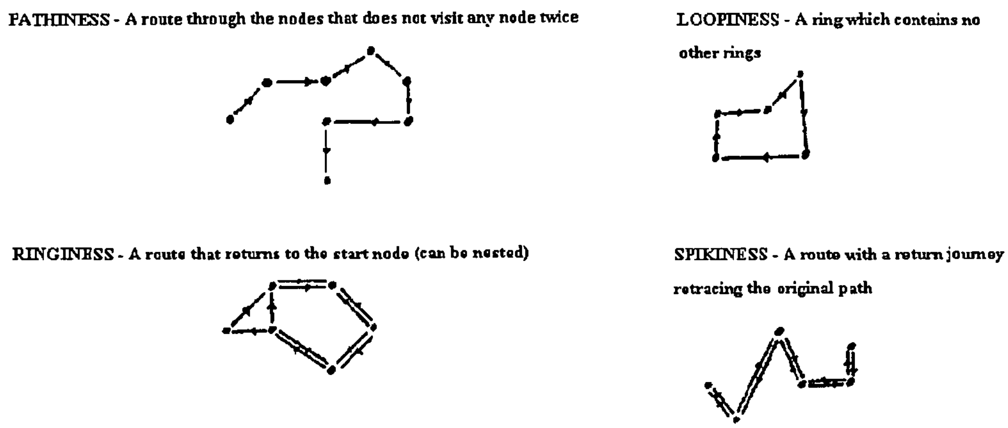


Figure 1

A further problem is that a student may use a particular strategy at one instant and then swap to another in response to some stimulus from the hypermedia domain itself. The rate of sampling, i.e. how many movements the user makes before the system determines the browsing pattern, can therefore result in the system providing differing results. For example, a user may be involved in an overall browsing strategy that is built up of several smaller browsing strategies, in that the student's overall information seeking goal may be served by the employment of several distinct strategies. It is difficult to say whether the student has engaged one overall browsing strategy or several strategies. It is therefore difficult to determine exactly what the student is doing at one particular instant in time. The result of these problems is that different results are obtained from a number of recognition methods.

Low-level Constructs to Browsing Pattern

In order to combat the above recognition problems it is necessary to identify high-level browsing patterns since the low-level constructs do not provide enough information about the student, since they are only formed in a relatively short time period and encompass a small amount of the domain (in comparison to an overall browsing pattern formed by the student to solve a particular information seeking problem). This is possible in Hypernet because it can identify the start of a browsing pattern. The start point can be defined as the point at which time the student leaves a tutorial node, i.e. they have been given a task to complete by the tutoring system. They then engage upon a browsing strategy, which induces a browsing pattern, in order to complete the requirements of the tutorial node. Once they have satisfied the requirements, the browsing pattern has concluded. Once the high-level browsing pattern has been identified, in terms of its start and end points, then the system may process it. It is stressed that Hypernet is a research system and is used here to extract these browsing patterns (and record them) so that they can be used afterwards in other systems (such as the WWW). It is therefore not necessary to always identify the start and end points of a browsing pattern, once Hypernet has recorded a representative sample the start and end points are patterns themselves within the sample. This situation is analogous to recognising the handwriting of an unknown script, in that enough examples should make the script clear. This is similar to the Case-Based Reasoning approach used by Micarelli and Sciarrone (1998) to identify content-based browsing patterns, in that recognition of the current case is based upon similar cases encountered previously. A possible criticism of this approach is that browsing patterns recorded as part of Hypernet may be specific to Hypernet and may not exists in other systems. As McAleese (1993) points out certain browsing strategies are facilitated by certain interface styles (graphical browsers and text-based browsers), it therefore follows that the interface style (in this case Hypernet's interface) has a direct influence upon the browsing pattern produced by the student's browsing strategy. However, it is likely to be the case that there is a core of patterns that are common to all styles. The recognition system may therefore record general information as part of Hypernet and may then adapt to individual browsing systems that it may subsequently be employed within.

In order to demonstrate that relationships exist between the browsing patterns made by similar types of user, in terms of interests (information seeking goals) and abilities, several experiments were undertaken. This information is to be collected by Hypernet as it is used over a prolonged period. However, this is a long-term goal of the current research project, in the meantime a smaller scale study was performed. This study is described below.

Browsing Experiments

The purpose of the browsing experiments is to establish whether different types of students browse the hypermedia in different ways and whether similar abilities of students show similarities in their browsing behaviour. The experiments have provided some interesting information that warrants further study.

The initial results demonstrate that, for the population of subjects tested, there are distinct differences between expert browsers and novice browsers. Further, results have demonstrated that there are two distinct types of novice students. A novice student may show reticence to move away from the initial node and therefore does not explore the domain. By contrast another type of novice student recklessly moves away from the initial node and become quickly lost.

Method

A simplified astronomy domain was dispatched to volunteers contacted via Internet news groups. The domain has a few tens of nodes representing information to varying depths. High-level nodes represent such items as planets and satellites, detailed nodes represent such items as weather systems, plate tectonics and probe missions. Volunteers were required to grade themselves into one of three grades of expertise with the solar systems domain: 1) Expert, 2) Intermediate, 3) Novice. Volunteers who described themselves as experts were obtained from astronomy related news groups on the Internet. Novice were generally the children of the expert volunteers. Intermediate users were people who has a passing knowledge of Astronomy but had not studies it at University.

The prototype system, supplied to the volunteers, recorded all browsing information and stored it on the volunteer's hard drive. The volunteer could then email the browsing data back for examination. Information recorded by the system was a real number value representing whether a node had been previously visited or not. Every time a student moves from one node to another the current node has its "visited value" set to one, whilst all other nodes that have been previously visited have their visited values reduced by a small amount. The actual amount is a function of the number of total nodes in the domain. This method allows for the representation of all of Canter et al's (1985) browsing patterns and provides some measure of temporal information.

Volunteers were given two tasks to accomplish, the first gave them a certain piece of information to find, the level of difficulty being dependent upon their self-perceived ability level. The second task was to browse the hypermedia for as long as they liked. Participants then emailed the results back at their leisure.

Results

The results described below are from a population of 11 volunteers. These were separated into three categories: 6 novices, 2 intermediate and 3 expert.

Results for expert level browsers demonstrated that they tended to use rings and loops with a high degree of pathiness. This is indicative of them being sure of the layout of the domain (since it is organised in a structured manner) and they are only crossing previously visited nodes as a means of getting to their destination, which could be determined because they only spent a second or so at each node on their return journey. The free browsing exercise produced more spikes, although these tended to be more distinct than for the novice levels of browser, in that they were likely to be returning along the same path to get to their next point of interest.

Novice browsers were more complex than expert browsers. They tended to be more chaotic in their behaviour, in that it was more difficult to discern regular patterns, although several distinct patterns did emerge. Novice browsers tended to use spikes much more than expert browsers. These spikes also tended to be short and often centred on a small cluster of nodes. This is indicative of the browser being reluctant to leave an area with which they are familiar. Novice browsers tended not to use loops and rings, suggesting that it is important to have an understanding of the structure of the domain before the browser can return to a previously visited node via a different path. It is also important to note that returning to a previously visited node is easily accomplished by selecting the "back" button (as in most hypermedia systems). This will automatically produce a spike. Hence novice students could return to a known point by the easier option of selecting the back button (and hence producing a spike), whereas intermediate and expert users were more likely to navigate themselves, perhaps via a shorter route which was already known to them.

Novice browsers tended to fall into two categories, the first category are reluctant to leave the area with which they are familiar. The second category tended to be more adventurous and move away quickly from the area. It is not a simple matter to determine which strategy is generally the more productive. The reticent browsers were obviously intent upon the domain and did not want to lose themselves, thus demonstrating their interest. It is possible that the more adventurous browser was just aimlessly wandering (a strategy identified as being undesirable by Canter et al (1995)). It was not possible to determine this with the free browsing task, since if the browser is not tested then it is impossible to determine whether they are involved in their own novel browsing strategy. The given task did however, provide some information with which to make a determination on a particular browsing pattern, in that the student's success with the task is an indication of the usefulness of their strategy. Results demonstrated that some browsers were indeed wandering, in that they were unable to fulfil the task or took much longer to accomplish it than other browsers of the same level. Obtaining this browsing pattern information whilst the student was using the system may have enabled the presentation of material to aid the student. However, some low-level students that appeared to be adventurous, did accomplish the task and often in times much quicker than reticent browsers. There were not enough examples of each type of novice browser to make a further determination about how these types of pattern differ and may be independently recognised. However, it is likely that there are differences that could be determined, given a larger set of example data. This is a major reason why a mechanism has been developed as part of the current research project to automatically obtain this information.

In summary then, novice browsers tend to use spikes, probably because they are unsure of the structure of the domain and need to use navigational cues. More expert users tend to use rings and loops, probably because they are more certain of the structure of the domain and know which node to return to in order to further their travels. Therefore there may be a strong correlation between spikes and more novice students and rings and more advanced users. Larger path values indicate the more adventurous types of user. However, even this small-scale study demonstrated that all levels of user did exhibit all of the browsing constructs to some degree, it is therefore not just a matter of relating a particular construct to a particular ability level.

Discussion

The experiments were limited in that they employed a restricted domain of only a few tens of nodes and only a few people were involved. However, the results have demonstrated some interesting relationships between individual browsing constructs and certain ability levels of student. This, along with research conducted by Canter et al (1985) and Micarelli and Sciarrone (1998), indicates that different types of student may use different browsing patterns and goes some way therefore, towards justifying the use of browsing patterns as a method for extracting information about the users of information resources.

An important outcome of this study was the identification of two types of novice student, namely adventurous and reticent browsers, with the possibility of the adventurous browsers being wanderers or "advanced novices". It should be stressed however, that this was a small study and this result may be unique to the study. It may also be that larger studies reveal more distinctions between people of the same level

The experiments give some evidence that Canter et al's (1985) low-level constructs are utilised to different degrees by different types of student. Expert students tended to use loops and rings with a high degree of pathiness and not to use spikes as much as more novice students. However, it must be remembered that the domain in use was highly structured. It may be that different patterns emerge for different types of domain.

Conclusion

This paper has discussed the patterns made by users of hypermedia systems and means of identifying and utilising them in order to determine information about the student, this information may then be used to aid them use the hypermedia. The browsing experiments suggest that different types of student do use low-level browsing constructs to different degrees and that a method for recognising these patterns is a potentially interesting and useful method for extracting some information about students and users of information structures. Further research is currently investigation a method for collecting browsing data over the World Wide Web, which potentially offers the large amount of browsing data required to make some determination as to what each pattern is used for.

References

Armstrong R, Freitag D, Joachims T, Mitchell T, 1995, WebWatcher: A Learning Apprentice for the World Wide Web, **In 1995 AAAI Spring Symposium on Information Gathering in Distributed Environments**, Stanford March 1995

Bates M J, The design of browsing berrypicking techniques for the on-line search interface. In **Online Review, Vol 13, No. 5, 1989, pp 407-431**

Canter D, Rivers R, Storrs G 1985, Characterising User Navigation through Complex Data Structures, In **Behaviour and Information Technology**; Volume 4, Issues 2, p93-102; 1985

Cartledge L, Pitkow J, Characterising Browsing Strategies in the World Wide Web. In **Proceedings of the 3rd International WWW Conference '95, Technology, Tools and Applications, Dormstadt, Germany**

McAleese R, 1993 Navigation and Browsing in Hypertext. In **Hypertext Theory into Practice**; R.McAleese (ed). Blackwell Scientific.

McAleese R, 1990 Concepts as hypertext nodes: The ability to learn while navigating. In **Hypermedia for Learning**; D.Jonassen (ed). Springer-Verlag.

Micarelli A, Sciarrone F, 1998, A Case-Based Approach to Usr Modelling, In **Proceedings of EWCBR-98 in Dublin.**

Mullier D J, Moore D J, A Web based Intelligent Tutoring System. In **Proceedings of NETIES at Leeds Metropolitan University**, 1998

Mullier D J, Hobbs D J, Moore D J, A Hybrid Semantic/Connectionist Approach to Adaptivity in Educational Hypermedia Systems. In **Proceedings of ED-MEDIA'99**, Seattle, WA. 1999

Mullier D J, 1999, The Application of Neural Network and Fuzzy-Logic Techniques to Educational Hypermedia. PhD thesis. Available from www.lmu.ac.uk/ies/comp/staff/dmullier/thesis/thesis.html

Learning Legal Case Solving with the Computer Program PROSA

Antoinette J. Muntjewerff
Department of Computer Science and Law
Faculty of Law
University of Amsterdam
The Netherlands
muntjewerff@lri.jur.uva.nl

Abstract: The computer program PROSA is an instructional environment for learning legal case solving. PROSA stands for PROblem Situations in Administrative law. PROSA enables the student to engage in legal case solving. PROSA supports, guides and evaluates the student's activities and outcomes.

The Computer Program PROSA

The computer program PROSA is an instructional environment for learning legal case solving. The instructional environment consists of two horizontal layers and three vertical columns (see Fig. 1).

In the upper layer the stimulus materials to elicit the required performance are presented specified to type of material in the different columns. In the lower layer the learner guidance and response are presented specified to type of support. In PROSA the student is required to engage in legal case solving. Legal case solving is the construction of a legal solution for a specific legal case. In the construction process the legal rules are the legal problem solving tools. To construct a legal solution for a legal case the student has to select legal rules. A distinction is made between legal case solving activities, the process, and the legal solution constructed, the product. Both process and product are assessed in PROSA. PROSA offers two types of support: elaborations and response. An elaboration presents prerequisite knowledge and examples. The student may request an elaboration at any moment in the legal solution construction process. A response is a reaction of PROSA to an activity of the student or to an outcome produced by the student. A legal case solving session in PROSA is described in more detail to see how the instructional environment makes a student perform in legal case solving.

A Legal Case Solving Session in PROSA

The student has to carry out a series of activities to solve a specific legal case. The student has to use the output of the activities to construct the legal solution. There is one series of activities that is classified as the most recommended route. However, there is some variation possible in the sequence of activities. These routes are classified as possible routes. Variations of activities that are not desired are not possible in PROSA. The description of a session in PROSA is based on the most recommended route.

Constructing a Legal Solution

In PROSA legal case solving starts when the student has selected a legal case. The student first has to select a legal case from the set of available legal cases using the menu button legal case. The legal cases in PROSA are arranged to topic. Within each topic the legal cases are arranged to level of difficulty. The selected legal case is presented in the upper layer in the legal case part (e.g. the Alexander Boer case topic: interested party; difficulty level: easy). At the same time the question that belongs to the case is presented in the upper layer in the construct legal solution part (e.g. Is Alexander Boer an interested party according to the General Administrative Law Act? see Fig. 1).

The Process Activities Select and Match

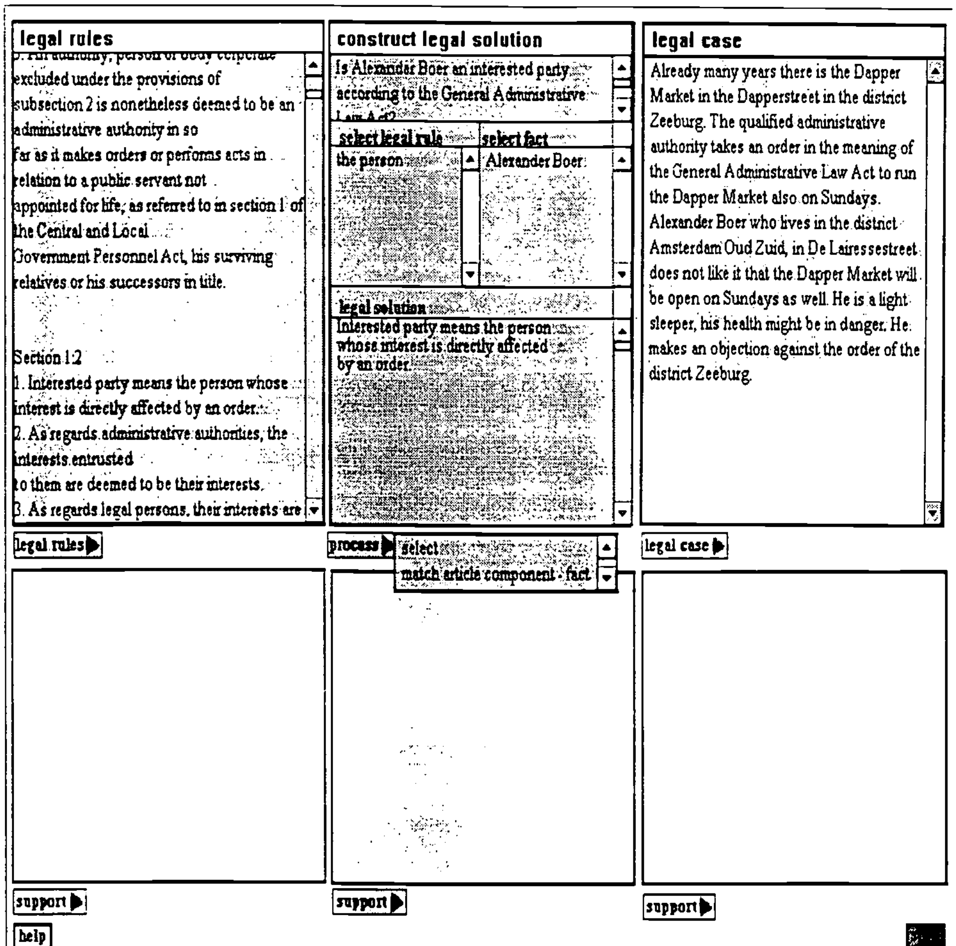


Figure 1: The instructional environment in PROSA

The student now has to construct the legal solution for the legal case presented. This construction process involves using the buttons process and product in the construct legal solution part in the upper layer. The student first has to select the menu button process. The process button shows the two basic legal case solving activities: select and match. The first activity to carry out is select. Being presented with a legal case either a legal rule or a fact from the legal case has to be selected. The option select causes a change in the construct legal solution screen. A distinction is made between select legal rule and select fact. There also appears a specific part in the construct legal solution screen that is titled legal solution. This is were the student has to put thc outcomes of the various activities, and so construct the legal solution (see Fig. 1).

Select a Legal Rule

The student now has to select a legal rule by choosing the legal rules button in the legal rules part in the upper layer. This button shows three different source categories of legal rules: statutes, other regulations and precedents. Within the statute option a further classification of statutes is made based on the area of law the statutes belong to. The student selects the option statutes from the legal rules button and then selects the statute that is applicable given the specific legal case and question to be answered (e.g. the General Administrative Law Act). The selected statute is presented in the legal rules part of the screen. Then the student has to select an applicable article (e.g. Interested party means the person whose interest is directly affected by an order.

This article has to be dragged to the construct legal solution part of the screen, in the specific sub part select legal rules. The student can then bring this article to the legal solution (see Fig. 1).

Match Article Component and Fact

An article is still too abstract to be matched to a specific case fact. Therefor the student has to decompose the article in its article components (e.g. the person; an order; interest is directly affected). The selection of an article component is followed by the selection of a fact from the legal case that can be related to the article component (e.g. Alexander Boer). Using the match option in the process menu relates the article component to the selected fact (e.g. the person = Alexander Boer). This relation is then automatically placed in the legal solution.

Answer the Question

The select activity has to be repeated until there are no statutes, articles, article components and facts left. The match activity has to be repeated until there are no more article components or facts. At that stage the student has to formulate the final answer to the question. She has to select the menu button product and choose the option answer (e.g. A. Boer is not an interested party in the meaning of the GALA) (see Fig. 2). The product button available in the construct legal solution part in the upper layer of the screen offers a set of option. These are: bring to solution, cut, up, down, large screen and answer. The option large screen is offered to enlarge the legal solution part to get a better overview of the legal solution constructed so far.

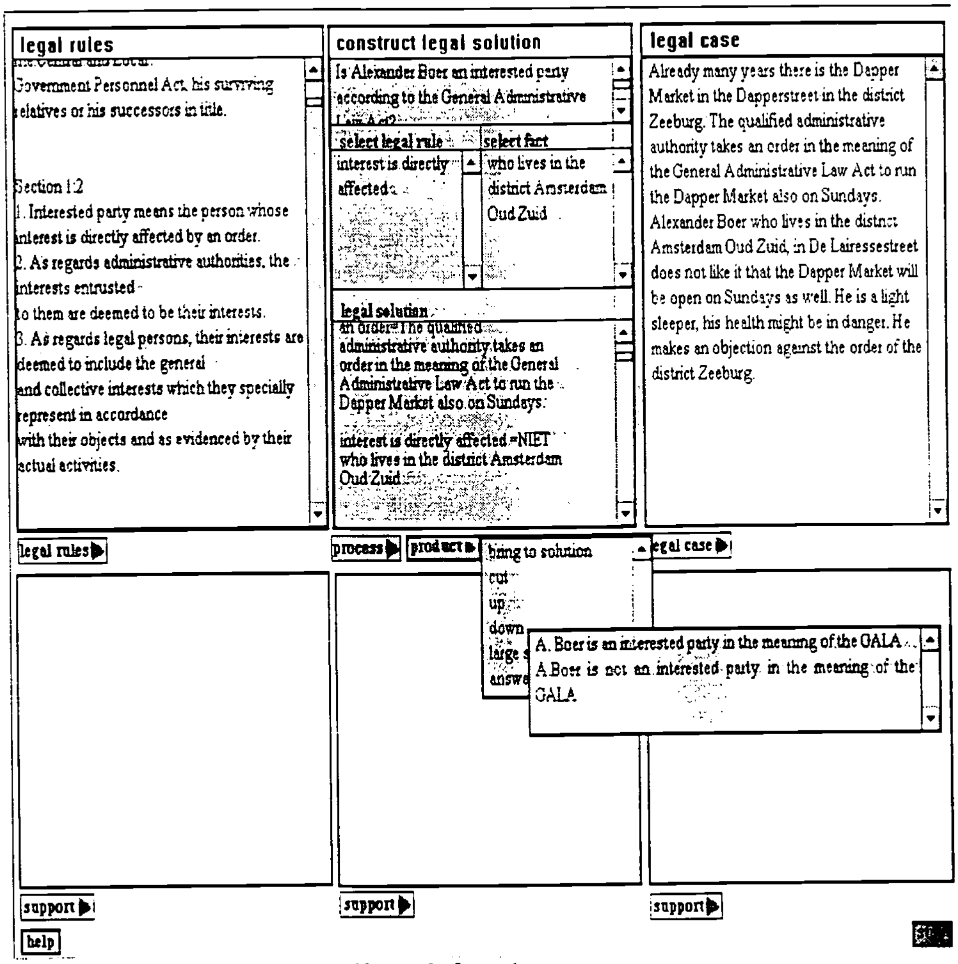


Figure 2: formulate answer

Elaborations and Response

In the lower layer the support is presented. There are two types of support: elaborations and response. The student may request support at any moment in the legal solution construction process. An example of an elaboration available in the legal case part of the lower layer in the form of a list of domain concepts is presented in Fig. 3. When selecting a particular domain concept, for instance interested party, the background knowledge about the concept and a reference to statutes and articles within statutes are presented.

The student can use the assess button in the construct legal solution part in the upper layer to ask for an assessment of her activities (the process) and her legal solution (the product). The process is assessed according to the route followed. The product is assessed on completeness, correct sequence and correct answer. The assessment results, specified to process and product, are presented in the construct legal solution part in the lower layer.

BEST COPY AVAILABLE

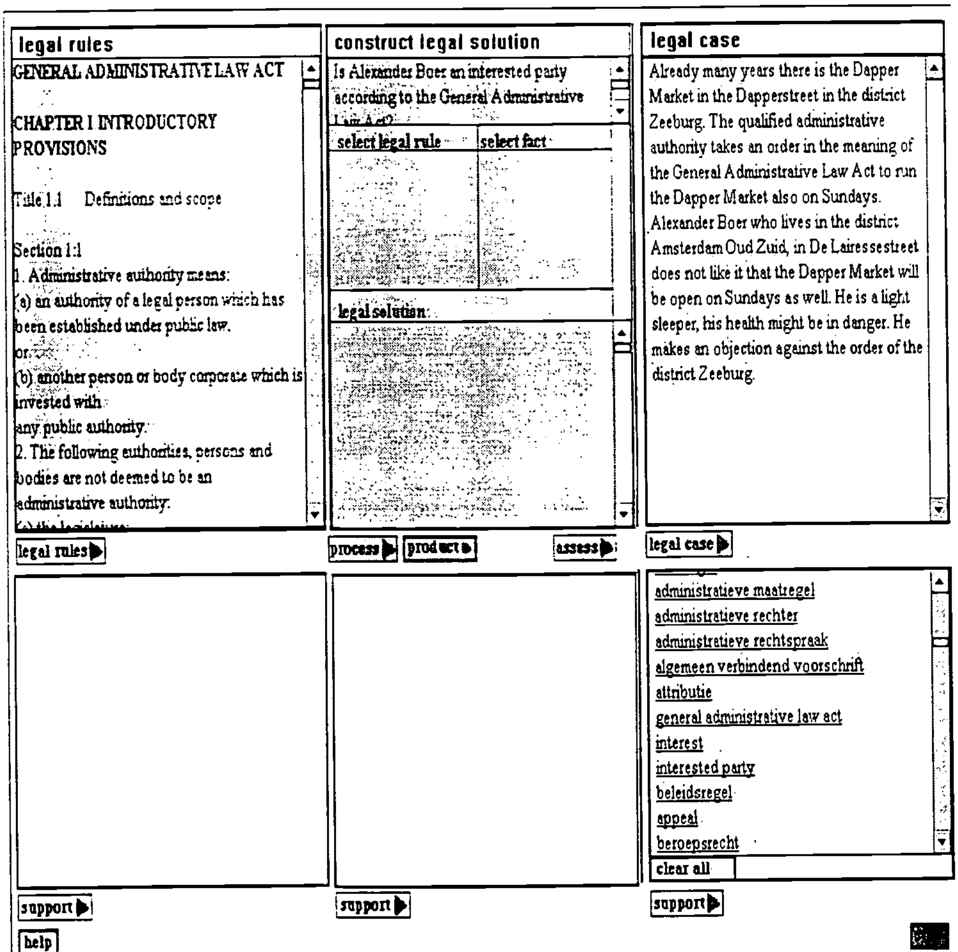


Figure 3: presentation of an elaboration

Implementation of the computer program PROSA

The program Authorware is used for implementing the specification of the design of the instructional environment. Authorware is an authoring environment for creating and publishing interactive information and can be used for the construction of interactive learning and training applications. Authorware has many evaluation functions that make it possible to handle all kinds of input. The program Authorware has been chosen for the realization of PROSA on the basis of these specific Authorware aspects: interactivity and evaluation of input. As Authorware is an icon-based authoring tool, a program is made by assembling icons on a flow line. Different types of icons contain different types of objects like text, graphics or a set of instructions and herewith the content of a program. The way in which these icons are arranged on the flow line forms the architecture. In Fig. 4 the top level of the architecture of PROSA is shown. The icons on the main flow line are visible at this level.

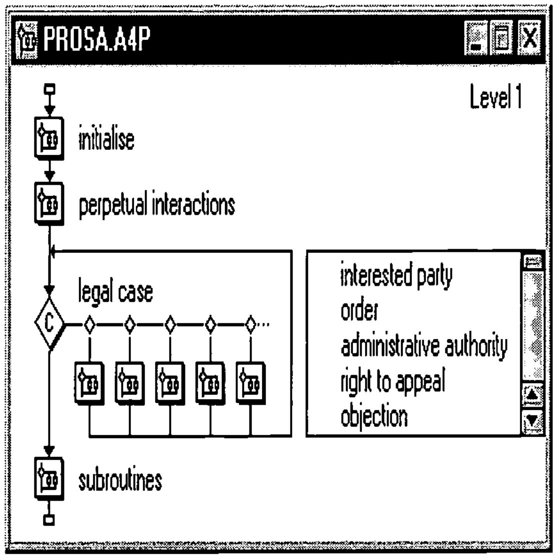


Figure 4: the top level of the PROSA architecture

Initialize

When PROSA is run, Authorware executes the icons from top to bottom along the flow line. The first icon that is executed is the *map icon* 'initialize'. This map icon contains a number of *display icons* that contain the first screen, the so-called startup screen. Furthermore the variables used in PROSA are defined and initialized in a *calculation icon*. These variables are used to keep track of the students' actions and to store and use general PROSA information like available items for the menu buttons. And finally the 'initialize' icon contains *display icons* which contain the standard PROSA screen with the two layers and three parts (see Fig. 1). This 'initialize' icon is executed only once per session.

Perpetual interactions

The second icon 'perpetual interactions' (see Fig. 4) contains two kinds of so called *perpetual interactions*. An interaction is an *interaction icon* with different types of response type symbols attached to it. These response type symbols tell the interaction icon whether to display a button, a menu, a text-field or some other element. An interaction monitors the actions of the student and sends that information to the response type symbols attached to it. If Authorware encounters a perpetual interaction it activates the interaction and immediately continues down the flow line. This is used in PROSA because the student is given personal control in learning to solve legal cases. The first perpetual interaction displays the menu buttons available for the six different parts and defines the reaction of PROSA when the student uses the buttons. The student throughout the whole session of solving a legal case can use these buttons. The second perpetual interaction defines the responses of PROSA to the students activities regarding the construction of a legal solution in the sub parts select rule, select fact and legal solution part in the construct legal solution part of the screen. An example of such a student activity is dragging an article to the 'select legal rule' sub part of the construct legal solution part.

Main loop

After the perpetual interactions the main loop of the program occurs, the so called *decision icon* 'legal case' with *map icons* for every case topic attached to it. Within each case topic map a similar *decision icon* for the different levels of difficulty is used. When Authorware encounters a decision icon it branches to a path according to certain criteria. In PROSA these criteria are the choices the student makes. The student uses the menu button legal case and the choices she makes are stored in two variables caseTopic and caseDifficultylevel. On the basis of these variables Authorware first branches to the *map icon* of the chosen case topic and then to the *map icon* of the chosen difficulty level. A difficulty level *map icon* contains (1) *display icons* which contain the legal case text and the accessory question (2) a *calculation icon* in which the correct legal solution is stored in a variable (3) an *interaction icon* to monitor the students activities specific to the chosen case. In the architecture a specific legal case and the accessory question are considered to be the basic element, because it is the current problem to be solved by the student and in this way PROSA is able to give case- and student specific feedback. Also many student characteristics can be recorded per case, like, for instance, the sequence of the students activities in solving the legal case, the legal solution the student constructs and the cases the student selects. These student characteristics are an example of characteristics that are recorded and maintained during all sessions of the student working with PROSA. In this way a student history is built to be able to adapt to the individual students activities and to evaluate the individual student.

Subroutines

The last icon at the top level flow line is the *map icon* 'subroutines' and Authorware never automatically encounters it. This icon contains a number of subroutines implemented as *map icons* attached to *framework icons*. These subroutines appear only once in PROSA, but are called many times by various parts of the program. An example of a subroutine is adding a student activity to the list that is used to keep track of the series of activities the student carries out to construct a legal case solution. Because of the way the main loop in PROSA is structured, new legal cases of the existing topics and difficulty levels can be added easily. Furthermore, legal cases of new topics and difficulty levels can be added. For each new case topic and difficulty level a new *map icon* containing the case specific *display, calculation* and *interaction* icons has to be added. The same structure can also easily be used for a different domain if the problems to be solved can be divided in a hierarchy of topics and difficulty levels.

References

Aleven, V. (1997). *Teaching Case-Based Argumentation Through a Model and Examples.* Pittsburgh: University of Pittsburg.

Anderson, J.R. (1995). *Cognitive Psychology and its Implications.* New York: W.H. Freeman and Company (fourth edition).

Centina, F., Routen, T. Hartmann, A. & Hegarty, C. (1995). STATUTOR: Too Intelligent by half? In Hage, J.C., Bench-Capon, T.J.M., Cohen, M.J. & van den Herik, H.J. (Eds.). *Legal Knowledge Based Systems: Telecommunications and AI & Law JURIX'95.* Lelystad: Vermande.

Crombag, H.F.M., de Wijkerslooth, J.L. & Cohen, M.J. (1977). *Een theorie over rechterlijke beslissingen..* Groningen: Tjeenk Willink. (A theory on decisions by judges).

Gagné, R.M. (1985). *The Conditions of Learning.* New York: Holt, Rinehart and Winston (fourth edition, first edition 1965).

Haan, N. den (1996). *Automated Legal Reasoning.* Amsterdam: Thesis University of Amsterdam.

Henket, M.M. & Hoven van den, P.J. (1990). *Juridische vaardigheden in argumentatief verband.* Groningen: Wolters-Noordhoff. (Legal skills in argumentative context).

Keller, J.M. & Suzuki, K. (1988). Use of the ARCS Motivation Model in Courseware design. In: Jonassen, D.H. (1988). *Instructional Design for Microcomputer Courseware.* Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Merrill, M. D. (1983). Component Display Theory. In: Reigeluth, C.M. (1983) *Instructional design theories and models: An overview of their current status.* Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Muntjewerff, A.J. (1991). *Legal Experts and Law Students Solving Legal Cases while Thinking Aloud.* Transscripts of the protocols. Amsterdam: University of Amsterdam.

Pontier, J.A. (1988). *Rechtsvinding.* Nijmegen: Ars Aequi Libri. (Judicial construction).

Scholten, P. (1974). *Algemeen deel.* Zwolle: W.E.J. Tjeenk Willink. (third edition, first edition 1934) (General part).

Span, G.P.J. (1992). *LITES een intelligent tutorsysteem voor juridisch onderwijs.* Maastricht: Universitaire Pers Maastricht. (LITES: an intelligent tutoring system for legal education).

Valente, A. (1995). *Legal Knowledge Engineering. A modelling approach.* Amsterdam: IOS Press.

Role Play, Discussion, and Analysis: Project-based Learning in a Web-based Course

Karen L. Murphy
Department of Educational Curriculum and Instruction
College of Education
Texas A&M University
College Station, TX 77843-4232
e-mail: kmurphy@tamu.edu

Yakut Gazi-Demirci
Department of Educational Curriculum and Instruction
College of Education
Texas A&M University
College Station, TX 77843-4232
e-mail: yakut@tamu.edu

Abstract: In this study, we identify the characteristics of project-based learning activities in an online environment. Based on the data collected from 17 students in a Web-based graduate telecommunications course, we found that the project-based activities were authentic and useful in terms of gaining a variety of skills like group collaboration and communication, facilitation of online activities, and intercultural communication. We describe the strategies used by the instructor and by the student facilitators and participants in project-based learning activities in this online course. We also stress the importance of these kinds of characteristics and strategies of project-based learning activities in terms of course design and implementation.

Introduction

The surge in Web-based and Web-supported courses has prompted course designers and instructors to identify appropriate ways to adapt traditional courses to a Web environment (Khan, 1997). An instructor's typical responsibility is to design, develop, and teach courses and to conduct research. However, in online learning environments, the focus tends to change: the instructor's role shifts from that of the sole dispenser of information to that of facilitator and resource for learning activities (Gunawardena, 1992). The online environment is constructivist in nature, providing an arena for collaborative learning and learner-centered activities. Active construction of meaning (Vygotsky, 1978) about experiences should take place through "experiential exercises followed by interpersonal interaction in small groups, and with facilitators to guide the group towards useful conclusions" (Romiszowski, 1997, p. 33). Project-based learning involves students working collaboratively to solve a problem that results in a product. Project-based learning on the Web presents special challenges and opportunities that groups in conventional settings may not encounter.

This case study describes a Web-based course in instructional telecommunications at Texas A&M University. The following questions guided the inquiry into project-based learning on the Web:

1. What are the characteristics of project-based learning activities that produce the desired learning outcomes in a Web-based course?
2. What are the strategies that the instructor, student facilitators, and student participants use to prepare and conduct project-based learning activities in a Web-based course?

Theoretical Framework

Two theoretical assumptions frame this study about Web-based courses: learner-centered instruction can foster positive learning outcomes, and project-based learning can encourage learner-centered instruction.

Learner-centered instruction. Researchers have described a role change among distance education faculty from the instructor as a content expert to a facilitator of learning and an accompanying shift from teacher-centered to learner-centered instruction (Gunawardena, 1992; Harasim, Hiltz, Teles, & Turoff, 1995). Providing learner-centered instruction requires the instructor to understand the distance learner. In the introduction to her edited book about distance learners in higher education, Gibson (1998) challenges faculty to "do more than provide access to information. We need to truly understand that learner and design learning environments that facilitate learning, environments that enhance access to and success in higher education" (p. viii).

In constructivist learning environments, the instructor provides the overall structure and the parameters for the course. In computer conferencing environments, "course design becomes more important, and preparation entails the structuring of conferences and topics, and the design of activities and small group work" (Romiszowski & Mason, 1996, p. 447). Students in learner-centered settings construct their own learning within the framework of the course in their attempts to make sense of their experiences.

Project-based learning. To meet learners' needs and allow them to profit directly from their learning experience, instructors need to provide authentic activities. Such "coherent, meaningful, and purposeful activities" (Brown, Collins, & Duguid, 1989) are similar to those that Romiszowski (1997) recommends for developing learners' critical thinking skills: small-group discussions, simulation games, project-based work, and collaborative problem-solving activities.

One of these activities, project-based learning, is described as learners working collaboratively over an extended period of time to solve an authentic and challenging problem that results in an end product (Fung, 1996; Moursund, 1998). Project-based activities have explicit educational goals and are typically learner-centered, rooted in constructivism, and facilitated by a teacher who acts as a facilitator. The "rich environments for active learning" in which project-based learning is likely to occur engage learners "in a continuous collaborative process of building and reshaping understanding" (Dunlap & Grabinger, 1996, p. 67). Fung (1996) lists the following advantages of project-based learning—the encouragement of student initiative, self-directedness, inventiveness, and independence.

The literature has identified ideal characteristics and responsibilities of learners and instructors involved in project-based learning. For example, a study of British Open University students participating in project-based learning in a telecommunications environment found that the students were required to have heightened levels of self-confidence, motivation, and the ability to organize their own work plans (Fung, 1996).

The Project

"Applications of Telecommunications in Education" is a Web-based graduate course that focuses on instructional applications of telecommunications; the analysis of characteristics of varied systems, both dedicated and public networks; and the design of appropriate instructional strategies and methods using those systems. The course is designed to help learners apply the latest developments in telecommunications technologies to specific education or training contexts.

The instructor designed the Fall 1999 course for students to engage in constructivist learning through a combination of independent and project-based learning activities. The course materials were available on the Web, and the students used FirstClass™ computer conferencing software to communicate with their classmates and the instructor and to do all of their coursework. The students sent private messages through the FirstClass closed email system and public messages to the conferences, and they used the chat function to hold scheduled and impromptu real-time text-based discussions with their project groups. FirstClass also allowed them to attach files and work together on collaborative documents.

Students had three independent activities in this course. The major independent activity was a "report for action" addressing an educational or training problem that might be solved through the application of telecommunications. Students were also required to keep a telecommunications journal for their reflections on learning and teaching in an online environment. The students' classmates and the instructor could read these "public" journals. Finally, the students completed pre-existing evaluation forms for group presentations, Web sites, formative evaluations, and pre- and post-course surveys.

Two project-based learning activities that took place in small groups —generally three to four students per group—were facilitating the unit activities and developing a Web site. The five two-week units were based on the assigned readings and included discussions, role-play, case-study analysis, Web site evaluations, and panel discussions. The students were told in advance which type of activity would be used for each unit theme. This project was designed to assist students with their individual action reports, to guide them through the content of the course, and to foster skills in communicating effectively with co-facilitators in planning, implementing, and synthesizing the unit. The other project-based learning activity was creating and publishing a Web site about an issue critical to telecommunications in education. The students selected their topics from a list of options including equity issues, digital libraries, futuristic issues, literacy, and copyright issues and were assigned to those groups on the basis of their common interests. The five critical issues Web sites were designed to be used by future classes as well as by the general public.

Methods

This study is an investigation of two project-based learning activities in a graduate level Web-based course. We asked about-- (a) the characteristics of project-based learning activities that produce the desired learning outcomes, and (a) the participants' strategies for preparing and conducting the project-based learning activities.

Participants. The participants were the 17 students enrolled in the Web-based course in Fall semester 1999. Thirteen of the students were females and only four were males. Ten were master's students primarily in the educational technology program, while the seven doctoral students represented three departments in the College of Education, and one was from Computer Science. The class consisted of an unusually high percentage of international students: nine of the students were from the United States, while the other eight were international students who spoke English as a second language (ESL).

No students had taken a Web-based course before enrolling for this course, though two of the students were taking a second Web-based course simultaneously from the same instructor. The students' previous experience with taking coursework at a distance was limited to two-way interactive videoconference in combination with computer conferencing. Their telecommunications skills were varied: one student used email only rarely prior to the beginning of the course; most were accustomed to using computers and telecommunications in their studies; and a few had jobs that were based on telecommunications.

Data sources. The data sources included: (a) students' online communication through FirstClass threaded computer conferencing messages, collaborative documents, and real-time chats; and (b) students' evaluations and assessments, and interviews with the students via FirstClass.

Evaluations and assessments were used prior to beginning the course, during the semester, and at the end of semester for varied reasons. The pre-course surveys provided participants' background information and their perceived readiness for an online class. During the semester, students assessed their own and their group members' contributions to the two group projects by completing and sending private group evaluation forms directly to the instructor. Formative evaluations took place as a single collaborative document, to which the students contributed anonymously. Beginning in the fifth week of the semester, the instructor asked the students to "assess how things are going" by contributing to the formative evaluation. During the last two weeks of the semester, the instructor asked the students to contribute to another collaborative document "Final Thoughts" to get feedback on the various aspects of the course, including the books, assignments, and the use of FirstClass for communication and the Web for obtaining course information. Students also completed an online course evaluation administered by the university.

The graduate assistant used FirstClass to conduct the interviews. Interviews were open-ended and included questions about students' experiences as facilitators and participants in project groups. The questions aimed to uncover perceptions about the different types of activities.

Data Collection and Analysis. The investigation relied on case study methods, which are characterized by rich description of processes (Merriam, 1998). The case study describes the characteristics of problem-based learning activities and the strategies used to prepare and conduct these activities in a Web-based course. We conducted the electronic interviews and downloaded all of the electronic evaluations and assessments from FirstClass conferences and from the Web, copying them into individual files for each data source. We conducted content analyses of the data sources (Krippendorff, 1980). This process consisted of coding the data by categorizing them according to the two research questions, using QSR NUD*IST (Non-numerical Unstructured Data*Indexing Searching and Theorizing) qualitative data analysis software. For each major theme regarding the research questions, we created "nodes" or categories; and for each sub-theme we created "child nodes" or sub-categories. We generated four nodes (i.e., Website Projects, Group Activities, Facilitator Strategies, and Participant Strategies) and 40 child nodes (e.g., Preparation in Advance and Periodic Contact for the node Facilitator Strategies).

We reported on the data using the participants' verbatim accounts. We established the following method to identify messages that are quoted verbatim in the text: the data source and the author of the message (if known). The data sources are: I=Interview, F=Final Thoughts, and S=End of Course Surveys. Each student was assigned a number. Message identification is enclosed in brackets after the verbatim messages in the text. For example, a message that Student 11 wrote in the Interview would be identified with this description: [I-11].

Results

The results of the two research questions are addressed in this section. These questions are concerned with the characteristics of project-based learning activities that produce the desired learning outcomes, and the participants' strategies for doing project-based learning activities.

1. **What are the characteristics of project-based learning activities that produce the desired learning outcomes in a Web-based course?**

The intended learning outcomes for project-based learning activities were based on the learning objectives specified at the beginning of the course. The project-based learning objectives were--

- In a small group, create and publish a well-designed research-based Web site that focuses on a critical issue facing telecommunications.
- Demonstrate proficiency in participating in and facilitating online activities and discussions.

We identified four characteristics of project-based learning activities that produce the desired learning outcomes in a Web-based course: (a) authentic activities; (b) collaborative work and communication via telecommunications; (c) opportunities for knowledge enhancement and skill building; and (d), intercultural communication skills.

First, the learning experiences were designed to be authentic, i.e., the students were to engage in actual real-life situations. The students created real Web sites, which were research-based, published on the Web, and used by others to obtain needed information about critical issues in telecommunications. Most students responded that the Web site activity was fairly authentic, although many students "would have liked one less group activity and more time to improve on those completed" (F-anon]. The students perceived the unit group activities to be somewhat more authentic, as they planned, implemented, and synthesized the activities related to the assigned readings. One student shared that, to him, authentic "means purpose was generated by the learner and acted upon ... in terms of learner arranged tasks, i believe it was authentic" [I-12]. However, he continued to explain that "to be truly authentic, the students would have had to recognized the problem" [I-12], possibly conveying that the students didn't select their own topics and instead were presented with a list from which to choose. Two students wrote in the final course survey that the course was strengthened by projects that were "meaningful" to them [F-anon].

Second, the project-based learning activities provided opportunities for the students to work as a team, which is an activity encountered frequently in real-life. By participating fully in these activities, the students learned how to work collaboratively in a group and communicate via telecommunications. An ESL student explained how the group projects helped her: "By working with my partners, I improved my language skills, ability of organizing my thinking, and rate of interactions with others, also technological skills for handling online communications" [I-17]. To another ESL student, the projects were "a means of learning how cooperate and exchange ideas, knowledge, materials" [I-8]. The same ESL student continued to explain how the Web site project provided a good opportunity for a "teamwork learning environment":

> 1) It has several different aspects such as site development, presentation to content selection; 2) Many times group members need to decide things for its group and a compromising decision process happens; 3) Each group member has strengths and weaknesses. When members working together they can learn to improve weakness and creating new ideas with strengths. [I-8]

Third, the activities fostered the development and enhancement of a variety of skills. Some students referred to their learning gains in terms of objectives, while others identified a variety of skills they gained as an outcome of these activities. They referred to having built content knowledge, even becoming an expert, as one student expressed, "at the end, I became an expert in that issue to some extent" [I-8]. They also referred to the dual benefit of applying new content knowledge to Web site creation. One student claimed that "the project was a good one because not only was I learning about the topic, … but I was also becoming better at making web pages" [I- 5]. Similarly, "It not only help me understand the topic itself, I also learn a lot about how to design a web site" [I-4].

Fourth, the activities provided for the development of intercultural communication skills by working in a multicultural environment. The American students developed the skills as "a conscious effort to keep from regressing into Texas slang and colloquialism" [I-12]. Another American student reflected, "I believe that in the planning and implementation of the activities, groups had to be sensitive to the differences among cultures" [I-5]. On the other hand, the ESL students encountered difficulties in online communications, particularly in real-time chats, when they "cannot express what [they] really meant and understand what other meant" [I-5]. Still, they reported several benefits of group projects. For example, an ESL student acknowledged, "When we had a chat to discuss our project, my language skill prevented me from exactly expressing my thinking. However, the members in my group encourage me a lot and helped me when I encountered some difficulties" [I-17]. This effort to pay attention was described by an American student who said, "I did realize that my informal writing tends to include many terms people from other countries might not understand - and caught myself many times backspacing and pondering a more understood phrase!" [I-4].

2. What are the strategies that the instructor, student facilitators, and student participants use to prepare and conduct project-based learning activities in a Web-based course?

The instructor, the students as facilitators, and the students as participants used a variety of strategies in preparing and conducting project-based learning activities in the Web-based course.

Before the course began, the instructor, who acted as a facilitator of learning rather than as a content expert, developed the course with project-based learning activities in mind. Preparation for project-based learning involved structuring the conferences and topics, and designing the activities and small group work. The instructor arranged for the students to develop group learning contracts to govern their group behavior. During the semester, the instructor had real-time chats with each group to help plan the unit activities. The instructor also monitored the progress of groups, gave feedback to the groups, and contacted specific individuals and groups as needed.

The co-facilitators scheduled and posted periodic live chats before, during, and after their two-week unit activities. The facilitators saved and posted a total of 17 live chats for the 5 group activities during the semester. One chat strategy was "to wait for other group members who didn't type as fast as I do, or who needed more time to formulate a response" [I-1]. One facilitator gave value to the group learning contracts written at the beginning of the semester, explaining that she needed "to finish all the required reading in time and not break the contract in the group work" [I-14]. The facilitators posted drafts of communications, instruction, and syntheses; and they edited each other's work. They used collaborative documents to develop their plans and create outlines and documents, often taking care to be "very detailed in the writing of the procedures for the activity ... I was forced to look at every detail of the process ... from the perspective of the participants" [I-5]. The same facilitator explained her strategy:

> I think as the prepare of the information, it's best come at the information asking "What is that I would hope to get out of this web site?" "How will I provide the content for the audience?" and "What can I do to make it more real to the audience?" "Are there other technologies that can be used?" "Are there other sites I can take them to?" [I-5].

The co-facilitators monitored their activities by replying, weaving responses, and sending private email to individual participants to encourage them to participate by "more than just post[ing] a response" [I-5]. They even covered for each other when co-facilitators had a conflict or problem during the activity.

The students as group project participants deciphered the instruction that the facilitators developed and posted, and they logged in frequently to maintain their participant role. One participant explained, "I tried to check email frequently and respond immediately, whether I knew the answer to the question being asked or not - 'I'll get back to you' is better than not hearing from someone at all" [I-1]. They also assisted other participants by contributing their ideas and editing their work, and they conducted peer reviews of the other groups' work. In the group projects, they recognized the importance of giving "enough time to other participants for conducting learning" [I-2]. They needed this time for preparing to participate in the group activities, as one student described:

> As a participant, I have to read and organize the thought in the books, then answer the questions and observe the discussion among all participants and facilitators. The best stance of a participant is always be ready to answer and give feedback, so it is natural that I have to finish all the reading for joining the discussion [I-15].

Educational Significance

Answers to the research questions provide insight for Web-based course designers and instructors as well as students in Web-based courses. Knowing important characteristics of project-based learning activities will assist those who plan to incorporate such activities into the design of a Web-based course. The strategies that the instructor, student facilitators, and student participants used to prepare and conduct project-based learning activities are transferable to other types of activities.

The findings of this study support the developing body of literature on designing for online environments. Researchers posit that there are six design considerations for computer conferencing, two that involve administrative design considerations--grading system and grouping--and four instructional design considerations--collaboration, relevance, learner control, and technological preparation (Cifuentes, Murphy, Segur, & Kodali, 1997). Based on the data collected from the students in a Web-based graduate telecommunications course, we found that the project-based activities were authentic, or relevant--useful in terms of gaining a variety of skills like group collaboration and communication, facilitation of online activities, and intercultural communication. The students in this study recognized the value of trying to understand each other as they worked toward common goals. For example, one ESL student concluded, "I also listened to the others and saw the difference and similarities among us. Sometimes I needed to comprise to others and sometimes I needed to stick to my opinions. Whatever I did was to show I am a responsible and collaborative person to work with others for the goals of successfully finishing the project" [I-15].

References

Brown, J.S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Cifuentes, L., Murphy, K. L., Segur, R., & Kodali, S. (1997). Design considerations for computer conferences. *Journal of Research on Computing in Education, 30*(2), 172-195.

Dunlap, J. C., & Grabinger, R. S. (1996). Rich environments for active learning in the higher education classroom. In Wilson B.G. (Ed.), *Constructivist learning environments: Case studies in instructional design* (pp. 65-82). Englewood Cliffs, NJ: Educational Technology.

Fung, P. (1996). Issues in project-based distance learning in computer science. *Journal of Distance Education, XI*(2), 57-74.

Gibson, C. C. (1998). The distance learner in context. In C. C. Gibson (Ed.), *Distance learners in higher education: Institutional responses for quality outcomes* (pp. 113-125). Madison, WI: Atwood.

Gunawardena, C. N. (1992). Changing faculty roles for audiographics and online teaching. *The American Journal of Distance Education, 6*(3), 58-71.

Harasim L., Hiltz, S. R., Teles, L., & Turoff, M. (1995). *Learning networks: A field guide to teaching and learning online.* Cambridge: Massachusetts Institute of Technology.

Khan, B. H. (Ed.). (1997). *Web-based instruction*. Englewood Cliff, NJ: Educational Technology.

Krippendorff, K. (1980). *Content analysis: An introduction to its methodology*. Beverly Hills, CA: Sage.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass.

Moursund, D. (1998). Project-based learning in an information-technology environment. *Learning and Leading with Technology, 25*(8), 4, 55.

Romiszowski, A. J. (1997). Web-based distance learning and teaching: Revolutionary invention or reaction to necessity? In B. H. Khan (Ed.), *Web-based instruction* (pp. 25-37). Englewood Cliffs, NJ: Educational Technology.

Romiszowski, A. J., & Mason, R. (1996). Computer-mediated communication. In D. H. Jonassen (Ed.), *The handbook of research for educational communications and technology* (pp. 438-456). New York: Simon & Schuster Macmillan.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University.

Difficulties Students are Having with Cognitive Processes in Problem Based Learning Environments

Som Naidu, PhD
Multimedia Education Unit, The University of Melbourne, Australia
e-mail: s.naidu@meu.unimelb.edu.au

Iain McAlpine, PhD
Institute of Land and Food Resources, The University of Melbourne, Australia
e-mail: i.mcalpine@landfood.unimelb.edu.au

Abstract: For most students inquiry-based learning environments such as problem-based learning (PBL) comprise a major shift away from approaches to learning with which they are most comfortable and familiar. We have been observing PBL students *in situ* with particular focus on the *cognitive processes* with which they are having greatest difficulty, the processes that students need help with, and specifically when in the PBL process they require this help. The outcomes of this empirically-based understanding of the cognitive processes with which students have difficulties, is assisting us with the development of cognitive support tools for incorporation into the inquiry-based learning environments.

Research Context and Background

Problem-Based Learning (PBL) which represents a form of inquiry-based learning is being widely adopted as a powerful teaching and learning strategy at all levels of education. Situated in a constructivist paradigm, PBL is a learner-centered pedagogical strategy where the students themselves assume major responsibility for their learning. Generally PBL is divided into several phases spread over periods of small group work and independent study (Barrows & Tamblyn, 1980; Schmidt, 1993). The PBL process begins with an encounter of a problem situation through the use of a case study or incident, which the learners analyze. During this phase learners generate hypotheses about the occurrence of the problem in the case or incident. Based on this exercise learners identify what they already know about the problem and determine what they need to know, and develop plans to research the information. Students then embark on a period of self-directed learning where they research or investigate issues that emerged in the first phase. During the next phase, the findings of individual inquiry are shared with the group, which results in a re-evaluation of the problem and perhaps revision of their first perceptions of the problem. Through this iterative process, students develop the required content knowledge and problem-solving skills. Central to the PBL process are the following cognitive processes: (1) activation of prior knowledge, (2) elaboration of content, (3) restructuring of semantic networks/schemata, (4) development of an intellectual scaffold.

Activation of Prior Knowledge

The first step in PBL involves the presentation of a problem, which the learner relates to his/her prior knowledge. Schmidt (1993) suggests that the extent of prior knowledge about a subject is one of the major determinants of the "nature and amount of new information that can be processed" (p. 424). Ausubel (1968) has suggested that the essential factor in the acquisition of knowledge is that content must be linked to what is previously known. The exchange of ideas between participants of the PBL session, under the guidance of the PBL tutor, assists in activating or mobilizing prior knowledge of students. This has the effect of creating 'learner readiness' for subsequent stages of learning by asking students to generate hypotheses for the problem.

Elaboration

This comprises exploration of alternative interpretations of the problem and an understanding of relationships among concepts. The storage and retrieval of information is said to be enhanced when elaboration of the material takes place (Schmidt, 1993). This elaboration of the content by the student may take the form of listening to other students' hypotheses and determining the merit and worth of these different hypotheses. The cognition involved in evaluating these different perspectives begins the process of elaboration. Use of other learning resources such as journal articles, books, multimedia teaching modules and relevant websites should also help elaborate the student's understanding of the problem.

Restructuring

Depending upon the existing knowledge of the student, a process of *accretion*, *tuning* or *restructuring* occurs to actively change existing schemata. Gagne (1986) defines schemata as "a set of interconnected propositions centering around a general concept, and linked peripherally with other concepts" (p. 8). Schemata are not static but continually evolving in content and structure. When new learning occurs, new schemata develop or old schemata undergo structural changes. When more information is incorporated into an existing data structure, *accretion* occurs. *Tuning* refers to the adjustment of existing schemata. The continual tuning or modification in categories of interpretation occurs to bring the categories more in congruence with the functional demands placed on them (Gordon & Rennie, 1987). *Restructuring* is an important process for changing existing schemata or developing new schemata to interpret new information (Keppell, Elliott & Harris, 1998).

Group discussion is an asset to this process. Brown and Palincsar (1989) assert that change is more likely when individuals are required to explain, elaborate or defend their positions to others as well as to themselves, which gives rise to cognitive conflict in the individual. Cognitive conflict arises when the learner is exposed to disagreement between existing knowledge and new anomalous information. Through observation and explanation, learners can elaborate and integrate knowledge in new ways. Chin and Brewer (1993) attribute conceptual change to the following: status of the anomalous data in the perception of the students; characteristics of prior knowledge; learner's perception of the credibility and validity of the new information; and processing strategies. Problem-based learning attempts to create and induce cognitive conflict within learners with the aim of bringing about conceptual change. This conflict may emanate from a disagreement or mismatch between existing knowledge of learners and the knowledge that is generated from the problem situation. In fact this is an axiom of PBL. Typically, alternative explanations are not provided by tutors but are constructed in small group discussions, based on a combination and evaluation of the knowledge of all group members and verified later on, during self study.

Scaffolding

In the process of PBL the student will develop a framework for use with subsequent clinical problems. Ausubel (1960) referred to this framework as an "intellectual scaffold". Intellectual scaffolding is an infrastructure of information to which new material can be anchored (Ausubel, 1960). "By beginning a task embedded in a familiar activity, it demonstrates to students the legitimacy of their implicit knowledge and its availability as scaffolding in apparently unfamiliar tasks" (Brown, Collins and Duguid, 1989, p. 38).

Challenges and Constraints

While PBL has substantial advantages for teaching and learning in practice-based professions (Barrows & Tamblyn, 1980; Barrows, 1994; Koschmann, Kelson, Feltovich, & Barrows, 1996), for most educators PBL comprises a significant shift away from approaches to teaching with which they are most comfortable and familiar. For most students, at least in the beginning stages, PBL is somewhat disorienting. So for all its promise, problem based learning poses a number of challenges for both teachers and students alike. A major barrier to the success of PBL is students' initial discomfort with the increased degree of freedom they experience in a PBL environment. Students have generally been enculturated into a model of schooling in which their role is more or less limited to comprehension and synthesis of instructor-specified information, based on instructor-formulated learning objectives, and participation in instructor-led learning activities. Many students often lack the skills even to know where to begin when confronted with ill-defined, real-world problems, let alone manage the complex cognitive processes that are part of PBL.

Aims

The aims of this research program have been to observe PBL students *in situ.*

- The focus of this observation has been the above-mentioned cognitive processes associated with PBL: (1) activation of prior knowledge, (2) elaboration of content, (3) restructuring of semantic networks/schemata, (4) development of an intellectual scaffold.
- Our goal has been to pinpoint the cognitive processes and/or components of these processes with which students have been having difficulties.
- We expect to be able to identify the cognitive processes that students need help with, as well as specifically when in the PBL process they require this help.

Significance of this Research

The use of PBL as an instructional method reflects the rise of teaching and learning programs, which encourage students to take responsibility for their own learning. Such programs commonly present students with an ill-structured subject area and require them to conduct their own inquiry which involves formulating hypotheses, developing questions, gathering and interpreting data, and communicating their findings to peers and tutors (Schank, 1997; Glasersfeld, 1987; Brown, Collins, & Duguid, 1989; Linn, Songer, & Eylon, 1996). Our work seeks to understand the challenges and constraints of these processes so that as educators, we are better prepared to help students achieve the desired learning outcomes. Results from this study should highlight the phases of PBL and the cognitive processes with which students are having real difficulty. These results are being used to develop software-based support tools to help students with their learning. By focussing on cognitive processes with which students are experiencing difficulties, such tools have the advantage of being tailored to the specific learning needs of students. The immediate benefits of this work accrue to students and educators associated with the course principally being investigated. However, we believe that our work has significance for any course which supports student-centered learning in inquiry-based educational environments either here at the University of Melbourne or elsewhere.

Software-Based Support Tools

While a considerable amount of work has gone on in supporting student learning with various types of cognitive tools and strategies (see for example, Jonassen, Peck, & Wilson, 1999; Kommers, Jonassen, & Mayes, 1992; Pea, 1985; Salomon, Perkins, & Globerson, 1991; Naidu & Bernard, 1992; and Bernard & Naidu, 1992), there has been little work carried out on the area of "*software-based* cognitive support tools or strategies". Existing software-based cognitive support tools for ill-structured learning environments is believed to impose an inflexible structure on students' learning (see Edelson, & O'Neill, 1994; Scardamalia, & Bereiter, 1991). These support tools can help students organize arguments for presentation *after* they have reached a critical summary point in their inquiry, but they are less useful in guiding students in cognitive processes associated with PBL. However, before we can begin building any such software-based support tool to provide students with the kind of cognitive support they need for learning in ill-structured learning contexts, we need to know exactly what *cognitive processes* students have problems with, and what is the exact nature of these problems. These are the preliminary questions, which this research program has been seeking to answer.

Expected Outcomes

The expected outcomes of this research program are as follows:

- An empirically based and reliable understanding of the *cognitive processes* that students have difficulties with, while engaged in the PBL process.
- To be able to identify the *specific stages in the PBL process*, where students are having these difficulties.

- Assist students and educators identify areas/phases where learners require assistance and areas/phases where courses require refinement.
- Empirical data from this investigation provides the foundation for the design and development of suitable software-based cognitive support tools. These tools will be incorporated into the PBL curriculum, and their effectiveness will be evaluated in terms of their use as well as benefits to the learning and teaching process.

Research Plan, Methods, and Techniques

Research plan and methods

This research utilizes a "case study" approach. The classes that we observe comprise the case studies. Yin (1994) defines the case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life context. Case studies are able to explain the causal links in real-life situations that are too complex for the survey or experiment.

Study sample and procedure

The study sample is a group of second year Agricultural Science students. An instructional package using multimedia materials designed for Intranet/Internet delivery is under development for application in this subject area. The students will be the first trial group for the multimedia materials. Data from the trial group will be used to formatively evaluate the multimedia package, in preparation for its implementation with students on several campuses. The study will focus on the cognitive processes the students engage in while learning within a PBL framework. The multimedia package introduces the students to a range of real scenarios, presented using photographs and interviews with farmers. Students need to interpret the farmer's conception of the problem, and develop a solution using the range of resources built into the program. These resources include interactive maps, databases, maps, spreadsheets, and a pasture growth simulator developed during a research project, and interactive tutorials on key concepts. Students select whatever they feel they need to solve the problem from this range of resources.

In this trial, students will work individually to cover the conceptual base, and come together in small groups to reach their resolution of the problems. As the students will be all together for this formative trial, group work will be face to face. The multimedia materials, however, are structured to allow computer conferencing for problem solving. This will enable students to work collaboratively with students on other campuses or external students to work in collaborative groups.

Development of data gathering instruments

Data gathering in case study research typically uses multiple sources of data. For this study direct observation, questionnaires and a focus group will all be oriented to the identification of difficulties that the students encounter, that may hinder their problem solving processes. Any technical problems will be identified by observation and, hopefully, rectified at the time. The questionnaire and focus group will address issues relating to the learning method and the resources. The questionnaire will be oriented towards providing some quantifiable data that can be used to identify proportions of students who encounter specific difficulties or, conversely, feel that the range of aspects of the materials work well. The focus group will be oriented towards more subjective issues such as how the group functioned in the problem solving process, and how realistic the experience of working this way is perceived to be.

Data gathering and analysis

Data from direct observation will be analyzed to identify any major impediments to problem solving that the students appear to be encountering. This data tends to reveal significant issues such as technological problems or major misconceptions caused by inadequacies in the project materials or in the students' perception of the nature of the task. An example of this is that the students must feel that the topic is important to them, rather than that they are actually tcsting software. If there are problems of this nature then they need immediate rectification. If the situation cannot be properly rectified however, then direct observation data provides a context for consideration in the analysis of other data. Questionnaire data will be analyzed to reveal trends or tendencies that indicate the effectiveness of different aspects of the program in relation to stages in learning, such as activation of prior knowledge, elaboration, and restructuring. The way the students felt about the PBL process, and how they perceived the effectiveness of the overall learning task will be extrapolated from the focus group data. Following this, all three sources will be considered together to enable an interpretation of major themes and issues, and how these have either helped or hindered effective learning.

Results

This is an exploratory study that is in progress. Results from the trial will reveal a number of aspects relating to PBL as a method, and the use of instructional technology for delivery. As PBL is essentially a way of structuring a learning process, data relating to how students experience the process, and its effectiveness in promoting effective cognitive processes is important. The approach to analysis of the case study is designed to reveal this. It is important that the critical processes of PBL are identified, and more important that the processes in PBL with which students have difficulty with are identified. Too many inquiry-based technology-enhanced learning environments place students in information dense learning situations without appropriate cognitive supports or scaffolding. Our research agenda is to develop a suite of supports that students can use in such learning environments. We argue that the development of these sorts of supports and scaffolding must be based on empirical data, and that is what this research program is all about.

References

Ausubel, D. P. (1960). The use of advance organizers in the learning and retention of meaningful verbal material. *Journal of Educational Psychology 51*(5), 267-272.

Ausubel, D. P. (1968). *Educational psychology: A cognitive view.* New York: Holt, Rinehart & Winston.

Barrows, H. S. & Tamblyn, R. (1980). *Problem-Based Learning: An Approach to Medical Education.* New York, Springer.

Barrows, H. S. (1994). *Problem-Based Learning Applied to Medical Education*. School of Medicine. Springfield, IL: Southern Illinois University.

Bernard, R.M., & Naidu, S. (1992). Post-questioning, concept mapping and feedback: A distance education field experiment. *British Journal of Educational Technology, 23*(1), 48-60.

Brown, A. L. & Palincsar, A. S. (1989). Guided, cooperative learning and individual knowledge acquisition. In L. B. Resnick, ed., *Knowing, Learning and Instruction*, (p. 393-451). Lawrence Erlbaum Associates, Hillsdale, New Jersey.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Bruffee, K. A. (1995). Sharing our Toys: Cooperative Learning versus Collaborative Learning. *Change, 27*(1), 12-18.

Chin, C. A. & Brewer, W. F. (1993). The role of anomalous data in knowledge acquisition: A theoretical framework and implications for science instruction. *Review of Educational Research, 63*, 1-49.

Edelson, D. C., & O'Neill, D. K. (1994). The CoVis Collaboratory Notebook: Supporting collaborative scientific inquiry. In *NECC 94: National Educational Computing Conference*, (pp. 146-152). Boston, MA: International Society for Technology in Education.

Gagne, R. M. (1986). Instructional technology: The research field. *Journal of Instructional Development 8*(3), 7-14.

Glasersfeld, E. von. (1987). Learning as constructive activity. In E. von Glaserfeld (Ed.), *The construction of knowledge: contributions to conceptual semantics.* Intersystems Publication.

Gordon, C. J. & Rennie, B. J. (1987). Restructuring content schemata: An intervention study. *Reading Research and Instruction 26*(3), 162-188.

Jonassen, D. H., Peck, K. L. & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective.* New Jersey: Prentice-Hall, Inc.

Keppell, M., Elliott, K. & Harris, P. (1998). *Problem based learning and multimedia: Innovation for improved learning of medical concepts.* In R.M. Corderoy, (Ed.) Australian Society for Computers in Learning in Tertiary Education. ASCILITE'98 Conference Proceedings. (pp. 417-424). University of Wollongong, NSW.

Kommers, P., Jonassen, D. H., & Mayes, T., (Eds.). (1992). *Cognitive tools for learning.* Berlin: Springer.

Koschmann, T., Kelson, A. C., Feltovich, P. J., & H. S. Barrows (1996). Computer-supported problem based learning: A principled approach to the use of computers in collaborative learning. In Koschmann, T. (ed.) *Computer Supported Collaborative Learning: Theory and Practice in an Emerging Paradigm.* Mawah, NJ, Lawrence Earlbaum.

Linn, M. C., Songer, N. B., & Eylon, B. S. (1996). Shifts and convergences in science learning and instruction. In D. C. Berliner, & R. C. Calfee (Eds.), *Handbook of Educational Psychology* (pp. 438-490). New York: Macmillan.

Naidu, S., & Bernard, R.M. (1992). Enhancing academic achievement in distance education with concept mapping and inserted questions. *Distance Education, 23*(1), 48-60.

Pea, R. D., (1985). Beyond amplification: Using the computer to reorganize mental functioning. *Educational Psychologist, (20)*4, 167-172.

Salomon, G., Perkins, D. N., & Globerson, T., (1991). Partners in cognition: Extending human intelligence with intelligent technologies. *Educational Researcher, (20)*, 10-16.

Scardamalia, M., & Bereiter, C. (1991). Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media. *The Journal of the Learning Sciences*, *1*, 37-68. Lawrence Erlbaum Associates, Inc., Mahwah, NJ.

Schank, R. (1997). *Virtual Learning: A revolutionary approach to building a highly skilled workforce.* McGraw-Hill, New York.

Schmidt, H. G. (1993). Foundations of problem-based learning. Some explanatory notes. *Medical Education, 27*, pp. 11-16.

Yin, R.K. (1994). Case study research: Design and methods (2nd Edition). Beverly Hills, CA: Sage.

Ability Grouping for Teaching Computer Literacy Classes

Michio Nakanishi
Cybermedia Center, Osaka University
Japan
naka@rd.ecip.osaka-u.ac.jp

Akira Harada
Faculty of Human Sciences, Osaka University
Japan
harada@hus.osaka-u.ac.jp

Abstract: This paper shows that ability grouping in the middle of a semester is effective for teaching computer literacy to freshmen who have a variety of skill levels. Three teachers including the authors have been teaching a computer literacy course to 150 students for about five years. In 1998 and 1999, we reorganized three 50-student classes based on an achievement exam in the middle of the semester. After the reorganization, we adjusted lectures according to the students' ability. Our statistical analysis shows that the exam scores were improved and the students' self-assessment scores of their own skills were upgraded in all classes. The effect was significant in the slow-learners class compared to the other two classes.

Introduction

In Japan, computer literacy education in colleges and universities is facing a problem of diversity of students' computer skill levels. The reason for this is twofold. One is that the computer literacy education is incorporated in very small number of high schools. The other is that as computer price is falling down the number of students is increasing who learn how to use computers by themselves at home. Besides the skill levels at the beginning of the class, there are differences between students how fast they get accustomed to computer operations in class. These were the problems to overcome for us to help students learn this subject in good quality.

Since 1994, the computer literary education has been a required subject for all freshmen of Osaka University. Three teachers including the authors have been teaching a computer literacy course to over 150 freshmen majoring in Human Sciences for five years. The course consists of 15 sessions, and each session lasts 90 minutes, which includes demonstrations by a teacher and hands-on activities by students. Usually an assignment is also given which takes an hour or two to complete.

At the beginning of the course in 1995 and 1996, we organized three parallel 50-student classes according to the students' computer experience using a questionnaire survey. Other background variables (age, gender, future academic field) were not considered for this class organization. The organization method aimed at ability grouping, that would provide non-experienced students with a slower work pace and allow high-achieving students to be sufficiently challenged by more demanding lessons. In a few months, we realized that our approach was somewhat idealistic and did not work well. Nevertheless, six months after the semester had ended, we conducted a follow up study to see the students' attitudes toward computer use, and compared the log-on time and the number of mails sent when they were freshmen to those when they were sophomores. This result showed that the sophomores who took this course in their first year used computers more actively than when they were freshmen. There was, however, weak positive correlation between computer experience and log-on time or number of mails. This is because, we think, students' skills were not objectively grasped by the questionnaire and because experienced students are not necessarily diligent.

In 1997, we introduced a written examination in the middle of the semester in order to reorganize classes based on the exam score. This trial showed us that this class organization was not so effective because students' skills were not objectively grasped by questionnaire and written examination.

In 1998, we introduced hands-on work into the exam in the middle of spring semester, such as word document processing, looking into online dictionaries, and finding web sites using a web browser. Then we reorganized the three classes based on the exam score. At the end of the spring semester, we again gave them an exam that would measure how they made progress. This ability grouping strategy brought us success. In 1999, we refined this method and compared the result of two years trial.

In this paper, we begin with related work and a brief explanation of our computer literacy course, followed by the methodology of class reorganization. Then, we give the statistical data analysis to show that both exam score and self-assessment score of low-ability class were significantly improved.

Related work

Although there has been much previous research on ability grouping, tracking, and class organization, they are mainly for K-12 school education, e.g. (Wiggins, 1993, Mills, 1998). Furthermore, as far as the authors know, there has not been any research on class reorganization in the middle of a semester for computer literacy education. The authors have tried class reorganization for years and presented its result in (Nakanishi & Harada, 1999). This paper includes the result in 1999 and completes our method.

Computer literacy education

Since the 1970s, the definition of computer literacy has evolved, and many researchers have discussed the courseware and teaching methodology of the computer literacy course, e.g. (Higdon, 1995), (Keizer, 1997), (Mills, 1998). The authors believe that to learn details of word processing and spread sheet application is not important but to grasp the concept and principal facilities of those applications is a key for students to become literate. Furthermore, the attitude to learn by himself or herself is also a key.

In the syllabus of the computer literary course in Osaka University, topics consist of two categories, '*Requisites*' and '*Options*'.

Requisite category consists of the following items.

- Login/logout, password, touch typing
- File system, file operation, floppy disks
- Word processing, kana-kanji conversion (for Japanese characters)
- Concept of the Internet, network etiquette
- Electronic mail, web
- Draw and/or paint software

Options are

- Net news
- LaTeX with graphics
- Spreadsheet
- Writing HTML
- Mathematica
- SAS
- Script languages (perl, awk, shell, etc.)
- Computer ethics, social problems
- Computability.

Since one course session lasts 90 minutes and is held once a week, all topics of requisite category which authors think are the minimum competencies, are covered in about seven weeks. For the rest of one semester, teachers select some of the items from optional category depending on the students' majors. For example, LaTeX and Mathematica are chosen for students majoring in Physics and Mathematics, while spreadsheets and SAS for Economics.

Class reorganization Method

Reorganizing by a written exam

In April 1997, we started our three parallel classes with a questionnaire on computer experience. The class organization was based not on their computer experience, but on the enrollment order. The questionnaire showed 60% of the students had experience of word document processing using computers or word processors.

After we completed topics in requisite category, we conducted a written examination to reorganize classes based on students' competencies. The exam requested students to write computer operations, e.g., how to change fonts, how to cite the body of the mail to make a reply, why the login password is important, etc. A total of 150

#1 Change this plain text file to rich text format, then change the font of the marked words to Ryumin 12point, and place it in the center.
#2 Explain how to use Japanese Kana-Kanji translation and how to register your name in your own dictionary.
#3 Look up three words (omitted here) in the following dictionaries: English-Japanese, Japanese-English, and Webster.
#4 Draw a tiny picture and insert it into this page.
#5 Find URLs of the National Diet Library and two online book stores.
#6 Look into "/SharedLibrary/Literature/" and describe what's in it.
#7 What should be considered when deciding your password string?
#8 Find Akutagawa's books using Online Public Access Catalog (OPAC) of the University Library.
#9 What should you do if you find a nice picture of Madonna with a notice saying "copy free" and you would like to have its copy on your web page?
#10 Describe how to limit the line length to fewer than 65 characters in the body of an e-mail.

Table 1: Mid-term exam sample in 1998.

- Touch typing
- Mouse operation (click, double click, drag)
- Window operation (resize, move, iconify, hide)
- Japanese Kana-Kanji translation
- File/Folder operation (move, rename, create)
- Word document processing (fonts, centering, insert graphics)
- Mail (MIME, signature, save to file, reply, delete, re-file)
- Web (search engine, book-mark)
- Use of online dictionary (Japanese, English)
- Canceling your printer job

Table 2: A questionnaire survey for self-assessment

students in three classes were reorganized according to the exam score. In all reorganized classes, spreadsheets and HTML were selected from optional category. LaTeX was also selected in the two high-scored classes, while in the low-scored class word document processing was selected instead.

At the end of the semester, we again gave the students a written examination and a questionnaire, which asked whether the students were satisfied. The scores of the two written exams showed no remarkable difference between classes; however, most of the low-ability class students were satisfied with the class reorganization. There remained a problem that the student competencies were not so exactly evaluated by our written examination.

Reorganizing by a hands-on performance exam

In 1998 and 1999, we conducted a mid-term exam which demands hands-on work in an hour, in order to reorganize classes based on students' competencies (Table.1).

We included two questions, which had not been taught in detail in all classes, to see whether students could solve it using the online manual (question #3, #8).

We marked the examination papers out of 100 (each question of 10), and used the scores to reorganize classes. Because of the limit of PCs available in computer labs, each class could not exceed 60 students. So, 53 students who got more than 67 points were grouped to A-class. The threshold between B-class (50 students) and C-class (50 students) was 52 points. The average total score in 1999 was 60.3 (s=15.7).

The average scores of the new classes A, B, and C were 77 (7.4), 60 (3.9), 42 (7.5) points, respectively. The average score for A-class students was more than 5.5 for all ten questions, whereas the students who were grouped into C-class got only 2.2 and 2.3 for question #5 (web search) and #6 (file search), respectively, which were significantly lower than the other two classes. This tendency was very similar to the score of 1998.

Self-assessment by students

After the mid-term exam, a questionnaire survey paper was distributed to the students. The survey consisted of 10 questions, which would measure students' mastery of competencies taught by that time (Table.2).

The answers to these questions were collected on a 5-point scale. The scores of the collected questionnaire showed a positive correlation between the exam and the students' self-assessments. That is, A-class students felt good at the following competencies: inserting graphics into a document, operation of files/folders, and searching web site, whereas C-class students answered that they had not mastered those topics. As for searching files from hierarchical file structure, C-class students perceived that they were good at it; however, its exam score is poor. This indicates that C-class students did not understand the file structure itself. Touch-typing and Email competencies were not statistically significant between three classes.

What and how should we teach after the class reorganization

The result of the exam and a questionnaire showed us what we should teach in the new classes after the class reorganization. We provided C-class students with a slower work pace and revisited those competencies which they were not good at. For A-class students, self-teaching of LaTeX was given as an assignment during summer vacation.

In order to allow them to have an active participation in the shaping and augmenting of their learning, we also took an independent study approach for teaching spreadsheets in all classes. That is, after a brief explanation given by a teacher, students follow tutorials on the teacher's web pages. Since graduate teaching assistants (two assistants per classroom) were also available to assist the students, we asked them to give students only hints not to give detailed step-by-step operations.

Statistical evaluations of exam and questionnaire

At the end of the course, we gave a final examination that included three questions similar to the mid-term exam and required hands-on work of about an hour. After the exam, self-assessment questionnaire survey was conducted. Here we begin with the analysis of the questionnaire.

Analysis of exams

The total score and the scores of three questions (use of online dictionaries, OPAC search, and limiting line length of Mail body), which are similar in two exams, were considered in a two-way ANOVA. As a result, these four items showed an "interaction" between the two exams and classes belonged to ($p > 0.05$).

Figure 1 shows a comparison of the average scores of two examinations. Note that Figure 1(a) shows the "ceiling effect", that is, the scores in A-class are distributed downward after the class reorganization.

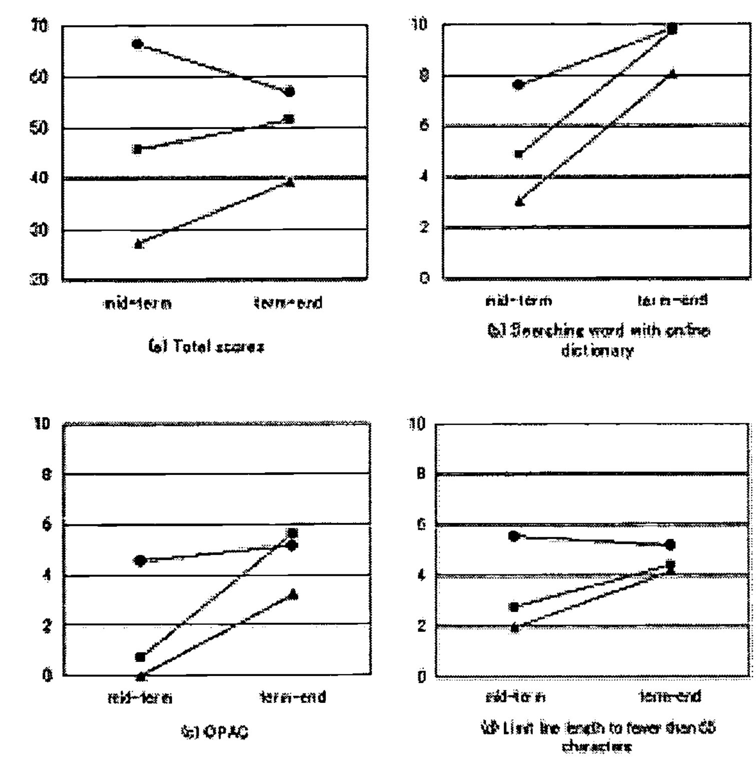
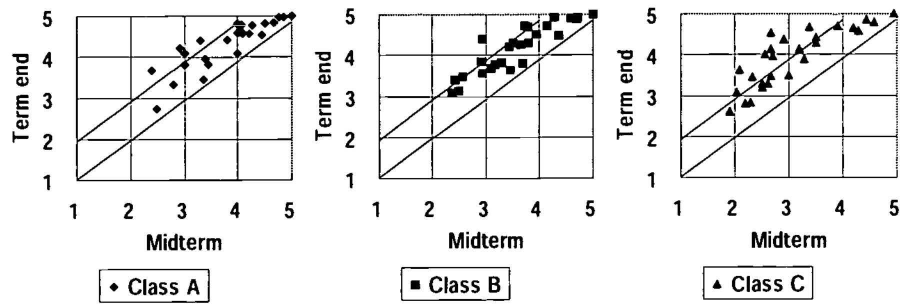
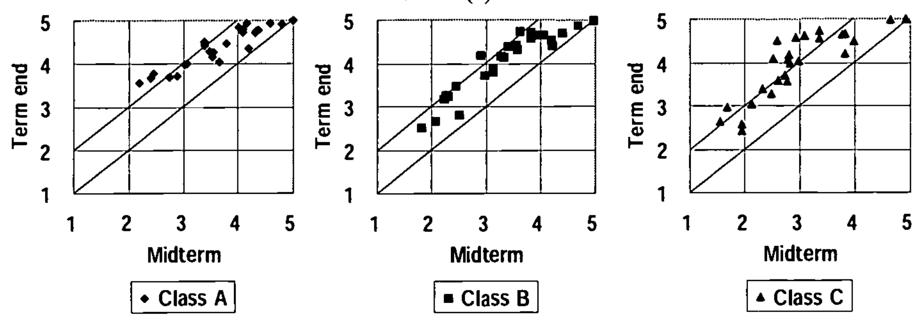


Figure 1: Comparison of the average scores of two examinations



(a) Scores in 1998



(b) Scores in 1999

Figure 2: Self-assessment scores in 1998 and 1999

As for spreadsheets, two sessions (which means 180 minutes) were assigned for C-class and one session was assigned for A, B classes using self-learning web based text. But the score was is 8 points in A-class and 5 points in C-class. The score of writing HTML also supports this tendency. From this fact, it is proved that A-class students had higher ability in computer operations than other two class students.

Analysis of self-assessment questionnaire

As for the 27 items that were included both mid-term and term end questionnaires, the average term end exam scores were higher than mid-term scores in all classes in 1998 and in 1999. In Figure 2, the x-axis shows the mid-term score, the y-axis shows term end score, and each scatter point in the graph represents the score of one item. Two years analysis shows same tendency.

We took the exam timing (mid-term or term end) and classes the students belonged to as the factors of the two-way analysis of variance (ANOVA). The following four items of the questionnaire shows that there is an "interaction" between exam timing and classes ($p > 0.05$).

- Creating a new folder (directory)
- Editing a word document
- Browsing web pages
- Searching web site

Figure 3 compares the average scores of these four items obtained through the questionnaire survey. From this figure, we conclude that C-class students perceived they were as self-confident in these items as the students in the other two classes.

Though the exam scores are not significantly correlated with students' self-assessments, the class reorganization was effective for slow learners class students.

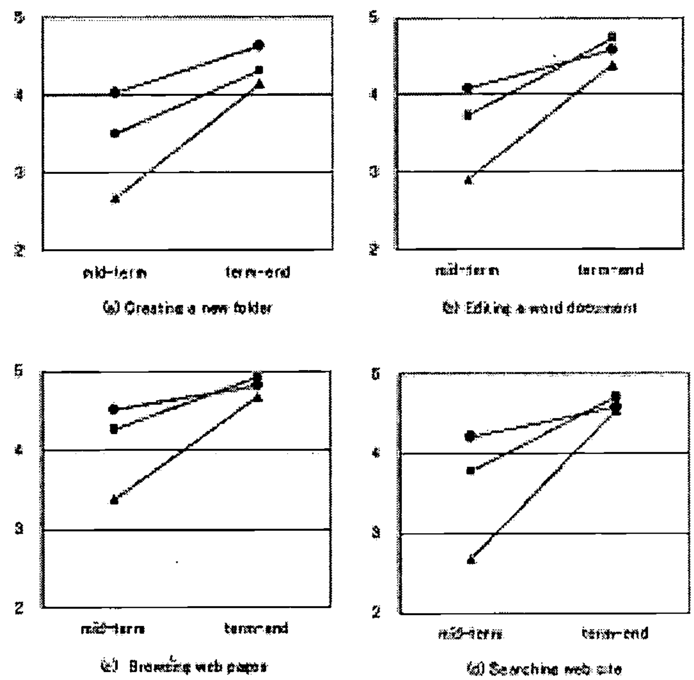


Figure 3: Comparison of the average scores of these four items obtained through the questionnaire survey.

Conclusions

This paper described the efficiency of ability grouping strategy. Class reorganization in the middle of a term has enhanced learning outcomes in computer literacy classes. It is also good tool for teachers to know the way to lead students to higher skill level.

We are planning to refine the examinations and questionnaire items so that we can more accurately measure the students' competencies and introduce RUBICS for assessment. In 2000, we will incorporate group work, discussion and presentation for high ability students after the class reorganization.

References

Higdon, J. (1995) The Evolution of Computer Literacy for Preservice Teachers, Proc. of 6th Int. Conf. of the Society for Information Technology and Teacher Education (SITE).

Keizer, J. and Wright, V. (1997) Constructivism Implementation in Undergraduate Computer Application Classes, Proc. of 8th Inf. Conf. of the Society for Information Technology and Teacher Education (SITE).

Mills, R. (1998) Grouping Students for Instruction in Middle Schools: ERIC Digest, EDO-PS-98-4 .

Nakanishi, M. and Harada, A. (1999) Reorganizing computer literacy classes in the middle of a term, Proc. of 7th Int. Conf. on Computers and Education (ICCE) .

Raiford, P. and Braulick, L. (1995) Computer Literacy Class for Preservice Teachers at University of Texas at Austin, Proc. of 6th Int. Conf. of the Society for Information Technology and Teacher Education (SITE).

Wiggins, G.P. (1993) Assessing student performance: exploring the purpose and limits of testing: Jossey-Bass Publishers.

Mixed-Mode Delivery Models in First Year University

John C. Nesbit
Technical University of British Columbia
301 – 10334 152A Street
Surrey, BC, Canada
nesbit@techbc.ca

Abstract: A course delivery model is a framework promoting the scalable application of effective pedagogies and educational technologies. This paper describes how course delivery models were designed and implemented for the inaugural first year program at the Technical University of British Columbia (TechBC). In Fall 1999, ninety first year university students took 6 courses delivered through a central Course Management System (CMS) providing online conferencing, announcement posting, online quizzes, support for team-based learning, and course content in the form of web pages, streaming video, and animation. The courses, representing 5 distinct delivery models, differed substantially in their application of these features and in the use of face-to-face class time. A comparative analysis of questionnaire and web log data focusing on learner engagement and achievement with the delivery models will be presented at ED-MEDIA 2000.

In a widely publicized comparison of online and face-to-face teaching, Schutte (1997) attributed the higher achievement of the online group to "higher perceived peer contact and time spent on class work". Schutte's conclusion is compelling because, to no one's surprise, time spent learning has long been confirmed (e.g., Carroll, 1963) as perhaps the most powerful determinant of learning achievement and, more interestingly, decades of research on cooperative learning (Slavin, 1995) have established structured, team-based learning as among the most effective educational methods.

In addition, research on metacognition and self-regulated learning (Butler & Winne, 1995) is revealing the critical role of these aspects of engagement in learner achievement. Thus, for the purposes of this paper, learner engagement is regarded as a combination of three inter-related factors: Time spent working on, metacognitive processing of, and social interaction in relation to, learning resources and tasks.

This paper describes the design and implementation of 5 course delivery models constructed from different combinations of educational technologies and teaching methods. In so doing it presents the groundwork for a study, to be presented at ED-MEDIA 2000, of how learner engagement varies across delivery models.

Institutional Goals for Educational Technology and Learning

The Technical University of British Columbia, Canada's newest public university, welcomed its initial cohort of first-year students in August, 1999 with a curricular emphasis on Information Technology, Management & Technology, and Interactive Arts. The development of a strategy for the use of innovative pedagogy and educational technology began before, and extended throughout, the planning and development of the first year curriculum.

In the early institutional planning for educational technology and learning, four standards emerged with regard to the first year program:

- Most courses would emphasize collaborative learning with classes organized into teams.
- Averaged across the program, about half of learning contact time would occur online.
- Most courses would integrate online and face-to-face learning.
- All courses would include a substantial web-based component.

It was apparent that achieving these standards for the first set of courses and the small initial cohort of students would be easier than maintaining them as student enrollment and course offerings grew rapidly. To enable scalability it was decided to design a relatively small set of delivery models consisting of appropriate combinations of learning methods and technologies. Each course is assigned to a delivery model so that technical and pedagogical support and planning can be organized around the delivery models rather than the unique requirements of each course. Having each of the delivery models represented in the initial set of course offerings also ensured that a variety of approaches would be explored and compared at the outset.

The TechBC Course Management System

Crucial to the successful implementation of course delivery models is the support for learner engagement provided by the course management system (CMS). After reviewing several commercially available systems it was decided to build a web-based CMS with core functionality written in XML/RPC, Dynamic HTML, and JavaScript. Specialized functions were provided by commercial products. For example, we used SoftArc's FirstClass for online conferencing and QuestionMark's Perception for online tests and quizzes.

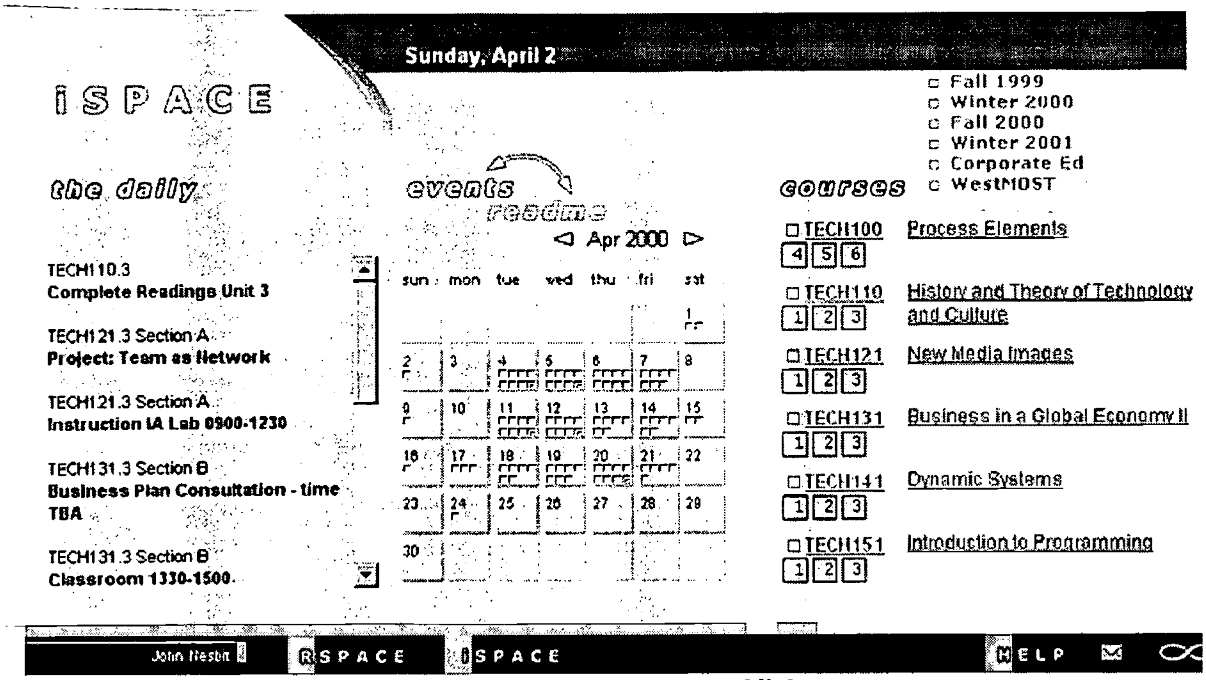


Figure 1. The iSpace page provides a calendar, announcements, and links to courses.

To promote learner engagement, features of the TechBC CMS were designed to provide convenient access to course content and interaction with instructors and other learners:

- An entry page, was designed to support community building by providing general announcements, Java-based text chat serving as a virtual café or hallway, voting on community issues, and links to online conferences dealing with a variety of student concerns.
- A personal page (Figure 1) provides links to courses, email, a calendar, announcements, and personal file space on a university server.
- Each course has a syllabus page (Figure 2) providing links to learning objectives, presentations, online conferences, and descriptions of assignments and exams.
- Most courses have a teams page listing all class members by team. The teams page also provides access to team conferences.
- A navigation bar shown at the bottom of the Figure 1 is available throughout the CMS.

The course developers, faculty and teaching staff, were provided with preformatted web page templates specific to the delivery model for which they were working. Most developers were subject matter experts with little or no experience developing for the web. They entered text and graphic content into server files using Dreamweaver and received support from educational technology staff for the creation and licensing of interactive and multimedia elements.

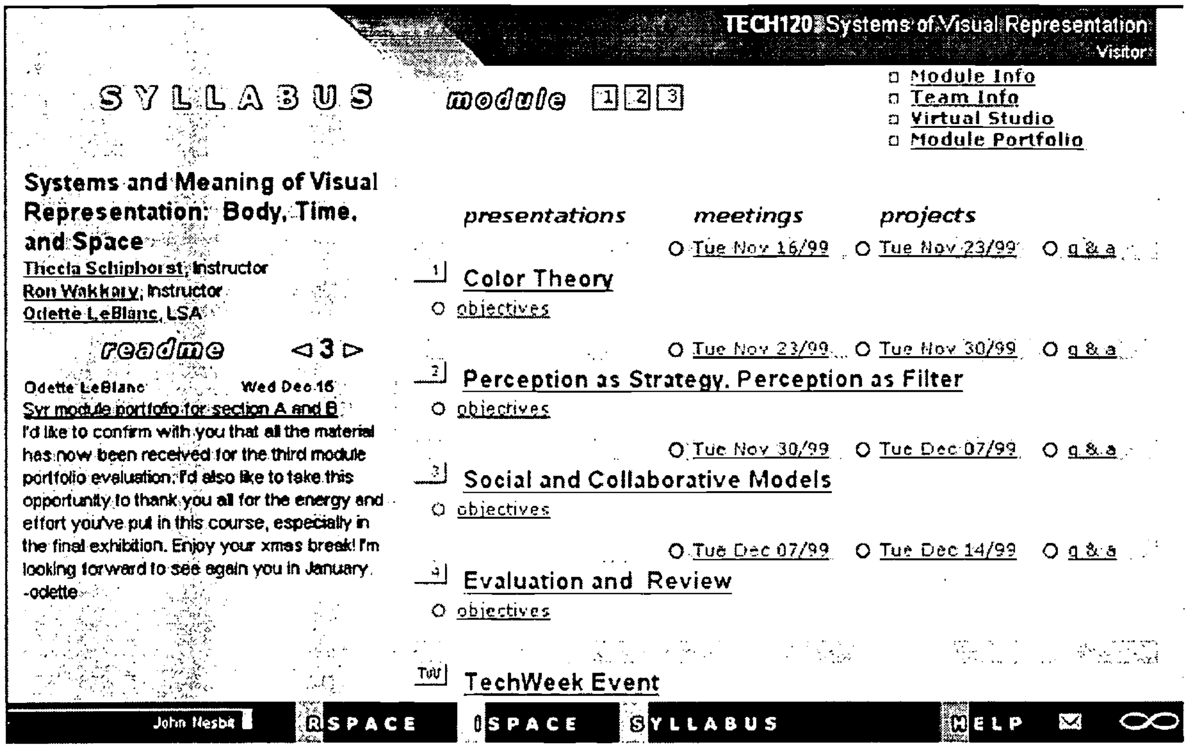


Figure 2. Example of a syllabus page in the TechBC course management system.

Many of the web page templates included interactive components. For example, a template in one delivery model included links to pre-study and post-study quizzes. A template in another model included a voting poll in which each student had one anonymous vote.

Some design goals intended to promote learner engagement were postponed to later versions of the CMS:

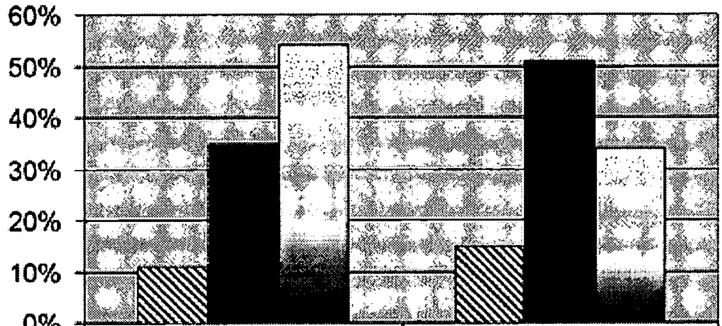
- Team management tools enabling instructors to easily assign learners to teams and evaluate team projects.
- Team participation tools assisting team members in collectively managing project work.
- Interactive features of the CMS interface further supporting self-monitoring and self-regulation of individual learning, such as meters or check lists showing progress through the objectives of the course.

Network Access Requirements and the Expansion of Broadband Service

Learners accessed the course management system from on-campus labs and from home. TechBC required that they have access to the internet through 3rd party ISPs at a minimum 56 kbps. In fact, learners' home subscriptions and modem speeds ranged from 28.8kbps dial-up to cable modem and ADSL.

TechBC is located in the lower mainland of British Columbia, a region in which both ADSL and cable subscriptions are available for under $30 USD per month. Throughout the Fall of 1999 local cable companies were aggressively expanding internet subscriptions at a rate of about 300% per year.

As shown in Figure 3, There was a substantial increase in learners' subscriptions to broadband internet services (ADSL and cable) in the early months of the term. By the 3rd week of classes in September, 46% of ISP accounts accessing the CMS were through broadband services. This figure had risen to 66% by mid-November.



	Sept	Nov
ADSL	11%	15%
Cable	35%	51%
other	54%	34%

Figure 3. Percent of learners' ADSL, Cable, and other ISP accounts accessing the course management system (CMS) in September and November, 1999

Despite developers attempts to optimize streaming video for 56 kbps, anecdotal reports from TechBC learners indicated that broadband access may be necessary to enable effective home use of streaming video presentations provided through the CMS. Some learners with dial-in connections report having to come to on-campus labs to effectively use streaming video.

When broadband access can be mandated for all learners, likely within a year or two, new delivery models using real-time, one-way video presentations with interactive components will become increasingly feasible.

The Course Delivery Models

A course delivery model is a combination of logistical, technological, and pedagogical features. Each model has implications for the scheduling of classrooms and labs, division of roles among teaching staff, course development time, demographic profile of learners, learners' hardware and network requirements, fit to curricula, and so on. Our design of logistical and technological components of the delivery models was influenced by, among others, Bates (1995) who discussed access, cost, teaching and learning, interactivity and user-friendliness, and organizational issues as key criteria for making decisions about educational technology and media.

The pedagogical components of the delivery models were influenced by theory, research and practice in asynchronous learning networks (e.g., Harasim, 1995), cooperative learning (e.g., Millis & Cotell, 1998) and instructional design (e.g., Diamond, 1998). The models were designed to shift one-way delivery of information out of lectures toward print or web media, or better yet, to replace one-way delivery with interactive approaches. Among the methods adopted were the use of explicit learning objectives, team-based learning in both face-to-face (F2F) and online settings, moderated discussions, primary trait analysis for assessment, and interactive simulations.

Curricular needs also influenced the design of the models. For example, a program focus on Interactive Arts led to the development of a Studio Lab model building on art school traditions. In fact, each of the models can be seen as a re-working of one or more traditional teaching models.

The following sections summarize the five delivery models used by TechBC's first year courses.

Presentational Cooperative (PC) Model

Section size:	48 learners
F2F cooperative learning:	1.5 hours per week

Study of web presentation:	~ 1.5 hours per week

Derived from the lecture-seminar method, this model replaces the lecture with a web presentation containing multimedia and interactive elements. During weekly face-to-face sessions students work in teams of 4 to 6 on structured cooperative learning tasks. An asynchronous online conference is provided for students to ask questions. Some courses may add open lab sessions where students come to receive help and work on assignments.

Studio Lab (SL) Model

Section size:	24 learners
F2F studio session:	3 hours per week
Study of web presentation:	~ 1.5 hours per week

This model bears some similarity to the PC model, but differs in the duration of required on-campus sessions, and in the learning activities carried out in those sessions. Studio sessions are held in a computer lab, and the learning activities tend to be project based. Although learners are pre-assigned to teams of 6, they are just as likely to be working individually as working within their teams. This model provides a weekly web presentation containing multimedia and interactive elements, and an asynchronous online conference for students to ask questions. Some courses may add open lab sessions where students can come to receive help and work on projects.

Computer-Mediated Classroom (CMC) Model

Section size:	24 learners
On-campus activities:	infrequent if any
Online conferencing:	~ 3.0 hours per week

The CMC model is built on the tradition of asynchronous learning networks (Harasim et al., 1995) and makes heavy use of online conferencing. Every week, a section of 24 learners takes up a new topic in an online conference. Some web-based interactive and multimedia resources may be provided, but these are not expected to be extensive. The CMC model imposes a relatively low development cost, but the need to moderate and manage conferences results in high delivery costs. Students are pre-assigned to teams of six, with each team carrying out some of its work within its own conference.

Flexible Study (FS) Model

Section size:	unlimited
On-campus activities:	optional open labs
Study of web presentation:	~ 3.0 hours per week

Derived from the distance learning tradition, this is a self-paced model with no requirement to attend face-to-face sessions. The flexible study model demands the production or acquisition of high quality web-based and multimedia resources. Compared to other models described here, it imposes the greatest development costs but the least delivery costs. There are frequent self-diagnostic quizzes and less frequent formal examinations. An asynchronous online conference is provided for students to ask questions. To compensate for the absence of scheduled on-campus sessions, web-based conferences and contact support are provided to support the formation of informal study groups. Some courses may add open lab sessions where students visit campus to receive help and work on assignments.

Threaded Process (TP) Model

Section size:	unlimited
F2F integrated activity:	1.5 hours per week
Study of web presentation:	~ 1.5 hours per week

This model arose from the curricular need to integrate the learning of communication, writing, team process, research and learning skills with other courses in the first year program. Thus the learning activities in this model tend to piggyback on the learning activities of other courses. For example, for a unit on concept mapping learners studied a web presentation on concept maps. Then later, in a PC class covering operating systems in a different course, they were asked to create a concept map to illustrate structures in a operating system. The concept map they created could be used in a portfolio to assess their learning of concept mapping.

Implementation of Delivery Models

Table 1 shows how courses were assigned to delivery models. Online components of the first term courses included a total of about 5000 web pages and 90 interactive or multimedia objects.

A few outcomes were apparent even during the early weeks of the term. First, delivery models placing more emphasis on online learning did not necessarily provoke greater activity in the CMS. Table 1 shows the mean number of hits to the course syllabus pages per learner during a fairly typical week in early December. In that week the delivery models with the greatest emphasis on f2f contact actually garnered the most syllabus hits. Second, the demanding schedule imposed by the 6 first-year courses inclined learners to assign low priority to the self-paced flexible study course. The model was subsequently adapted by introducing assignments and exams on a fixed schedule. Third, pressure to converge the delivery models emerged as instructors and learners requested features from other models and declined use of some features specific to the model assigned to their course.

Table 1. Courses and delivery models used in first term courses.

Delivery Model	Course	Mean syllabus hits per learner in one week
Threaded Process (TP)	Tech100 Process Elements	3.2
Computer-Mediated Classroom (CMC)	Tech120 Business in a Global Economy I	3.1
Studio Lab (SL)	Tech130 Systems of Visual Representation	5.7
Presentational Cooperative (PC)	Tech140 Linear Systems	5.5
	Tech150 Introduction to Computer Systems	7.8
Flexible Study (FS)	Tech142 Probability and Statistics	3.4

References

Bates, A. W. (1995). Technology, Open Learning and Distance Education. Routledge.

Butler, D., & Winne, P. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research, 65* (3), 245-281.

Diamond, R. M. (1998). Designing and Assessing Courses and Curricula. Jossey-Bass.

Harasim, L., Hiltz, S. R., Teles, L., & Turoff, M. (1995). Learning Networks: A Field Guide to Teaching and Learning Online. MIT.

Millis, B. J. & Cottell, P.G. (1998). Cooperative Learning for Higher Education Faculty. Oryx.

Schutte, J. G. (1997). Virtual teaching in higher education: The new intellectual superhighway or just another traffic jam? http://www.csun.edu/sociology/virexp.htm

Slavin, R. E. (1995). Research on Cooperative Learning and Achievement: What We Know, What We Need to Know. http://www.successforall.net/cooplearn.html

SMILe: Giving Internet Instruction a Human Face

Matthew Nickerson
Gerald R. Sherratt Library
Southern Utah University
Cedar City, UT, 84720, USA
nickerson@suu.edu

Abstract: Southern Utah University has over five years of successful programming on the state's closed circuit two-way video educational network. We have recently capitalized on this experience and expertise to create a unique web-based humanities course supported by video-on-demand lectures using RealNetworks® media streaming technology and SMIL (Synchronized Multimedia Integration Language).

Introduction

Streaming video technology is transforming multimedia content on the Internet and adding powerful new possibilities to on-line education. More powerful compression algorithms and broadening bandwidth capabilities make video delivery over the web more and more feasible for serious distance educators who want to maximize content delivery options.

Just as video-on-demand programs using VHS tapes added the power of video and moving images to "traditional" distance education programs now video streaming technologies make it possible to bring the power of video to web based courses as well. Mention of video as a possible ingredient in new on-line educational offerings began appearing in the literature as early as July 1999 (Thornton, 1999). Though relatively rare there are a few institutions using streaming video to support web based instruction. The majority of these programs are using in house products developed by their institution to create Internet courses that include video and "electronic presentations" (Brusilovsky, 2000). At Southern Utah University (SUU) we have created a general education humanities course for delivery over the Internet that includes video-on-demand capability providing students with over 150 mini lectures in support of the content material. In seeking to create a new, exciting Internet offering we chose a general education humanities course as an ideal vehicle for testing the efficacy of multimedia streaming technology in Internet based university instruction. In short, we wanted to make our Humanities 1010 Internet course as human as possible.

The Course

The Humanities course selected is part of SUU's growing distance education program and is taught yearly over live interactive TV as part of our concurrent enrollment program. Students across the state can take the course live via Utah's closed circuit educational network, EDNET. The course was ideal for this project in that it is taught in a studio setting where a high quality recording of the lecture was possible. In addition, the instructor has designed the course to be delivered over TV so many of the instructional aids and projects have been optimized to the camera/TV environment adding quality to the video recording as well.

Lectures for the entire course were recorded digitally during Fall 1998 in preparation for developing the Internet course. Editing the recorded lectures into 5-10 minute mini lectures and securing still images to illustrate them all was a very time consuming process. The faculty instructor worked with a team of three student assistants to create the illustrated mini lectures. Development of the Internet course was funded in part with grants from the Utah Education Network (UEN) and the Higher Education Technology Initiative (HETI).

The Technology

The innovative structure and delivery of the course is made possible by a powerful WWW multimedia tool, SMIL, (Synchronized Multimedia Integration Language) pronounced, "smile." Recommended by the World Wide Web Consortium (W3C) it allows for the creation of time based multimedia delivery over the web (World Wide Web Consortium, 1998). Based on XML, it allows developers to mix many types of media together including, text, video, graphics, audio and vector based animation, and to synchronize them to a timeline. Specifically, SMIL provides Web users with:

- Easily defined basic timing relationships
- Fine-tuned synchronization
- Spatial layout
- Direct inclusion of non-text and non-image media
- Hyperlink support for time-based media
- Adaptability to varying user and system characteristics.

Our Humanities course for the Internet uses these capabilities to deliver video and still images to create an illustrated video lecture format unique to on-line instruction.

The simultaneous streaming of a variety of media is the key feature of SMIL that we use to create the "illustrated lecture" format of the class. We use RealNetworks® technology for our video encoding, streaming and player system. When we first envisioned video-on-demand support for a course delivered over the WWW RealNetworks® was the industry standard for streaming media on the Internet. Since beginning our program Apple, Microsoft and others have introduced streaming systems as well but we are pleased with our choice to use RealNetworks® and with the improvements they continue to make in their product and support. In addition, RealNetworks® was the first of the major streaming technologies to make their player SMIL compatible.

SMIL is a programming language similar in structure to html. Layout tags allow the player window to be customized, including the creation of multiple player regions, each capable of displaying a different media stream. Our mini lectures use a simple rectangular window divided into three separate regions: a video region, a menu region and a slide region (Fig. 1).

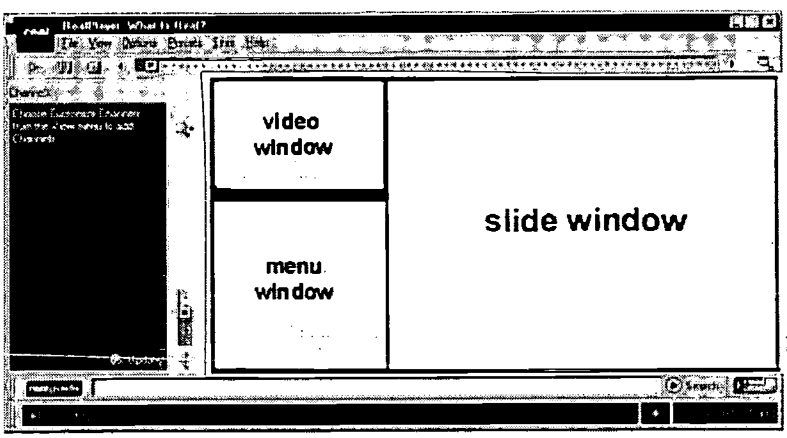


Figure 1: General layout of player window

The video and menu regions take up the left side of the window with the video region immediately above the menu region. The video region displays the instructor in a tight shot, as well as any visuals he used during the TV broadcast of the class. These visual supplements include such things as computer images, overheads and use of the white board. The menu region lies just below the video window and is a simple point and click menu for navigating through the current lesson.

The slide region is the largest window and lies to the right of the other two. The slide region displays still images that illustrate what the instructor is discussing. Standard video controls (play, stop, pause, fast forward, rewind) above the video window allow students to control the flow of the presentation (Fig. 2).

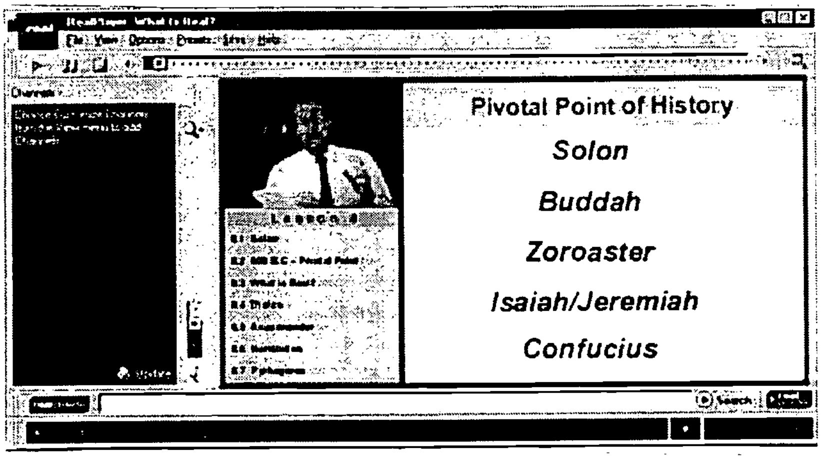


Figure 2: Screen capture of player window in operation

Another important SMIL feature beyond its layout capability is SMIL's ability to create simultaneous streams of various media. This is the heart of the "narrated slide show" format of our class. SMIL allows the designer to synchronize various media streams to produce a multimedia product. Our design uses SMIL to "tie" a series of still images to the time line of the video so that they stream simultaneously with each graphic appearing in the image window "on cue" as the lecture progresses.

We initially demonstrated the video-on-demand courseware to a small number of students and were encouraged by their response. They found the video to be engaging and personal and they react very positively to the instructor's excitement and enthusiasm for the subject matter. In fact, students tended to rely too much on the video which is meant to supplement and interact with the course reading assignments, *not* replace them.

One draw back of Internet-based multimedia is the fairly high bandwidth required for quality streaming. Our suggested minimum requirement for online students is a pentium class (or comparable Macintosh) computer, with 64K RAM, 300MhZ processor and a true 56K Internet connection (or faster.) The high end technology does limit access to the course but we are confident that streaming video will be a major element in the future of web-based instruction and we feel it is necessary to begin working in this arena now. The necessary bandwidth and processor speeds for streaming video are already in place at most colleges and universities and at many public schools as well. With cable modems and other emerging technologies increasing the receiving capabilities of home users our early foray into this field will prepare us to better serve the needs of students in the future .

A Beginning

The course was officially opened winter 2000 with ten students. We are using this first course as a test of the program and pedagogy we have employed in creating it. All students will be expected to fill out a survey as part of the exit requirements for receiving credit for the course. The survey instrument will be distributed from a continuing education web site, unrelated to the course site, in hopes to encourage students to be frank and open in their response. The survey will focus on:

General

- Student demographics
- Satisfaction with course
- Satisfaction with the technology
- Satisfaction with student support

Specific

- Satisfaction and perceived value of the video lectures
- Satisfaction and perceived value of the streaming technology
- Satisfaction and perceived value of the on-line assignments and quizzes
- Satisfaction and perceived value of the student-teacher interaction

Conclusion

Overall, we are excited about what streaming video can bring to Internet instruction and look forward to implementing our first course using this new technology. We hope to have enrolled sufficient numbers by the fall of 2000 to be able to publish significant findings from our research into the operation, teaching effectiveness and student satisfaction related to streaming video-on-demand in support of Internet based college courses.

References

Brusilovsky, Peter. (2000). Web lectures: electronic presentations in web-based instruction. *Syllabus*, 13 (5) 18-23.

Thornton, Carla. (1999). Back to school, web style. *PC World*, July 1999. Retrieved March 20, 2000 from Academic ASAP database on the World Wide Web: http://web2.infotrac.galegroup.com/.

World Wide Web Consortium. (1998). *The world wide web consortium issues SMIL 1.0 as a W3C recommendation.* [Press Release]. Retrieved October 13, 1999 from the World Wide Web: http://www.w3.org/Press/SMIL-REC.

CoCoA2: Computer Supported Collaborative Language Learning Environment Based on Online Proofreading

Hiroaki Ogata Yoshiaki Hada Yoneo Yano
Department of Information Science and Intelligent Systems, Tokushima University
2-1, Minamijosanjima, Tokushima 770-8506, Japan
Email: ogata@is.tokushima-u.ac.jp

Abstract: CoCoA (Communicative Correction Assistant System) was developed for supporting students and teachers to exchange online marked-up documents via email. Its environment is very similar to a real one in which people use paper and pen. In order to effectively reuse marked-up digital documents created with CoCoA, this paper proposes a computer supported proofreading exercise environment called CoCoA2. CoCoA2 can reduce the overload of the teacher, and it can make composition learning more effective. CoCoA2 has been developed and used it experimentally.

Introduction

Recently, researchers in educational systems attempt to provide technological support for cooperative and collaborative learning advocated by educational theories (O'Malley, 1994). The explosive growth of networking, in particular, raises the possibility of widespread collaborative and open-ended learning activities (Harasim, et al., 1995). We have investigated technological support for open-ended and collaborative learning activities (Ogata, et al., 1996; 1997). In composition studies, coupled with the shift in writing pedagogy toward an open-ended and learner-centered approach, the theoretical view of learning has created a surge of interest in collaborative learning in such way as to prize conversation and interaction among students and among students and teachers.

In computer-based classrooms, writing teachers and students use various software tools based on some theories of writing. Writing compositions includes various sub-processes such as planning, transcribing, and revising, which do not need to occur in any fixed order (Scardamalia & Bereiter, 1986). Hence, it is very important for students to receive the instruction through the review. There are some asynchronous editing systems that support teachers to review and correct the students' drafts with online mark-up. These systems adapt the traditional mark-up model to the computer screen. The symbols are both familiar and intuitive for editors and authors; for example, deletion, insertion, and move (Farkas & Poltrock,1995). For instance, MATE (Hardock, Kurtecbach, & Buxton, 1993) allows the editors to use both online markup and comments. In this model, authors and editors can readily interpret the editor's markings. Although there are many systems that employ markup that allows multiple users to correct an electronic document as if they were marking up a printed copy of the document, the systems do not provide a generalized format for exchanging the documents using Internet.

CoCoA (Communicative Correction Assistant system) has been developed for supporting foreigners and teachers to exchange marked-up documents by e-mail (Ogata et al., 1997). Its environment is very similar to a real one in which people use paper and pen. CoCoA allows teachers not only to correct the compositions sent from foreigners by E-mail, but also foreigners to see where and why the teacher had corrected them. CoCoA improves the opportunities that foreigners have for writing Japanese compositions and for receiving instructions from teachers. CCML (Communicative Correction Mark-up Language) (Ogata et al., 1998) has also been proposed for the representation of marked-up documents, which is based on SGML (Standard Generalized Mark-up Language) (Herwijnen, 1990). With CCML, teachers and students can exchange marked-up documents via e-mail (Ogata et al., 1999). In the experimental use of CoCoA, most of users commented that CoCoA was easy for them to understand the mistakes in documents because of the use of marks, and that the optional view of the original, marked or revised text was very useful.

This paper proposes an online markup based collaborative learning environment called CoCoA2, for Japanese language composition studies. In order to effectively re-use marked-up digital documents created with CoCoA, CoCoA2 reuses the documents in proofreading exercise for other learners. In CoCoA2, a learner sends a teacher an original text. The teacher then corrects the text with CoCoA2, and returns the learner the marked-up text. The marked-up texts of all the learners are stored into a repository of the teacher. From the students in a networked writing classroom, CoCoA2 chooses an appropriate learner for proofreading exercise by analyzing writing errors in the CCML formatted documents repository. CoCoA2 presents the selected learner with an original text in which there are a number of errors that the learner has to find and correct. This exercise elevates error-correcting skills and self-monitoring skills in writing a composition (Coniam, 1997). After the learner finishes proofreading, CoCoA2 evaluates the result through comparing the correction of the learner with that of the teacher. CoCoA2 creates the opportunity of collaborative learning by connecting the proofreading learner and the learner who wrote the original text. The document can be improved through the collaboration. Because of the reuse of online marked-up digital documents, CoCoA2 can reduce the teacher's load, and it can make composition learning more effective.

Overview of CoCoA and CCML

CoCoA-Editor & CoCoA-Viewer

CoCoA system consists of CoCoA-Editor for a teacher and CoCoA-Viewer for a student. Figure 1 shows the interface of CoCoA. By selecting a mark from the mark palette shown in the window (A), a teacher can correct learners' documents. Moreover, the teacher can annotate in the document using the annotation palette, and he/she classifies the marks using a window which looks like (B). The "undo" button erases corrections. In figure 1, the teacher changes the words which means "attend", and determines the importance level of the correction is three. A learner obtains a marked text in a window (C). In this case, CoCoA-Viewer provides only the marks over the level two of importance. "?" denotes a question and "*" shows a explanation from the teacher. The system displays the contents of the annotation after clicking the mark. As shown in the message window, the learner can reply to the message and send it after revising the document.

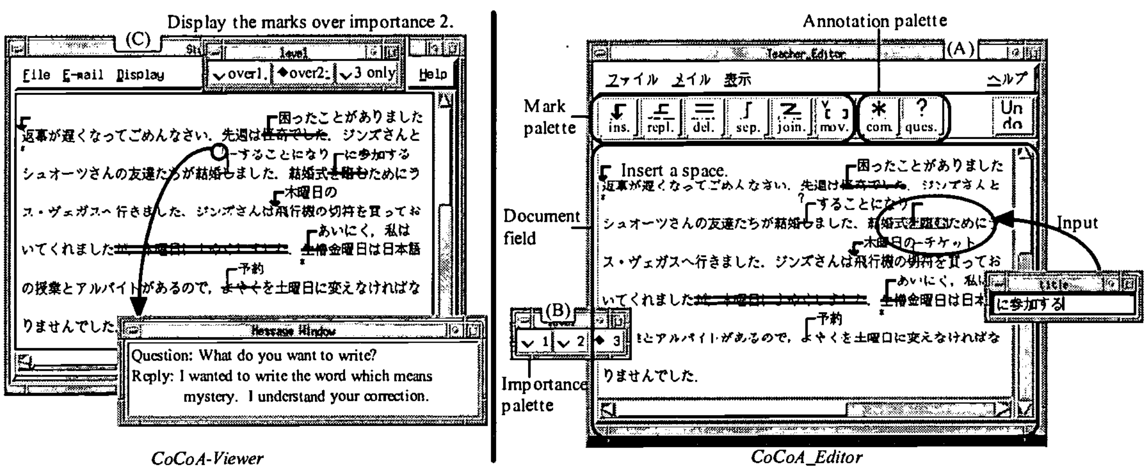


Figure 1: Screen snapshots of CoCoA-Viewer and CoCoA-Editor.

CCML

Japanese Industrial Standard (JIS) defines 20 marks and 18 sub-marks as the marks for proofreading (Shimano, 1986). A mark shows the spot of correction, e.g., text insertion. All the marks are not required in our situation because documents are inputted with a computer. Based on this standardization, seven marks were selected through our experiments. The seven marks for correction were selected; insert, replace, delete, separate, join, move and annotation. Based on SGML, CCML for exchanging marked-up documents has been proposed. SGML is an ISO standard (ISO 8879:1986) which supplies a formal notation for the definition of generalized mark-up languages. SGML is device-independent methods of representing texts in electronic form.

CCML document consists of three parts: header, body and close. A header part has an editor name, an author name, and the revision time. A close part shows the editor's comments. A body part consists of the six marks and the annotations. Every tag has an attribute "level" that a teacher gives a number from one to three; 1:weak correction, 2:normal correction, and 3:strong correction. It is very important for a teacher to annotate the marked text for instruction in composition. For example, PREP Editor (Neuwirth et al, 1996) is a word processor that allows writers and reviewers to create electronic margins, or columns, in which they can write and communicate through their annotations. In CCML, annotations are classified into three categories: explanation, question, and comment. The main characteristics of CCML are:
(1) Based on the experiment, CCML presents six marks and annotation CCML tags.
(2) The marks have three degrees of importance levels against respective corrections.
(3) Removing all the CCML tags generates the original text.
(4) The revised text is derived from the CCML document.
(5) Because CCML documents are text-formatted, it is easy to send them by e-mail.
Needless to say, CCML inherits its features from SGML.

CoCoA2: On-line Markup Based Collaborative Learning Environment

Learning process

Correcting exercise can help learners understand reasons for writing errors. Exercise materials can also transform the learning experience and enhance learner motivation. In making full use of every corrected document and writing errors data processed, in CoCoA, the correcting exercise method is suggested to assist learners for enhancing their writing ability. Figure 2 shows the method of providing learner with some similar documents for learner's correcting exercises.
(1) Learner A writes an original text and sends it to a teacher by e-mail.
(2) The teacher corrects the text with CoCoA-Editor.
(3) The teacher sends learner A the marked-up text by e-mail.
(4) The teacher stores the marked-up text of learner A into the CCML document database.
(5) CoCoA2 selects a suitable document for proofreading exercises of learner B using the CCML document database. Analyzing the document database, the system recommends a candidate document containing similar errors to learner B's errors. In figure 2, the system selects a learner A's document for the exercise.
(6) Teacher sends learner B the CCML document of learner A.
(7) CoCoA generated the original document from the CCML text, and provides learner B the uncorrected document that includes similar writing errors of learner B. Then, learner B revises the text with CoCoA2.
(8) After learner B finishes correction, CoCoA2 evaluates it through the comparison between the correction of learner B and that of the teacher. Moreover, learner B can be helped to re-correct the document with some advice of learner A who received the corrected text by the teacher before.

In CoCoA2, it is very important how the system can support process 5 and 8. These designs are described in the following section.

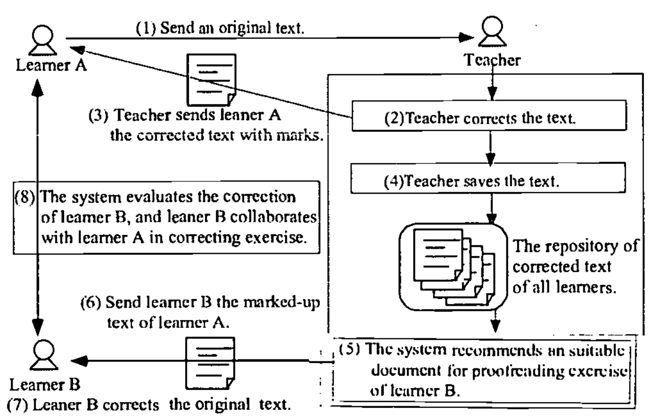


Figure 2: Learning process of collaborative learning in CoCoA2.

Selecting a target document for proofreading exercise

In order to select an appropriate document for proofreading exercise, CoCoA2 analyzes the CCML document using natural language processing technologies (Feng, Ogata & Yano, 1998). Error words are identified by a morpheme analyzer called Chasen (Matsumoto, 1997). Statistical analysis of these errors can help the system to find a suitable document that includes similar types of errors to a target learner for the exercise. Using a TF-IDF *vector space model* (Salton et al., 1994), writing errors are classified. TF-IDF is one of the most successful and well-tested techniques in information retrieval. A document is represented as a vector of weighted terms. The computation of the weights reflects empirical observations regarding text. Terms that appear frequently in one document (TF = term frequency), but rarely on the outside (IDF = inverse document frequency), are more likely to be relevant to the topic of the document. Therefore, the TF-IDF weight of a term in one document is the product of its term-frequency (TF) and the inverse of its document frequency (IDF). In addition, to prevent longer documents from having a better chance of retrieval, the weighted term vectors are normalized to unit length. With this method, CoCoA2 compares the number of each morpheme of the learner's errors with that of other learners' errors, and CoCoA2 finds similar documents including the same errors as the target learner's errors.

Evaluation of learner's correction

The system evaluates learner's correction as follows:

1. Standardizing the corrected documents;
2. Comparing correction of the respective document;
3. Scoring a point on the learner's correction.
4. Advising the learner about the different correction.

The standardization is needed to make it easy to compare the two corrections, because the learner may correct the text with the different marks from the teacher. The standardization is based on the following two rules:

(1) Replacement rule: If there is an insert mark after delete mark, or if there is an delete mark after insert mark, then the two makes change one replacement mark.

(2) Union rule: If the two same marks adjoin, they are united. For instance, the delete mark and the neighboring delete mark are combined into one delete mark.

After the standardization, the system compares the correction of the learner with the model correction of the teacher. Correction marks of two standardized documents are classified into the following states:

1. Same correction: Learner completely corrected the same words/sentences as the teacher.
2. Different correction: The correction of learner is different from that of the teacher. For instance, corrected words are different, or learner was not aware of writing errors.

In order to make it easy for learner to understand the evaluation result, the system gives a score on the

$$X = \frac{\sum_{i=1}^{n} \frac{M_i}{C_i}}{n} \times 100(\%)$$

proofreading exercise. The point of same answer (X) is proposed as follows:
n is the total number of teacher's correction. Mi shows the correspondent number of correction between the learner and the teacher. Ci shows the number of the teacher's correction. The more similar to the teacher the correction of the learner is, the higher X.

Implementation of CoCoA2

CoCoA2 consists of a server for a teacher and a client for a learner. With CoCoA-Server, teacher stores all of the learners' documents that the teacher has corrected with CoCoA-Editor and the teacher selects the document for proofreading exercise. CoCoA2-Client shows the proofreading learner the uncorrected document that is generated from the CCML document. After finishing correction, CoCoA2-Client evaluates it and connects the learner and the original writer.

CoCoA2-Server

Figure 3 shows an interface of the document selection function of CoCoA2-Server. Window *A* lists all of the learners' names. Teacher selects a learner for proofreading exercise from this list, e.g., Wang. Then, the system shows some files for proofreading in window B, comparing errors in all of Wang's documents and that of the other documents. Moreover a list of degree of similarity appears in window *C*. The degree shows the similarity between errors of Wang's documents and that of another documents. With this window, teacher can easily select a suitable document for the learner's proofreading exercise by referring the degree.

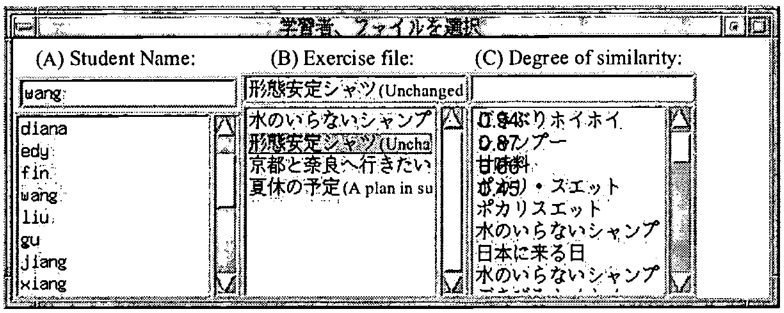
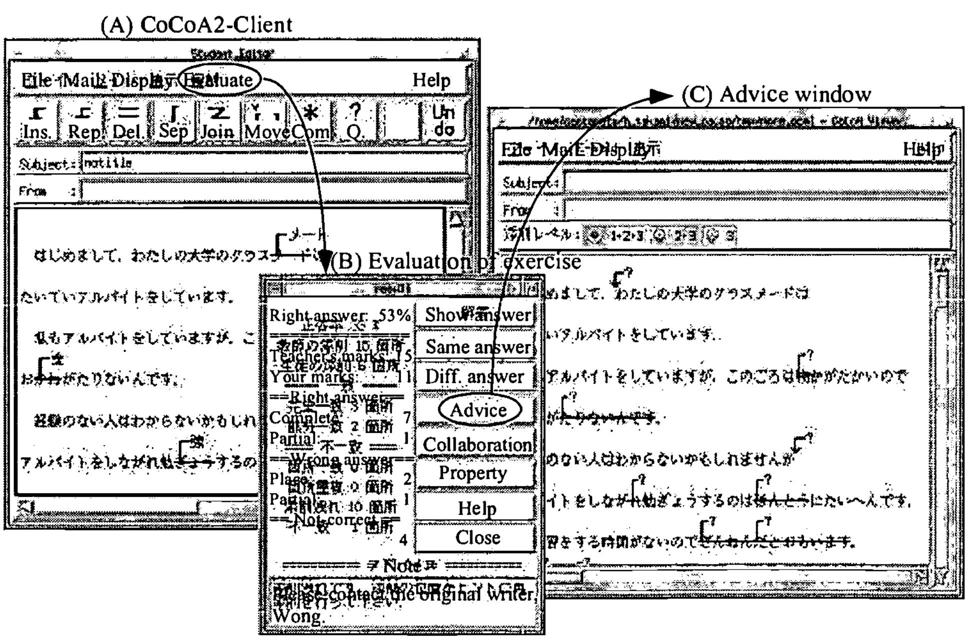


Figure 3: Interface for the document selection for proofreading exercise.

CoCoA2-Client

CoCoA2-Client is extended from CoCoA-Editor. Whenever a learner wants to study about compositions, s/he can start a proofreading exercise with CoCoA2 and correct a text with (A). The text is generated from the CCML document that the teacher sent to the learner. This system begins to evaluate the results of the learner's correction by pushing "evaluate" button. The results are shown in (B). The same answer rate is 53% in this case, comparing the learner's correction with the teacher's correction. "Show answer" button displays the teacher's correction as an answer. "Same answer" button shows only the same corrections of learner as teacher's correction. On the other hand, "different answer" button displays the different corrections of learner from teacher's corrections. "Advise" button shows helpful hints in (C), e.g. indicating the places to correct. "Collaboration" button creates a communication channel between the learner and the original writer of the document. The learner reviews and corrects in collaboration with the original writer. They can communicate with an online chat tool or email. If the original learner agrees with the learner's correction, the exercise will



finish.

BEST COPY AVAILABLE

Figure 4: Interface of CoCoA2-Client.

Conclusions

This paper proposed a computer supported proofreading exercise environment called CoCoA2 where a teacher and learners can exchange electronic marked-up documents. Although we tried to use CoCoA2 in Japanese language learning, CoCoA2 is independent of a language domain. Therefore, CoCoA2 will be able to be used for learning any language. In the future work, we will evaluate CoCoA2 in detail during long term, and we will also investigate how to support multi-lingual language learning in a cyber space. CoCoA2 have been implemented in Tcl/Tk on both Microsoft Windows 95/98/NT and Sun workstations. A Japanese version of this software is distributed to other researchers and developers for demonstration. For further information, our home page (http://www-yano.is.tokushima-u.ac.jp/research/cocoa/cocoa.html) is available. A commercial product of CoCoA that is called *E-Correct* is also download-able from the following URL:http://www3.apex.co.jp/~apex/ corret/english/

References

Coniam, D. (1997). "A Computerized English Language Proofing Close Program", *Computer Assisted Language Learning*, Vol.10, No.1, pp.83-97.

Farkas K. D., & Poltrock, E. S. (1995). "Online editing mark-up models, and the workspace lives of editors and writers," IEEE Trans. in Professional Communication, 38(2), pp.110-117.

Feng, C., Ogata, H. and Yano, Y. (1998). "Error Analyzer for Supporting Collaborative Japanese Language Learning," *Proc. of International Conference on Computers in Education*, Vol.1, pp.588-594.

Hardock, G., Kurtecbach, G., & Buxton, W. (1993). "A marking based interface for collaborative writing," *Proc. of the ACM Symposium on User Interface Software Techonogy*, pp.259-266.

Herwijnen, E. (1990). *Practical SGML*, Kluwer Academic Publishers.

Harasim, L., Hiltz, R. S., Teles, L., & Turoff, M. (1995). *Learning Networks -A filed guide to teaching and learning online-*, The MIT Press.

Matsumoto, Y, Kitauchi, A., Yamashita, T., Hirano, Y., Imaichi, O. & Imamura, T. (1997) "Japanese Morphological Analysis System ChaSen Manual," Nara Institute of Science and Technology Technical Report NAIST-IS-TR 97007. (in Japanese)

Neuwirth, M. C., & Wojahn, G. P. (1996). "Learning to write: Computer support for a cooperative process," *CSCL: Theory and practice of an emerging paradigm*, Koshmann, T. (Ed.), Lawrence Erlbaum Associates, Publishers, pp.147-170.

Ogata, H., Matsuura, K. & Yano, Y. (1996). Knowledge awareness: Bridging between shared knowledge space and collaboration in Sharlok, *Proc. of Educational Telecommunications*, 232-237.

Ogata, H., & Yano, Y. (1997). "Active knowledge awareness filtering toward efficient collaborative learning," *Proc. of AI-ED 97*, Kobe, Japan. (in press)

Ogata, H. and Yano, Y. (1997). "CoCoA: Communicative Correction Assisting System for Composition Studies", *Proc. of International Conference on Computers in Education*, pp.461-468.

Ogata, H. , Yano, Y., and Wakita, R. (1998). "CCML: Exchanging Marked-up Documents in a Networked Writing Classroom," *Computer Assisted Language Learning*, Vol.11, No.2, pp.201-214.

Ogata, H. , Feng, C., Hada, Y. and Yano, Y. (1999). "Supporting E-mail Based Correction in Computer Assisted Language Learning," *Proc. of Int'l Conf. on Computer Processing of Oriental Languages*, pp.241-244.

O'Malley, C. (1994). *Computer supported collaborative learning, NATO ASI Series, F: Computer & Systems Sciences*, Vol. 128.

Salton, G., Allan, J. and Buckley, C. (1994). "Automatic structuring and retrieval of large text files." *Commun. ACM*, 17(2), pp.97-108.

Scardamalia, M., & Bereiter, C. (1986). "Research on written composition," M. Wittrock (Ed.), *Handbook of research on teaching* (third ed.), Macmilian, pp.778-801.

Shimano, H. (1986). *Handbook of proofreading*, Miki Publishers, Japan, in Japanese.

Acknowledgment

This research was supported in part by the Grant from the Telecommunications Advancement Foundation and the Grant for Scientific Research (A) No.11780125, No.09558017, No.09480036 and No.11878032 from the Ministry of Education in Japan.

A Case Study of Student Tool Use During Hypermedia-Based Problem Solving

Kevin M. Oliver
Virginia Tech
Educational Technologies, #0232
Blacksburg, VA 24061
kmoliver@vt.edu

Abstract: During a qualitative case study in which middle school learners used computer tools to scaffold scientific problem solving, three research questions were addressed: how do students use technological tools to find, frame, and resolve open-ended problems; what is the nature of science learning in problem-based, Internet environments; and how do attitudes and environmental variables influence students' problem solving? While the students understood how to use most tools procedurally (i.e., collecting basic information), they lacked strategic understanding for why tool use was necessary (i.e., organizing, evaluating, justifying ideas). Students scored average to high on assessments of general content understanding, but developed artifacts suggesting their understanding of specific micro problems was naive and rife with misconceptions. Process understanding was also inconsistent, with some students describing basic problem solving processes, but most students unable to describe how tools could support open-ended inquiry. Personal barriers to effective problem solving included naive epistemologies, while environmental barriers included a lack of communication activities and training. In future studies, tools may support higher-order thinking by addressing study recommendations: training students procedurally and strategically, perhaps longitudinally; using students' personal problem models as an explicit part of instructional strategies; balancing students' epistemological comprehension of problem complexity with self-directed, self-management tactics; and employing the teacher as dialectic facilitator.

Introduction

National science standards call for increasing student exposure to inquiry and real-world problem solving (Hurd, 1997; National Academy of Sciences, 1995). Students can benefit from environments that stress the engagement of real problems and the development of thinking skills over the memorization of discrete facts. The Internet is an ideal vehicle for contextualizing problems with its seemingly endless supply of resources. Problems arise, however, since young students are developmentally ill-prepared to handle open-ended learning and have cognitive difficulties processing hypermedia. Computer tools were used to determine how they might support the process of solving open-ended problems. A preliminary hypothesis suggested students would solve open-ended problems more appropriately if they used tools in a manner consistent with higher-order critical and creative thinking.

Methods

Design and Participants

An embedded case study design was employed with an eighth grade science class. Multiple embedded units were analyzed: 12 individual participants who were grouped into 6 dyads that together represented the case or whole classroom.

Materials: Tools

The Knowledge Integration Environment (KIE) computer tools were chosen to scaffold student inquiry (Linn & Slotta, in press). The tools were designed to support students in developing advanced scientific understanding by integrating and reconciling scientific evidence on the Internet with individual scientific models. The KIE tools were of three primary types: processing, scaffolding, and communicating. The technical infrastructure of the research setting disallowed the use of communication tools for this research.

Processing tools seek to activate and model cognitive processes while extending the capacity of human memory (Kozma, 1987; 1992). KIE information processing tools included collecting tools to save web evidence into a conceptual framework, organizing tools to categorize evidence, and integrating tools to take notes and reflect on the data. Students in this study also used non-KIE information generating tools to develop sketches and web pages defending their ideas.

Researchers suggest scaffolding tools in particular are needed to assist learners who seek to process hypermedia effectively (Kinzie & Berdel, 1990; Lee & Lehman, 1993). Scaffolding tools are "engineered to assist learners in performing tasks for which they would otherwise be unprepared" (Laffey, Tupper, Musser, & Wedman, 1998, p. 75). They fall into three classifications: procedural, conceptual, and metacognitive (Hannafin, Land, & Oliver, in press; Iiyoshi & Hannafin, 1996). KIE tools allow for the embedding of procedural instructions suggesting how to go about tasks, conceptual prompts suggesting what topics were important to consider, and metacognitive advice suggesting strategies for resolving problems posed.

Materials: Curriculum Units

A theory comparison unit was employed in a pilot study, asking students to examine then choose and defend either the uniform or catastrophic theory of earth formation. A design unit was employed for the research study, asking students to find and frame various earthquake engineering problems, then resolve them with an original, evidence-based solution.

Data Sources

Data sources included artifacts, interviews, field notes, and tests. Eight artifacts collected included such items as student research questions, notes, argument graphs, and web pages. Field notes were taken daily during the four-week study. Each of six dyads was interviewed three separate times as the study progressed about their use of tools, their scientific understanding, and their attitudes toward inquiry-based learning. The teacher participant was interviewed twice regarding the same student outcomes. Individual students were interviewed after the study to clarify their understanding of the open-ended problem solving process. A content test and ordered tree instrument (Naveh-Benjamin, McKeachie, Lin, & Tucker, 1986) were used to determine conceptual understanding.

Procedures

Students were trained on tool use by means of a 2-day mini-project and a 3-week pilot study, during which they were explicitly instructed how and when to use specific tools. In the research study, however, students were given the choice of using or not using the tools to accurately depict "intentional" tool use. They were not told which tools to use in response to their tasks, but were provided with procedural scaffolding describing how to use tools if they forgot.

Data Analysis

As recommended by Yin (1994), data analysis sought evidence confirming or disproving a theoretical proposition: young students who use computer tools to manipulate hypermedia resources in higher-order creative and critical ways (e.g., organize, annotate, represent) will effectively solve open-ended problems. Hypothesis refinement situated this research within the analytic induction tradition– beginning with theory in mind and building to more focused theory (Merriam, 1998). Data analysis consisted of coding and reduction, then display and pattern seeking (Miles & Huberman, 1994). The data were reduced by coding against typological frameworks of critical and creative thinking to address tool use. Further codes were developed openly by seeking instances of learning, attitudes, and environmental factors in the data that would directly inform the theory-built research questions. A lengthy aggregated text and partially-ordered checklist matrices were developed from codes to seek categorical evidence of students thinking with tools, learning science, or displaying attitudes and behaviors (Creswell, 1998; Miles & Huberman, 1994; Stake, 1995) (see Figure 1). Matrices illustrated the thinking skills exhibited by each dyad and the tools associated with that thinking. Asterisks indicated a tool was used, but ideal or expected thinking did not occur (e.g., students created a web page to describe their solution, but did not justify their idea with web evidence). Categories were generated by studying the matrices for commonalities in thinking (e.g., "the first dyad rarely used metacognitive scaffolding, did the second, did the third, ... ?"). The process was consistent with "...discriminant sampling" suggested by Lincoln & Guba (1985). Categories were then related by studying their "semantic" relationships (e.g., X is a kind of Y, X is a cause of why) (Spradley, 1979). Shared relationships suggested themes that were developed into an "analytic text" of findings (Miles & Huberman, 1994). For example, one tool use theme noted was students organize information, but rarely use their frameworks as the basis for decision making or integration of further evidence.

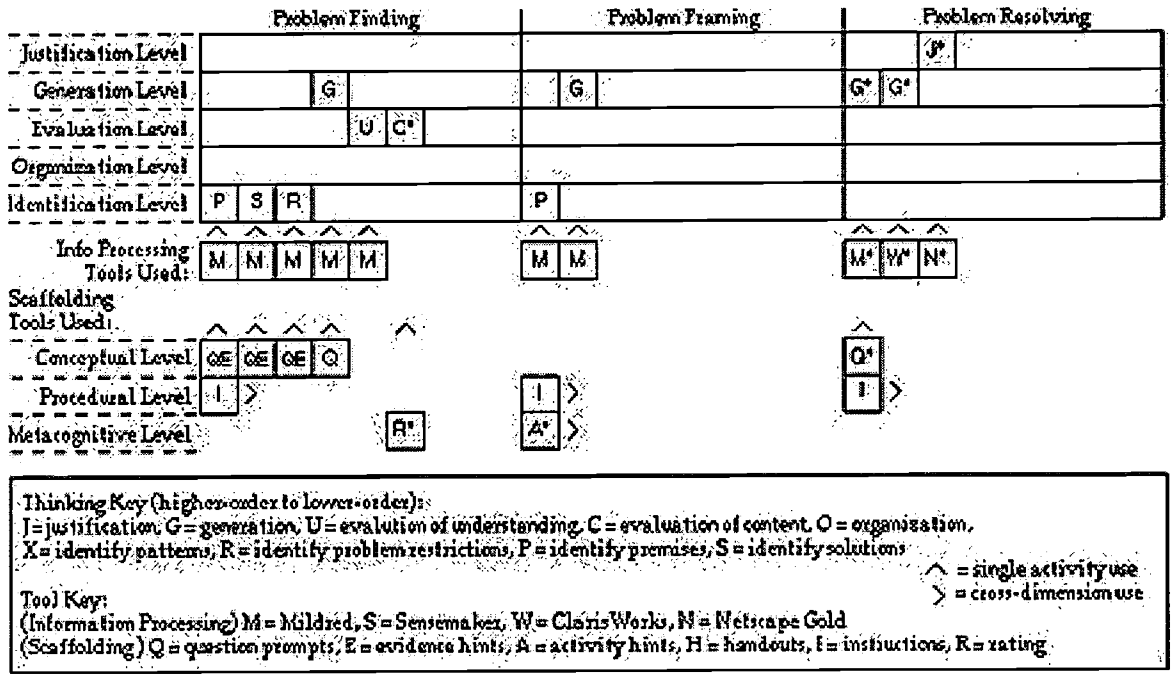


Figure 1. Checklist matrix partially ordered across three study dimensions.

Findings

On Tool Use

Students did not use tools strategically, as evidenced by three underlying themes. First, students used processing tools more appropriately when scaffolded and when provided with limited resource sets. During the initial problem finding stage, students were provided with 13 web pages and conceptual scaffolding in the form of question prompts in their note-taking tool. Students answered prompts explicitly, identifying underlying premises, conclusions, and restrictions, but neglected to describe patterns across and personal reactions about the information. During a problem framing stage, students were provided with 65 web pages and no conceptual scaffolding. Students identified less information overall, and skimmed resources by searching for keywords related to their problems.

Second, students did not attribute strategic values to the tools, using most infrequently and often inappropriately. For instance, some students did not effectively use their organization tool to seek patterns in the web evidence by generating problem-specific categories. Only 1 of 12 participants made use of a system function to integrate additional web information as "evidence" for a specific category or problem. Further, few students used print-based documents to evaluate resources or their own solution ideas with criteria, and most did not use information generation tools to argue for and justify their ideas (e.g., making hyperlinks on web pages to supporting evidence).

Finally, students relied heavily upon explicit procedural scaffolding, but neglected to use metacognitive guidance suggesting appropriate inquiry strategies.

On Learning

Three types of learning were evident in the study: problem, content, and process. Students identified basic problem information and used that to generate some original solutions. Students based these ideas on limited evidence, however, so many of the original ideas were flawed in design. For example, one dyad suggested an hourglass-shaped structure with external bracing. External bracing was a suggested technique found in the web evidence, but the odd-shaped hourglass design contradicted further evidence showing the structural failure of asymmetrical structures. Another dyad created an alternative design for building columns, employing layers of discs that could slide or pop-out during an earthquake instead of a single column that was shown to buckle and collapse. The solution was both original and relevant, but would not likely support an overhead load. The ability of students to test and revise their ideas within a lab or computerized simulation might have helped them move beyond partial understanding and misconception.

Beyond student understanding of specific self-selected earthquake engineering problems, most students acquired basic content understanding about general earthquake engineering constructs. Only one-half of the participants, however, demonstrated process understanding for open-ended problem solving following the study. Most were able to list steps in the process during post-study interviews, but few could describe the strategic value of tools to support that process.

On Student and Environmental Factors

Student and environmental themes suggested some possible causes for inadequate tool use. First, students exhibited characteristics of a naive epistemology: evaluating ideas summatively rather than formatively, infrequently revising and updating ideas on the basis of evidence, perceiving open-ended problem solving as non-complex, and seeking help from others rather than the system in a self-directed manner. Further, they managed resources and time improperly: skimming evidence, neglecting to use non-electronic resources, and rushing through activities. In terms of environmental factors, some students needed additional procedural training on tool use. Almost all students needed explicit training on strategic tool use, or at least more direction from the facilitators regarding which tools to use for strategic purposes. Finally, when student activities involved communicating with peers and facilitators, students' thinking reached high levels never managed by tool use alone (e.g., evaluation and justification of ideas). More communication activity during the study would have supported better inquiry and thinking.

Interpretations and Recommendations

Support Tool Use through Extended Training and Improved Interfaces

Students did not understand the value of their tools in this study. Myers (1993, p. 75) found students using hypermedia to solve open-ended problems needed time to learn to process that information in higher-order ways, "...perhaps a semester or school year." Such implicit, longitudinal training will eventually lead students to more appropriate tool use, or a more proactive technique would involve teachers explicitly training students on the strategic value of specific tools.

Students will tend to use scaffolding tools when they are conveniently located. Tool designers should embed scaffolding, particularly metacognitive, within information processing tools. These tools should not be far removed from the processes they seek to support. Further, tool-based scaffolding by itself is insufficient to support open-ended problem solving. Myers (1993) found teachers are also required to prompt students into appropriate action.

Support Learning with More Facilitation and Feedback Mechanisms

Students lacked endogenous models of earthquake engineering from which to interpret the evidence presented (Bruning, Schraw, & Ronning, 1995). In such situations, dialectical scaffolding is called for whereby peers and teachers with prerequisite facts and skills help students to reach proper levels of task engagement with selective help. Other techniques include the provision of manipulation tools which can promote personal theory development

(Land, 1995), or the provision of ongoing feedback from the teacher regarding student progress and performance. Finally, students should be required to state a prediction or hypothesis early in their inquiries, constantly reflecting on their stated assumptions as they encounter new evidence and revising their understanding when appropriate.

Encourage Student Intentions Strategically

Some students in this study exhibited characteristics of a naive epistemology which may simply be age-related or a function of the traditional school environment. While the problems provided to students in this study were open-ended, the KIE activity structure itself was rather explicit, structuring a series of activities for students. Students did not learn to apply processes, but gathered and learned basic information as one might expect from traditional learning environments. It seems likely that open-ended environments need to support students more implicitly in learning to handle the complexities of ill-defined problems. Laffey et al. (1998) designed tools that allow students to set their own goals and objectives, plan responsibilities, and allocate work to specific periods of time. To help students overcome their naive epistemologies, tool sets should strive to support processes implicitly rather than activities explicitly.

Implications and Conclusion

This research has implications for tool and instructional designers who can learn to design better open-ended systems and activities. Further implications apply to administrators and science teachers who seek to appropriately implement such curriculum reform. Authentic scientific inquiry is a model of learning that is far from prevalent in today's classroom. It stresses the development of lifelong metacognitive and strategic skills (Duffield & Grabinger, 1997; O'Reilly, 1991). Realistically, open-ended activities take more time to develop and implement, also limiting the number of topics that can be taught (O'Reilly, 1991). However, educators will better prepare students for the scientific community if they cover fewer topics in more depth and stress the development of strategic thinking processes (Linn, 1987; Norris, 1988, p. 219; O'Reilly, 1991).

The study hypothesis was neither supported or refuted. Students did not exhibit higher-order thinking, nor did they use tools effectively. If students had used tools with strategic intent, it is still possible they would have thought critically and creatively about their resources to generate elaborate, original solutions. Future research can build upon the study recommendations to improve tool use and develop better process understanding. Longitudinal studies of students learning to strategically use tools over time are highly recommended.

References

Bruning, R. H., Schraw, G. J., & Ronning, R. R. (1995). *Cognitive psychology and instruction* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions.* Thousand Oaks, CA: Sage Publications.

Duffield, J. A., & Grabinger, S. (1997, February). *Problem-based learning at the University of Colorado, Denver.* Paper presented at the Association for Educational Communications and Technology annual meeting, Albuquerque, NM.

Hannafin, M. J., Land, S., & Oliver, K. M. (in press). *Open learning environments: Foundations, methods, and models.* In C. Reigeluth (Ed.), Instructional design theories and models (2nd ed.).

Hurd, P. D. (1997). *Inventing science education for the new millennium.* New York: Teachers College Press.

Iiyoshi, T., & Hannafin, M. (1996, February). *Cognitive tools for learning from hypermedia: Empowering learners.* Paper presented at the National Convention of the Association for Educational Communications and Technology, Indianapolis, IN.

Kinzie, M. B., & Berdel, R. L. (1990). *Design and use of hypermedia systems.* Educational Technology Research and Development, 38 (3), 61-68.

Kozma, R. B. (1987). *The implications of cognitive psychology for computer-based learning.* Educational Technology, 27 (11), 20-25.

Kozma, R. B. (1992). *Constructing knowledge with learning tool.* In P. A. M. Kommers, H. Jonassen, & J. T. Mayes (Eds.), Cognitive tools for learning (pp. 23-32). Heidelberg: Springer-Verlag.

Laffey, J., Tupper, T., Musser, D., & Wedman, J. (1998). *A computer-mediated support system for project-based learning.* Educational Technology Research and Development, 46 (1), 73-86.

Land, S. M. (1995). *The process of developing theories-in-action with open-ended learning environments: An exploratory study.* Unpublished doctoral dissertation, Florida State University.

Lee, Y. B., & Lehman, J. D. (1993). *Instructional cueing in hypermedia: A study with active and passive learners.* Journal of Educational Multimedia and Hypermedia, 2 (1), 25-37.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry.* Beverly Hills, CA: Sage Publications.

Linn, M. C. (1987). *Establishing a research base for science education: Challenges, trends, and recommendations.* Journal of Research in Science Teaching, 24 (3), 191-216.

Merriam, S. B. (1998). *Qualitative research and case study applications in education.* San Francisco: Jossey-Bass Publishers.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis.* Thousand Oaks, CA: Sage Publications.

Myers, R. J. (1993). *Problem-based learning: A case study in integrating teachers, students, methods, and hypermedia data bases.* Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University.

National Academy of Sciences. (1995). *National science education standards.* [On-line]. Available: http://www.nap.edu/readingroom/books/nses/

Norris, S. P. (1992). *Practical reasoning in the production of scientific knowledge.* In R. A. Duschl, & R. J. Hamilton (Eds.) Philosophy of science, cognitive psychology, and educational theory and practice (pp. 195-225). Albany, NY: State University of New York Press.

O'Reilly, K. (1991). *Infusing critical thinking into United States history courses.* In A. L. Costa (Ed). Developing minds: A resource book for teaching thinking (pp. 164-168). Washington DC: Association for Supervision and Curriculum Development.

Slotta, J. D. , & Linn, M. C. (in press). *How do students make sense of Internet resources in the science classroom?* In M. J. Jacobson, & R. J. Kozma (Eds.), Advanced designs for educational technologies: Explorations and innovations in the learning of science and mathematics. Mahwah, NJ: Erlbaum.

Spradley, J. P. (1979). *The ethnographic interview.* New York: Holt, Rinehart, and Winston.

Stake, R. E. (1995). *The art of case study research.* Thousand Oaks, CA: Sage Publications.

Yin, R. K. (1994). *Case study research: Design and methods.* Thousand Oaks, CA: Sage Publications.

Exploring the Development of Students' Generic Skills Development in Higher Education Using A Web-based Learning Environment

Ron Oliver, Jan Herrington,
Edith Cowan University,
2 Bradford St, Mt Lawley 6050, Western Australia.
r.oliver@cowan.edu.au, j.herrington@cowan.edu.au

Catherine McLoughlin,
University of New England,
Armidale, 2351, NSW, Australia.
mcloughlin@metz.une.edu.au

Abstract: This paper reports on a study undertaken in Australia where the practice and development of generic skills was studied in the context of a Web-based learning environment. The results showed that students perceived the learning environment provided many opportunities for them to practice the generic skills being explored. Furthermore the results showed high levels of student perception of development of these generic skills. We conclude that Web-based learning environments offer many opportunities for teachers wishing to develop students' generic skills and this is yet another advantage of using this technology for program delivery.

Introduction

Education is often viewed by teachers and students as collections of courses and units, with units being comprised of learning objectives linked to domain specific outcomes. Increasingly we are becoming aware that effective university teaching and learning extends far beyond the development of skills and knowledge in specific subject domains (eg. Dearing Report, 1997). An holistic view of education suggest other forms of skills and knowledge that are important outcomes of university education. These holistic skills are often common to all courses and units irrespective of their subject domain and are often referred to as *generic* or *key* skills. The generic skills are those that students need, to become successful learners and successful practitioners in their fields of study and work and in other aspects of their life. In a society where change is rapid and where knowledge and information are now marketable commodities, this extended set of outcomes in curriculum and teaching are gaining prominence in all sectors of education.

One of the main factors causing the emergence of generic skills as a required outcome of formal education is the growing use of technology in all facets of life. Many of the generic skills that are defined and described relate to students' abilities to make meaningful use of technology. The influence of technology as the subject of generic skills coupled with emerging opportunities for students learning with technology appears to create a powerful synergy for generic skills development. The use of technology in teaching and learning already has been shown to provide many opportunities to teachers and learners. These opportunities include among other things, increased access to learning, increased flexibility for learners and enhanced learning outcomes in domain specific knowledge outcomes. If it can be shown that particular forms of technology use can also provide opportunities for learners' generic skills development, teachers and institutions can be guided by these findings into modifications and changes to their technology-based learning environments to provide even greater returns on their investments and efforts.

Defining Key Skills and Competencies

Defining the full range of generic and transferable skills that are useful (or essential) for university students is an exhaustive process. It is as almost as exhaustive as finding agreement in the terms which might best be used to describe the set. In the context of this paper we use the term *generic skills* to describe the full range of domain independent skills that are considered to be essential life skills for people both in and out of the workforce. There has been interest in key skills as outcomes of education for many years now. In different countries, different sets of skills are listed, all with similarity and consistency to each other. The 1993 New Zealand Curriculum Framework, for example, proposed 8 essential skills as important outcomes of New Zealand Schooling. These were: communication skills; information skills; self- management and competitive skills; physical skills, numeracy skills, problem solving skills and co-operative skills, work and study skills. In the United Kingdom, The Qualifications and Curriculum Authority have developed a set of key skills that the government and much of industry consider as essential for successful lifelong learning and a flexible workforce. The QCA key skills comprised 6 areas; communication; information technology; application of number; working with others; improving learning and performance and problem solving.

The conceptualisation of generic skills is problematic in many ways. Bennett, Dunne & Carre (1999) describe a number of synonyms including personal, transferable, generic, common, work and employment related skills. Are they skills or are they competencies, capabilities or learning outcomes? The skills that are reported as important outcomes of schooling tend to be broad and extensive. In university teaching, the skills set is often narrowed to focus on those that are not, or cannot, be taught as discrete components of coursework. At the same time, the generic skills sought by university education assume learners are numerate and literate as a consequence of the requirements of university entrance. The key skills included in the mission statements of most universities tend to include higher level aims relating to critical thinking, inquiry and a capacity for lifelong learning. Typical generic skills described for graduates include:

- skills that students need to develop to becoming successful and self-sufficient learners. For example, information literacy, metacognitive skills (eg. Candy, 1994);
- intellectual and imaginative powers, understanding and judgement, problem solving and critical thinking skills and an ability to see relationships (eg. Squires, 1990; Ramsden, 1992);
- personal and interpersonal skills needed for communication, cooperative and collaborative teamwork, and leadership (eg. Ashcroft & Foreman-Peck, 1994; Gibbs et al. 1994).
- skills required for successful work practices including time management, task management leadership and self evaluation (eg. Gibbs et al. 1992; Blumhof et al. 1996).

Management of Self	Management of Others
• Manage time effectively • Set objectives, priorities and standards • Take responsibility for own learning • Listen actively with purpose • Use a range of academic skills • Develop and adapt learning strategies • Show intellectual flexibility • Use learning in new or different situations • Plan/work towards long-term goals • Purposefully reflect on own learning • Clarify with criticism constructively • Cope with stress	• Carry out agreed tasks • Respect the views and values of others • Work productively in a cooperative context • Adapt to the needs of the group • Defend/justify views and actions • Take initiative and lead others • Delegate and stand back • Negotiate • Offer constructive criticism • Take the role of chairperson • Learn in a collaborative context • Assist/support others in learning
Management of Information	**Management of Task**
• Use appropriate sources of information • Use appropriate technologies • Use appropriate media • Handle large amounts of information • Use appropriate language and form • Interpret a variety of information forms • Present information competently • Respond to different purposes/contexts and audiences • Use information critically • Use information in innovative and creative ways	• Identify key features • Conceptualise ideas • Set and maintain priorities • Identify strategic options • Plan/implement a course of action • Organise sub-tasks • Use and develop appropriate strategies • Assess outcomes

Table 1: A framework for the development of key skills (Bennett, Dunne & Carre, 1999)

Bennett, Dunne & Carre (1999) offer an elegant model (Table 1.
) to conceptualise key skills in the higher education sector by suggesting a framework comprising 4 broad managerial skills. These authors argue that the important key skills are fundamentally those associated with being able to manage self, others, information & task. They contend that the bulk of all generic skills can be embraced within the four categories of this framework and they propose that this model can be applied "to any discipline, to any course and to the workplace and indeed to any other context " (p. 77).

Developing Keys Skills

The provision of generic skills and competencies can be undertaken through a variety of forms. Traditionally it has been attempted through 3 main types of learning activity: integrated approaches, stand alone approaches or approaches where key skills are developed in parallel with the conventional curriculum. (eg Drummond et al. 1997 cited in Bennett, Dunne & Carre, 1999). Many writers question whether it is really possible for the learning taking place in university settings to be transferable to vocations and the work place. One school of thought suggests that through situating learning in meaningful contexts, this transfer can be facilitated (eg. Brown, Collins & Duguid, 1989). Contemporary thinking is that university learning can be significantly strengthened through workplace-based practica and applications (eg. Seagraves, Kemp & Osborne, 1996).

On-line problem-based learning

We have been using the WWW in our university teaching for several years now and recognise that one of the major benefits of the use of this technology is the facility it provides to incorporate learning activities which help to develop students' generic and transferable skills (eg. (eg. Herrington & Oliver, 1997; Oliver, Omari & Stoney, 1999). In the introductory multimedia course in our undergraduate program, we have embraced a Web-supported problem-based learning environment with which the students engage and interact with the course content. The system involves learners working in collaborative groups to explore the solutions to open ended and ill-defined problems. From these activities we have sensed learners developing a raft of generic skills through their interactions and activities in the Web-based course.

The on-line system we have been using is a database driven Web-based learning system designed to support a form of problem-based learning. The database elements enable the system to record, manage and support the interactions of a large number of students and a large number of tutors. The system supports problem-based learning by providing a means for students to collaborate on set problems, to share resources, to post solutions and to compare and review answers from other groups. The system was designed with a degree of flexibility in mind to enable it to be used in a variety of ways in a variety of units and courses. Typical use of the system in a course of study is expected to revolve around the following activities which were characteristic of our initial implementations and trials. The system is Web-based and all the following activities are undertaken using on-line technologies:

- Each week a problem is presented to students, the purpose of which is to contextualise and authenticate the weekly content of the course.
- Students are required to work within groups of 3 or 4 to explore the topic, locate relevant information and resources, consider the various options and outcomes and to create a response which is informed and well argued.
- The group post this solution to the bulletin board, an action which then reveals to them the solutions of the other groups in their cohort . Each group is asked to review the solutions of the others and through their feedback, the solutions are given a peer-assessed grade. Each tutor also reads the solutions and gives a mark which is added to the peer-assessed grade to give an overall mark for the solution.
- Students are able to view the marks achieved each week in a number of ways and this mark accumulates throughout the semester as each new problem is solved.

The nature of the learning involves high degrees of self-regulation on the part of the students. There is very little support or help provided and students have to judge when and where their research will stop and when and where their summarising and reviewing will stop. At first glance, this learning environment appears to provide many opportunities for students to practice and develop their generic skills. It was our impression from observing the students' learning activities and levels of engagement in the problem solving tasks that students had many opportunities to practice a large number of the generic skills shown in Table 1. What was not clear though was the extent to which these skills were being practised and the influence of this practice on actually developing and extending students' existing levels of these skills. The aim of this study became to explore the generic skills which the problem-based learning environment caused learners to practise and the extent to which this developed, or had the potential to develop, the particular skills.

Method

The learning environment was implemented in a first year university course with an enrolment of 90 students. The theoretical component of the course was well suited to problem-based learning and the system was used to support students' problem solving activities through weekly problems for 10 weeks of the course. A questionnaire was administered to students in the 8th week of the course after they had completed 7 problem solving activities. The questionnaire provided students with a list of the generic skills described by Bennett, Dunne & Carre (1999) and students were asked to reflect on:

1. the level of practice that the problem-based learning environment encouraged; and
2. the extent to which this practice contributed to their development of the discrete skills.

The instrument used a Likert Scale to enable learners to show their responses. The questionnaire took 15 minutes to administer and was completed by the students in their class settings. After the questionnaire had been given, a small number of students were interviewed to gather some first had data on the strategies employed in the problem solving processes. It was clear that students were using a range of different approaches in creating their weekly problem solutions and the different strategies were likely to influence their practice and development of the generic skills.

Results

a. Practising Generic Skills

To explore the level of practice encouraged by the problem-based learning environment, the questionnaire showed each of the generic skills listed in Table 1 and asked students: *How often did you practise the* *following during the problem solving activities?* Responses were made using a Likert scale with the options: never, a little and regularly. Table 2 below shows the students responses as a percentage of the options chosen. A weighted index was calculated to determine the relative amount of practice each skill received on a scale from 0 to 2, with 0 representing no practice and 2 representing regular practice.

Generic Skill	never % 0	a little % 1	regularly % 2	Weighted Index (0-2)
Management of Self	3	57	40	1.37
Management of Other	15	47	38	1.31
Management of Task	4	52	44	1.39
Management of Information	1	44	55	1.55
Average	6%	50%	44%	

Table 2: Students' Perceptions of the Relative Levels of Practice of Generic Skills

The striking outcome from this first dataset was the extent to which students perceived the learning environment encouraged them to practise the generic skills. There is insufficient space to show the discrete scores achieved for the 40 individual skills listed in the table but the summary data conveys the overall information quite clearly. For example, in terms of practising generic skills associated with self-management, the sample of students perceived that they failed to practise any the listed generic skills only 3% of the time. In the sample of 32 students, there were only 10 instances when students felt that their learning activities did not practise one of the 12 generic skills listed for self-management.

The summary data shows that students perceived that overall their learning activities involved a little practice of the generic skills 50% of the time and regular practice of the generic skills 44% of the time. Among the 4 categories, the one category that seemed to be least practised was that of management of others. When we say least practised, there were more instances in this category than the others where students perceived they were practising these skills least but the overall practice level still remained quite high. The skills in this category related to working with others and practising the skills associated with delegation, negotiation, collaboration etc. It was clear that the way we had structured the approach limited students' opportunities to continually practise some of these skills. The students remained in the same group throughout the semester and from one week to the next, some members assumed roles within the group and this led to a lessening of their practise of such tasks as delegation, chairmanship, etc. The category that students appeared to practise the most was that of information management. The use of the Internet and WWW as a resource base was a fundamental component of the Web-based activity and each of the problems involved many skills associated with access, reading, reflecting and using information. It is difficult to imagine another learning environment where more practice was possible.

b. Development of Generic Skills

The study also sought to establish students' perceptions on how much skills development was associated with the practice they were doing. Although we often associate practise with skills development, it is useful to explore whether this is the students' perception and to explore whether or not students feel that their skills are being developed through their learning activities. Table 3 shows the results of students' responses to the question: *How much did the problem solving tasks help you to develop these skills?* against each of the 4 generic skills categories. To explore this area in more detail, students were given a 5 point Likert scale on which to record their results, the scale ranging from *not at all*, through to *very much*.

Once again, the results were very positive and showed that the students perceived that the learning environment helped them in more than minor ways to develop the various generic skills. There were only a small number of instances where students felt that the learning environment did not contribute to the development of particular generic skills. The value of 6%, as an average of those perceiving no learning at all, in Table 3 is indicative of a very small number of students and an even smaller number of discrete skills. The perceived levels of skills development correlate highly with students perceived levels of practice and if we assume that students can tell when they are developing skills, then the amount of practice is a metric which can be used to reflect skills development. Interviews with the students tended to support this assumption. In interviews, the students gave examples of their increased abilities to seek and use information, to work with others and to manage open-ended tasks, all examples of the skills in Table 1.

Generic Skill	not at all 0	1	2	3	very much 4	weighted index (0-4)
Management of Self	3	21	37	31	8	2.12
Management of Other	12	20	31	26	11	2.00
Management of Task	5	20	33	31	11	2.23
Management of Information	4	9	31	38	18	2.50
Average	6%	18%	33%	31%	12%	

Table 3: Students' Perceptions of the Relative Levels of Generic Skills Development

Table 3 provides an indication of the relative levels of skills development between the 4 categories and once again, the weighted index provides a measure by which this can be compared. Once again students perceived the management of others to be the skills which developed to the least extent and the management of information to the skill which they developed the most. In all cases however, both the results and the student interviews suggested that the students felt that had developed skills across all 4 categories. The weighted indices were all equal or greater than 2.00, the middle value of the scale. Once again, the discrete data for each of the 40 skills provides some interesting material for discussion and highlights particular skills which a small minority of students felt were less developed than others.

Summary and Conclusions

The results from this study have provided strong confirmation of our expectations that the Web-based learning environment helps students to practise and develop their generic skills. The study shows that the students' perceptions are that there were few generic skills in the framework described by Bennett, Dunne & Carre (1999) that were not practised in the process of learning through the Web-based learning environment which we had developed. Likewise, the results showed that the students found few instances where their learning activities did not also contribute to the development of the generic skills listed. While there were some small differences observed in the perceived levels of practice and development across the 4 categories, the results were very positive for them all.

It is our intention now to create our own set of generic skills based on the needs and demands of our course and programs and to use the data from this study to see which skills might need to be intentionally considered in modifications we will make to the learning environment. We sense that it will be possible to modify the learning environment in a number of ways to address those skills which we are particularly interested in developing and to reduce the levels of practice of students in skills which are of lesser importance. One limitation with this paper has been its reliance on student perceptions as its measure of the amount of practice and level of skills development. For the purpose of this exploration, we feel that our results still have validity and we base this feeling on substantiating evidence from student interviews and the consistency of the data that was gathered. We suspect that in our future work we will need to explore ways in which we might find more empirical measures on which to base assumptions about generic skills development and plan to make this an integral part of our future work.

Note: An earlier version of this paper was presented at ASCILITE'99 held in December, 1999 in Brisbane, Australia.

References

Ashcroft, K., & Foreman-Peck, L. (1994). *Managing Teaching and Learning in Further and Higher Education*. London, UK: The Falmer Press.

Bennett, N., Dunne, E. & Carre, C. (1999). Patterns of core and generic skill provision in higher education. *Higher Education, 37*(1), 71-93.

Biggs, J. (1987). *Student Approaches to Learning and Studying*. Melbourne: Australian Council for Educational Research.

Blumhof, J., Honeybone, A., Pearlman, D., & Pinn, K. (1996). Tackling the problem of skills development in a modular degree programme: the Skillswise Project. In G. Gibbs (Ed.), *Improving Student Learning: Using Research to Improve Student Learning* (pp. 328-339). Oxford, UK: Oxford Centre for Staff Development.

Brown, J., Collins, A. & Duguid, P. (1989). Situated cognition and the culture of learning. E*ducational Researcher, 18,* 32-42.

Dearing Report (1997). *Higher Education in the Learning Society*. London: HMSO.

Gibbs, G., Rust, C., Jenkins, A., & Jaques, D. (1994). *Developing Students' Transferable Skills*. Oxford: The Oxford Centre for Staff Development.

Herrington, J. & Oliver, R. (1997). Multimedia, magic and the way students respond to a situated learning environment. *Australian Journal of Educational Technology, 13*(2), 127-143.

Havard, M., Hughes, M. & Clarke, J. (1998). The introduction and evaluation of key skills in undergraduate courses. *Journal of Further and Higher Education, 22*(1), 61-688.

Laurillard, D. (1993). *Rethinking University teaching: A Framework for the Effective Use of Educational Technology*. London: Routledge.

Oliver, R. Omari, A. & Stoney, C. (1999). Collaborative learning on the World Wide Web using a problem-based learning approach. In (J. Chambers Ed.) *Selected Papers from the Tenth International Conference on College Teaching and Learning*,. Jacksonville: FCCJ.

Ramsden, P. (1992). *Learning and Teaching in Higher Education*. London: Routledge.

Seagraves. L., Kemp, I. & Osborne, M. (1996). Are academic outcomes of higher education provision relevant to and deliverable in the workplace setting? *Higher Education, 32*(2), 157-176.

Squires, G. 1990. *First Degree: the Undergraduate Curriculum*. Open University Press, Buckingham.

The New Zealand Curriculum Framework 1993. Wellington: Ministry of Education.

The ANTA Flexible Toolbox Project: Developing Sustainable and Scalable On-Line Learning Materials for Vocational Education and Training

Ron Oliver,
School of Communications and Multimedia,
Edith Cowan University, Western Australia.
r.oliver@cowan.edu.au

Stephen Towers,
Queensland Open Learning Network
Brisbane, Australia.
s.towers@qoln.net.au

Nic Pearl
Australian National Training Authority,
Brisbane, Australia,
pearln@anta.gov.au

Abstract: This paper describes a project undertaken in Australia where national flexible learning materials were developed. The paper describes the rationale and background of the project and the processes by which a set of Toolboxes were developed for widespread use in the Australian context. The paper discusses issues that arose out of the project and provides information and ideas for others who are looking at ways to create scalable and sustainable technology-based resources for education.

Introduction

On-line technologies such as the Internet and World Wide Web hold considerable promise for improving accessibility and quality of education and training programs. In the context of the vocational, education and training (VET) sector, these technologies have particular relevance. In the Australian setting, many authorities within the VET sector are using and promoting flexible learning as a preferred delivery form for their courses and programs (eg. ANTA, 1996). Within the VET sector, flexible delivery can support a wide array of learning settings including open learning and work-based learning. On-line learning materials are seen to be fundamental for increasing flexibility. However, the move to on-line learning among these groups, while desirable from many perspectives, has been slow and fragmented.

There has been considerable interest paid from all sectors in recent years to strategies that can support and encourage efficiencies and economies in both the development and delivery of on-line teaching and learning. Much of the early development of materials has been conducted by individuals or small teams for local and restricted use (Collis & Oliver, 1999). Whereas with CD-ROMs, people often planned large projects with big budgets and gained returns on their investment through widespread use of the product, the same cannot be said for the majority of developments of on-line learning materials. National and state authorities responsible for VET within Australia have recognised that developing online materials is expensive and best achieved through a collaborative approach (EdNa VET Advisory Group 1999). It was this challenge that prompted the Australian National Training Authority (ANTA) to consider strategies that could motivate and support registered training organisations (RTOs) to embrace modes of flexible delivery for their students. A resource strategy was formulated by which sets of generic and customisable materials could be developed and applied widely throughout the training sector. The intention was to create efficiency and economies of scale though large scale production of learning materials capable of wide acceptance and use. This plan became the ANTA Flexible Toolbox Project and is further described in this paper.

Vocational Education and Training in Australia

In Australia, the mission of ANTA is to "ensure that the skills of the Australian labour force are sufficient to support internationally competitive commerce and industry and to provide individuals with opportunity to maximise their potential" (ANTA, 1998a). ANTA's agenda has been "to deliver training more responsively and efficiently and to a wider catchment area" (ANTA, 1998). The Authority recognises that technological advances have been the catalyst for new forms of educational and training communication systems and that the demand for, and supply of vocational education and training is globalising. Consequently it has enacted and sponsored strategies to encourage the VET providers to provide more flexible, technological-based, delivery for domestic and international markets. ANTA recognised that implications of technology advances and globalisation required "new ways of creating and customising training material" (Eccles, 1998). The Toolbox initiative was one of ANTA's strategies to encourage development and delivery of more flexible learning materials for the training market – particularly for online learning. In 1998-1999 ANTA invested $3.8 million in "toolboxes" with the aim of producing a "smorgasbord of multimedia resources from which providers can pick and choose in designing online training programs" (Eccles, 1998).

The setting of a national framework with many discretionary elements provided a perfect opportunity for the Australian National Training Authority to explore the concept of Flexible Toolboxes to support learning. In the first instance, any products developed in this setting would have widespread application providing significant economies of scale. Secondly the use of on-line technologies appeared to provide and promote the many forms of flexibility associated with the delivery of the Training Packages in the national setting.

Flexible Toolboxes

The concept of a Toolbox as a building block for flexible delivery and open learning is relatively common in education. The concept imbues the notion of a set of tools that can be implemented by teachers and trainers to create and implement on-line and computer-based learning environments. The concept is a powerful strategy as a means to create sustainable and scalable materials for technology-based teaching and learning (eg. Hanley, Schneebeck & Zweier, 1998). Where a Toolbox creates unique and innovative opportunities is through the provision of alternative options to the creative teacher. Furthermore a Toolbox is intended to facilitate its use through its ability to stand-alone and to be employed through customisation and adaptation. Given these inherent characteristics, Toolboxes are often chosen as productive solutions to the development and delivery of flexible and on-line courses (eg. Oliver, Omari & Herrington, 1998).

Toolboxes come in varying shapes and forms and the term itself is quite flexible in the way in which it is applied. The single most important characteristic of the Toolbox concept is its flexibility of use and, in the various interpretations that have been made of the concept, this characteristic is extremely variable. Figure 1 shows a continuum describing flexibility of use as it can be applied to toolboxes used for on-line learning. Across the continuum, it is possible to identify discrete forms of toolbox applications. Consideration of the discrete forms shows that there are opportunities across each for open and flexible materials development. At the same time, each of the forms carries limitations and pitfalls that can act to impede their application and use.

Because of the impetus to create resources for Training Packages, ANTA deliberately sought to develop Toolboxes that were towards the "restricted" end of the continuum. It was recognised that it would be an advantage if the materials that were developed could be implemented in their immediate form. While a number of providers of VET courses have substantial information technology resources, many are not in a position to make major changes to on-line materials. Providing online materials which demanded high levels of input was not seen as desirable. At the same time, it was considered important for the materials to have the capacity to support user customisation, and thus an important component of the initial design brief was to require that any materials developed for the project had a capacity for customisation by the teachers and training providers.

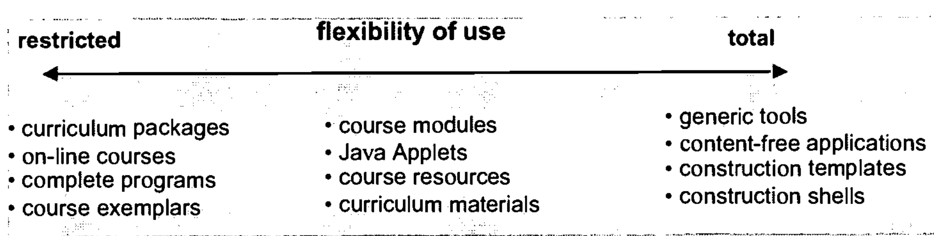


Figure 1: A flexibility continuum describing Toolboxes for on-line learning

Therefore, in the context of this project, a Toolbox was defined as "a set of multimedia resources that provides a framework for the development of training programs for online delivery to meet the requirements of Training Packages. As discussed, a key feature of the Toolbox was that providers could *customise* the contents to meet the needs of learners and enterprises. The toolbox was required to constitute two essential components (1) a completed multimedia program designed to satisfy specific training competencies and (2) a range of tools and functions which provide access to the program's components and resources. The building blocks that could come together to form the multimedia package were conceived to be available as separate resources. Each toolbox was expected to utilise a wide range of the building blocks. For example:

- Packages of generic resources in a variety of media;
- Developer's notes, guidelines, supporting documentation and technical guidance to facilitate online provision;
- Learning materials 'translated' from the Training Package and combined with authoring software to facilitate the development of further, customised materials;
- Assessment instruments which meet the assessment guidelines contained in the Training Package and combined with authoring software to facilitate the development of further, customised materials;
- Interactive tutorial packages on researching through the internet, including directory services, and WWW with simulated search examples, search tasks;
- Generic case studies, and interactive simulation games,
- Guidelines for communication functions (e.g. email, web forums and chat) and student management systems;
- Tips, hints, ideas for student friendly, student 'grabbing' instructional design;
- Web sites with email for comments, support and feedback on material developed as part of the Toolbox and
- Listings of publicly accessible Web sites relevant to the content of the targeted Training Package.

The Development Project

A detailed specification was developed and applications were called nationally for parties interested in developing Flexible Toolboxes. Over 100 expressions of interest were received and after an exhaustive selection process, twelve were finally selected for funding. In all instances the Toolboxes represented cohesive sets of course materials for various qualifications comprising around 12 areas of study, each with many defined competencies. The various Toolboxes covered a cross-section of training areas and qualification levels. Their proposed construction included a range of authoring tools and included CD-ROM, LAN and Web as intended delivery media. Portability, the capability of the software to run on a range of hardware systems, differed across the Toolboxes. Some Toolboxes were designed to be platform independent whereas others required the purchase or access to proprietary delivery systems, eg WebCT. Similarly the ease of customisation (sequencing learning events, adding/deleting/modifying resources and content, changing text/graphics) varied considerably across a range of dimensions (user skill levels, pre-requisite software and hardware). An additional project called the 'Toolbox Central' was established to provide an on-line professional development and quality systems to support the implementation and application of the Toolboxes once they had been developed. The Toolboxes covered a variety of training areas including Hospitality and Tourism, Metal and Engineering, Community Services, Agriculture, Information Technology, Workplace Training and Assessment, Printing and Graphic Arts, Rural Business Management and Agriculture.

The Evaluation Team

The Toolboxes were developed over an eight-month period and were completed by the middle of 1999. ANTA recognised that this was rather a bold and innovative project and contracted an external team to evaluate and monitor the development of the individual Toolboxes and to provide a mentoring facility for the developers to assist with the timely completion of a quality product. The Evaluation Team established close contact with all the developers and created channels of communication between them to create a sense of community and a sharing of knowledge. Communication and contact between the various teams was facilitated by a Web-based Communication Hub that was built for the project with a range of communication facilities (Figure 2). The Evaluation Team monitored all stages of the development process and provided constructive feedback in such areas as project management strategies, instructional design and system architecture. It was the intention of ANTA to use this project as a learning experience to inform and guide subsequent projects of this nature.

It was interesting but not surprising to find that the various development teams, while anxiously pursuing best practice in all aspects of the design and development, were generally reticent and reluctant to work in the collaborative ways which the evaluation team was seeking. The teams tended to have tight and fixed timeframes with firm development ideas and tended to know what they wanted to produce and the best approaches to be used. For these sorts of reasons, the planned high levels of communication and interaction planned for the teams were not achieved nor was collaboration and cooperative sharing. The Communication Hub did however provide a vehicle for enabling public scrutiny of the project and its various components and it served well as a distribution centre for project information and document delivery.

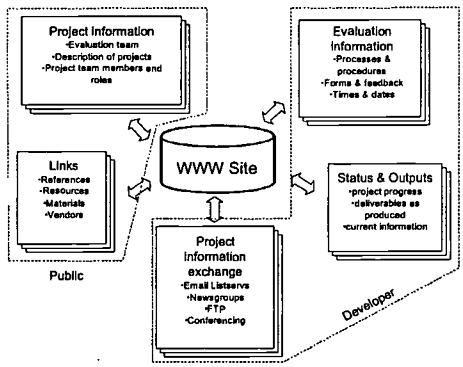


Figure 2: The Components of the Communication Hub

Project Outcomes

On completion of the project, the development teams had produced multimedia resources for nine Training Packages. Each development team created resources for ten to fifteen units of competency, each representing approximately 40 hours of independent study. The set of Toolboxes represented an enormous collection of new and exciting technology-based resources for the Australian VET sector. An on-line distribution system was established to enable institutions and training providers to view selections of the available resources and to order them for their own use. All of the Toolboxes were made available to any Registered Training Organisation for the cost of the media and distribution. In practice, this meant people could buy $A3.5 million dollars worth of teaching and learning resources for about $A2500. In most instances though, RTOs would buy only those Toolboxes appropriate to their own training areas.

Despite the broad range of subject areas involved and the range of industries represented, there were many patterns and consistencies identified by the evaluation team between the learning materials. Some comparisons and descriptions of the various toolboxes in terms of teaching and learning processes functionality, flexibility and utility are given below. There were many indicators by which the success of this project could be measured. Some of the more important indicators of success included:

- The timely completion of the Toolboxes;
- Extent of completion to the agreed technical and functional specifications;
- The quality of the learning materials within such functional criteria as: scope, flexibility, and portability; and
- The quality of the learning materials from an instructional perspective.

Despite the array of hurdles and obstacles that faced the teams embarking on new projects and working in areas and ways which were distinctly different from previous experience, timely completion was met by most and completion to the technical and functional specifications was generally achieved. The evaluation team observed an array of issues associated with large scale project development and many recommendations and new strategies were fed back to the organising panel as guides for future projects. Perhaps the most pressing item that emerged from the evaluation was the need for detailed specifications to guide all aspects of the design and the development processes. While developers were given strong indicators at the commencement of the project as to the intended audience and the need for flexibility in their development approaches, the resulting products differed broadly. The differences occurred across a number of areas and it became evident that the varying interpretations placed by developers on the stated requirements and product utility had the capacity to limit aspects of the projects' intentions.

Technical Requirements The requirements for utility as defined in the project brief included such technical requirements as multiple platform capability, modularity in structure, and consistent file organisation and directory structures. The large variations in approaches that were ultimately used created a number of challenges for determining how the products would be stored and distributed. Across the 12 Toolboxes, there ended up being many Gigabytes of information to store and distribute. While the various Toolboxes each represented independent entities, they still needed forms of consistency to ensure maximum scope for use among the various users and students.

Performance The specifications that the developers followed indicated that the Toolboxes needed to provide minimum levels of functionality in terms of progress tracking, privacy safeguards and ability to be customised to meet the needs of the users. Once again, providing descriptions of the functional requirements alone resulted in a range of different approaches and the extent of the differences proved to be a factor that had the prospect to limit application.

Flexibility Developers were required to provide flexibility in the form of an easily customisable set of resources with a range of customisable features. The end-products tended to meet the specified requirements but developers had chosen different approaches and solutions. The majority of the customisable elements and strategies appeared at the screen level and involved a high overhead time to implement. Once again, the extent of the variations gave rise to the feeling among the evaluators that these specifications needed expansion for the best outcomes to be achieved.

The second area of inquiry and guidance for the evaluation team related to the quality of the products from a teaching and learning perspective and as with the functional elements, large differences emerged in this area as the following sections demonstrate.

Content Developing multimedia learning materials is different in many respects to developing conventional learning materials. One major difference exists in terms of the content that can be used. The various Toolboxes differed considerably in the scope and extent of the media elements used. It became clear that some developers were using design and development processes more suited to development of print-based materials and were quite limited in their thinking and resourcing. On the other hand, the best examples from the project provide evidence of outstanding uses of the media and content to support learning. Developing guidelines which create more consistency in terms of the media applications among products was seen as an important future activity.

Learning Strategies As with the content, many differences were observed in the forms of learning strategies employed by the instructional designers across the various projects. As might be predicted when conventional design processes are being employed, many of the learning settings appeared as electronic forms of paper-based materials. Across the various Toolboxes there were many strong examples of effective design for electronic and interactive learning and many examples of learning strategies designed to take advantage of the best features of technology-based learning. For example, use of video and sound files in case-study settings, interactive modules to engage the learners and activities using the Web to facilitate cooperation and communication. Some development teams were constrained by the content provided and the view of their content experts and industry expectations in terms of how a learning package should appear.

Assessment The challenge for developers of technology and Web-learning environments is to creatively use the facilities to create assessment strategies and activities that enhance the learning experience as well as measuring achievement. All of the Toolboxes were required to provide activities for learners to self-assess their competency. While there were some sound examples among the various Toolboxes that could guide future developments, assessment tasks tended to measure learning outcomes through conventional processes such as objective tasks and multiple choice quizzes.

Media Usage One of the major criticisms of education and schooling in the past is that it is abstract and removed from reality. Multimedia and on-line learning can reduce the abstractness of education by providing learners with access to real life settings, realistic environments and authentic information and cases. Several Toolbox development teams used the opportunity provided by this project to create information and content that reflected this real world use. They used examples drawn from real life and presented cases rather than abstracted descriptions. These types of Toolboxes contrasted sharply with those that tended to present text descriptions instead of videos or pictures to portray real life settings; and subject matter experts talking about processes in place of videos showing the process studio re-enactments in place of real life footage. It was clear to the Evaluation Team that there were many opportunities where Toolbox projects could have made better use of the technologies from a teaching and learning perspective. However, it should be noted that there were many constraints on the designers in terms of expectations from teachers and industry about the forms they perceived the learning materials should take. It was clear that a process of education was needed to move thinking along the path to more student-centred and active learning settings. The first set of Toolboxes contained many fine examples for people to follow and these were seen as a good way to start and support this learning process.

Summary and Conclusions

This was a very large multimedia development project by any standards. The budget for the project exceeded $A3.5 million dollars and the completed Toolboxes contained on-line and technology-based learning resources for over 150 competencies, each a discrete, self-contained online learning program. ANTA purposely used the 1998 project as a pilot and as a learning exercise for future policy and resource emphasis. It was an intentional strategy to provide flexibility to the developers to encourage and stimulate creativity and innovation. The Evaluation Team was established as a means to gather data and to provide feedback which could inform future practice. The main findings of the Evaluation Team related to the forms of specification and prescription needed to be given to developers to provide consistency between the completed products in relation to their technical and instructional characteristics. In essence these specifications could provide consistent forms of quality between the Toolboxes in all the important areas.

As this paper was being written, the second stage of the project was in its early stages with an increased budget and the benefit of hindsight influencing the procedures and policies being used. An evaluation is planned that includes investigating the use and application of the first set of Toolboxes. At the same time, the second project has concentrated on developing effective environments for on-line learning and exploring ways to encourage developers and designers to use the technologies to promote students' knowledge and understanding. Feedback from the first project has been used extensively to guide and inform the second development round.

There were many things learned through the development and evaluation processes associated with the ANTA Toolbox project. The process was designed not only to produce learning materials but also to develop sustainable strategies and processes for these endeavours. As this project drew to an end and a follow-on project commenced, it was heartening to see the many lessons that had been learned by the stakeholders in this initial project being reflected on and used in meaningful ways in the follow-up project.

References

ANTA (1996) *National Flexible Delivery Taskforce: Final Report*, Australian National Training Authority, Brisbane

ANTA (1998a) *A bridge to the future: Australia's National Strategy for Vocational Education and Training 1998-2000,*. Australian National Training Authority, Brisbane.

ANTA (1998b) *National Investment in flexible Delivery Products: A Preliminary Options Paper*, Australian National Training Authority (unpublished), Brisbane.

Collis, B & Oliver, R (1999) Preface in B. Collis & R. Oliver (Eds), *Proceedings of the 11th World Conference on Educational Multimedia, Hypermedia and Telecommunications.* Association for the Advancement of Computers in Education, Virginia.

Eccles. C., (1998) *A New Training Culture for Australia: The Right Stuff*, Australian National Training Authority, Brisbane

EdNa VET Advisory Group. (1999) *Flexible Learning for the Information Economy: A Framework for National Collaboration in Vocational Education and Training 2000-2004.* , Australian National Training Authority, Brisbane.

Hanley, G,. Schneebeck, C. & Zweier, L. (1998) *Implementing a Scalable and Sustainable Model for Instructional Software Development.* [on-line] Available at http://www.cdl.edu/html/syllabus98.html

Oliver, R. & Omari, A. & Herrington, J. (1998). Developing converged learning environments for on and off-campus students using ther WWW. In R. Corderoy (Ed), *Conference Proceedings ASCILITE'98.* Wollongong, Australia: The University of Wollongong. (pp 529-538).

Information and Communications Technology Literacy – Getting serious about IT

Ron Oliver
School of Communications and Multimedia,
Edith Cowan University,
2 Bradford St, Mt Lawley, Western Australia, 6050.
r.oliver@cowan.edu.au

Stephen Towers
Queensland Open Learning Network,
s.towers@qoln.net.au

Abstract: The growing use of information and communications technologies in commerce and industry is once again encouraging debate and questioning of the development of students' skills and knowledge in this domain. Whereas in the past, the debate has centred on school education, questions about ICT literacy are now being raised in the context of post-compulsory education. Post-compulsory education sits ahead of employment and ICT literacy in the population and workforce is seen as an important component of a nation's competitiveness and advancement. This paper explores the concept ICT literacy in the light of new technologies and suggests factors that are currently seen to limit and impede its attainment.

Introduction

In the early days of computers in schools, a common rationale for the investment in hardware and software was the notion of computer awareness. This concept was premised on the view that schools had a responsibility to introduce students to this emerging technology and to prepare them for the fact that one day computers might have a role to play in their daily living. As time went on, and the impact of computers in society grew, the notion of computer awareness evolved to computer literacy, not only knowing about computers but being able to use them. Throughout the 1980s the relevant literature abounds with descriptions and comment on both the rationale for such programs and evaluations of their success (eg. McCormick, 1992).

In the past ten years, computer technologies have diffused into many aspects of everyday life and in recent years this diffusion has been accelerated and exaggerated by the convergence of computer and communication technologies. The place of computer technologies in schools has evolved from objects of study or specialist applications to tools for teaching, learning and administration. Computer literacy disappeared from main gaze and focus of attention as the stand alone computer lost its novelty. But today, the concept is regaining attention as the new technologies once again gain novelty and public attention through the next phase of their development. This renewed interest appears to be fuelled by Internet and communication technologies, which are causing yet another revolution their use and growing influence of life and society.

The renewed interest in computer literacy appears to be driven not only by those in education and industry but also by governments looking to maintain or to upgrade their world competitiveness through leadership in an activity set to dominate the trade and corporate world in the new millennium. Whether it is the place of schools to expose students to computers and information technology (IT) for vocational purposes, or simply for personal needs, remains a much argued point. It is clear that many in government perceive the development of IT skills in schools as an economic and vocational imperative. This view is not shared by all and we are frequently reminded that the role of education is:

> "Not so much to closely align to the ephemeral demands of industry but to equip students with the more fundamental, expansive skills of being able to critique and reflect on the changes taking place in their society" (Watkins, 1986, p. 85)

The concept of computer literacy appears now to have moved beyond schools to the post-compulsory education institutions that prepare graduates for employment. The purpose of this paper is to explore this renewed interest in computer literacy and to establish the growing implications for the post-compulsory education sector.

Defining Computer Literacy

There have been many studies over the past two decades into both the concept and attainment of computer literacy. These have focussed on many different aspects of the perception of computer literacy. Much effort has been put into defining set of skills, which adequately describe a computer literate person. Other efforts have focussed on devising assessment tools to measure levels of these skills, a difficult task in such a multi-faceted and complex area. Further studies have compared computer literacy levels and attitudes towards computers with different groups of people, based on gender, ethnicity or socio-economic factors.

Through the 1980s, computer literacy tended to be considered a grab-bag of different skills and attributes. A widely accepted definition of computer literacy is that of Simonson, Maurer, Montag-Torardi & Whitaker (1987) who define computer literacy as:

> "An understanding of computer characteristics, capabilities and applications, as well as an ability to implement this knowledge in the skilful and productive use of computer applications suitable to the individual roles in society. (p. 232)"

In this definition, the knowledge and skills of a computer literate person were divided into four components comprising computer attitudes, computer applications, computer systems and computer programming. While this is now a dated definition and classification, it has been used and modified in subsequent studies (e.g. Smith & Necessary , 1996) and the concepts broadened to be independent of a given time frame. The essential elements of this form of definition still hold currency today.

The Evolution to ICT Literacy

The rapid developments in communications technologies which have occurred over the past ten years has seen a broadening in the range of skills that are considered to be imperative to the constantly evolving notion of computer literacy. We now see a spectrum of differing expressions and terms which relate to computer literacy. For example, *information technology literacy*, *Net literacy*, *digital literacy* or *on-line literacy* (eg. Gilster, 1997). Overwhelmingly however more recent references in the literature still often use *computer literacy* as an appropriate keyword for reference listings. Definitions of computer literacy have varied in their breadth over time and with the rapid changes in technology are evolving accordingly.

Where once "basic" computer literacy was narrowly defined and could be used to easily differentiate students that were deficient. Such students could be directed to specific "context free" courses to build their computer literacy. Over the past decade, the notion of "basic" is too obscure when considering the myriad of potential contextually driven applications of computers in contemporary society. Increasingly there appear to be diverse cohorts of students, each with different bundles of computer skills, knowledge and attitudes. Students could be considered literate in one setting but illiterate in another. For example, many school leavers have the ability to confidently browse and use the WWW but may have little or no file management or word processing skills. Similarly, there are a large number of mature aged students who have had no prior computer experience.

The move toward the broader term of information and communication technology (ICT) literacy has at its roots the need to involve the acquiring and advantageous use of information through the use of technology. Use of a range of communication tools such as the Internet, e-mail and the World Wide Web (WWW) for the location of information and dissemination are now considered to be components of ICT literacy and yet not necessarily that of computer literacy. In addition, many of the skills, which had previously been associated with those that an individual would need to have acquired in order to be considered computer literate, are now commonly seen to be components of the more encompassing term of ICT literacy. Many authors describe the place of computer literacy as a component of a more encompassing list of ICT skills (eg. Eisenburg & Johnson, 1996; Shapiro & Hughes, 1996; Bruce; 1998).

Generic Skills
The notion of computer literacy is tending to be considered a component of a larger set of key skills that have been identified as important outcomes of schooling outside the domain of traditional curriculum areas. These generic skills include such elements as reading and writing literacy, communication skills, numeracy, critical thinking and people skills (eg. Gibbs et al., 1994; Harvard, Hughes & Clark, 1998). An emerging trend is the perception that ICT literacy forms part of a generic skill set, with implications for teaching and learning in the schools, as well as for life-long learning and just-in-time learning. The American Library Association, for example, recognizes the need for ICT skills in the form of information literacy skills as necessary for America's continuing success in the information age. The ALA (1999) discusses the future role of the teacher moving from textbook lecturer, to coach and that an effective information literacy (IL) curriculum moves away from learning traditional library location skills taught in isolation to one of learning IL skills which have been embedded in the curriculum. The desired outcomes are for people who are prepared for lifelong learning, because they can always find the information needed for any task or decision at hand.

The role of ICT skills as being fundamental to general work place literacy is reiterated by Mikulecky and Kirkley (1998) and Tomei (1999). The implications of this for post-secondary education are that there appears to be a significant shift to providing a range of generic skills that allow the learner to prepare for a life where learning is an ongoing process. The need for appropriate and sustainable ICT skills is implicit in these types of recommendations.

Operationalising ICT Literacy

The net result of the incorporation of ICT literacy into the realm of generic skills has seen a move away from its definition as a discrete series of a skills and attitude and knowledge components to a more competency-based description. ICT literacy is increasingly being seen as a capacity for purposeful and effective use of ICT technologies in one's own setting and this creates different needs for different people. In the context of schooling and education, it is now recognised that ICT literacy describes a range of personal competencies that are in many cases distinct from ICT components specific to the needs of individual subject disciplines and domains. It is interesting to note that there is now a perception of ICT literacy specific to being a successful student and across all sectors of education, discrete and appropriate ICT skills are being suggested.

For example, Collis (1999) argues that post-compulsory students today need, at a minimum, skills and competency in the use of appropriate presentation systems such as word processors, electronic display systems. Students need to be able to use e-mail to send and receive communications and need to be able to use Web browsers to access and retrieve information from this source. When one deconstructs exactly what levels of computer skills and use underpin these forms of competency, this level of specification necessarily includes an array of associated skills including competence, confidence and efficiency in the use of hardware, software and operating systems associated with personal computers, networked computers and the Internet.

Yet another component of the ICT literacy issue which is gaining prominence among teachers and educators is the impact of these technologies on the basic forms of reading and writing literacy. There are a number of writers who have demonstrated that computers and the Internet are changing the ways in which many people communicate through the written word (eg. Warschauer, 1999; Orlikowski & Yates, 1994). The Internet in particular is changing the way many people write and the screen-based technologies are impacting on the way many people read. Researchers are arguing that given the rapid uptake of ICT technologies, these changes will soon need to be recognised in the way literacy is taught and developed in schools and universities (eg. Bruce and Candy, 1994).

The use of Internet and communication technologies in the delivery of both information and instruction for learners has seen in recent years a significant lifting of the perceived baseline level of ICT literacy deemed necessary for post-compulsory students. Trends suggest that this list of competencies will likely grow in the near future as ICT technologies continue to develop and have application to teaching and learning. The increasing use of computers in all aspects of life seems set to bring about even more changes to our perceptions of what actually constitutes ICT literacy. The research suggests that different disciplines within education are now recognising the

impact of ICT on their core business and are creating strategies to deal with it, for example, linguists and language teachers and
teachers of writing and reading literacy, information skills, and teachers of training(eg. Victorian University of Technology, 1998).

With growing use of ICT in the workplace. demands for literacy have now heightened with growing emphasis on reading, comprehension and information literacy, and on the ability to gather information from multiple sources and to use the information meaningfully and critically. This is leading (in many low and middle-level jobs), to a more complex understanding of literacy that includes making critical judgements about the accuracy, current relevance, and unexpressed messages implicit in information (eg. Mikulecky & Kirkley, 1998).

The concept of 'just in time learning' is diminishing in many instances the need for the general resources employees must bring to an occupation. Technology can now manage many of the operations in a job by sending exactly the right information to exactly the right terminal at the right time (eg., Talbot, 1999; Flew, 1998; Tomei, 1999). The scenario appears to exist for future workers to go to a workplace without the specific skills to operate in that particular environment but with the technology skills and abilities to rapidly adapt to the potentially changing requirements of the job. The rapidly changing nature of the workplace can mean that given the appropriate information the worker has the skills needed to seek out information, as it required.

Achieving Computer Literacy

There are formal programs now in many countries to encourage and support the development of IT skills in schools. The results of these programs and activities ensure that many students entering post-compulsory education have some level of ICT literacy although all too often, students demonstrate largely varying levels of skills and knowledge. There is evidence that many post-compulsory institutions are moving positively to address the need for ICT literacy among students. Some require prospective students to undertake ICT literacy tests and to take bridging courses prior to commencing their studies. A survey by the American Association of State Colleges and Universities in 1995 reported that 22% of American State Colleges and Universities require computer literacy of their students (Davis, 1999). Many of these have initiated computer survey courses to redress the lack which was reported at this time. In addition a number of universities worldwide require that students purchase their own computers to use in their learning programs (eg. Davis, 1999).

Increasingly students at all levels of education are gaining ICT skills at home as home ownership of PCs increases to almost saturation levels. In Australia, for example a recent survey of student Internet users in school, vocational education and universities, revealed that for 96% of them, the primary point of access for students was through a home computer. Sixty seven percent of those surveyed indicated that the educational institution was their secondary point of access (White, 1999). In Australia in 1999, 96% of the educational institutions had access to on-line services. Recent studies among school students have clearly indicated the strong influence of home use on skills development. The students with the highest levels of ICT literacy are frequently those with home access to computers and Internet technologies.

Achieving ICT skills going forward into the next century is becoming increasingly complicated as education authorities move toward embedding a whole raft of ICT skills into the general curriculum. Models of different approaches are:

- to either include intensive courses in ICT at the commencement of enrolment or at periods throughout an individuals life
- to present individual modules which occur at the precise time when the skills and tools are required by the learner to satisfy other learning objectives.

Tomei (1999) describes these models with respect to adult learners who were reported to prefer the second model. This 'infusion' approach differs from the more traditional approach of delivering a single intensive course at a less appropriate but probably at more convenient times, the 'concentration' approach.

Whilst both approaches have benefits and disadvantages educational institutions at all levels may find that a hybrid of these two models may be desirable. Certainly there are often subject specific components of ICT which have to be dealt with in an 'infusion context as they are required whereas more generic ICT skills outcomes can be achieved by the 'concentration' approach. But in the long run, most appropriate forms of skills development are those where the skills are practised and developed from relevant experience. Karsten & Roth (1998) report results from their study that suggest that it is the relevance rather than the quantity of computer experience that students bring to class that is the most predictive of performance. The results also suggested that although a wide variety of computer experiences enhance student perceptions of their computer competencies, only those experiences that develop or enhance the specific computer skills defined to comprise computer literacy in a particular context are likely to have an impact on computer-dependent course performance.

There is a growing awareness in all circles of education of the need for context and relevance in the teaching and learning processes especially those associated with ICT literacy. For both adolescents and adults, the most likely path to success lies in integrating the new technologies into the activities of everyday learning. Computer simulations, tutorial programs, the Internet, and information-processing and electronic communication tools can be used to address these learning goals. These goals are (a) learning to think critically while solving problems, (b) becoming familiar with the use of technology tools for processing information, (c) expanding the breadth of materials encountered by learners, and (d) developing habits of mind suitable for lifelong learning (Tomei, 1999).

ICT In Post-Compulsory Education

For the majority of students post-compulsory education sits between schools and workplace. It is in this setting that many believe ICT literacy is most importantly dealt with. Studies have revealed differences in ICT literacy between minority groups and discipline areas (eg. Smith & Necessary, 1996). Institutions with active social justice views and policies are now stipulating benchmark levels of generic graduate skills for the workplace among which ICT literacy in its various forms can be found. In most studies where ICT literacy has been explored, an important indicator of students' skills development has always been the extent to which students have been exposed to the new technologies in their courses and programs. And research in this field has always demonstrated that this is heavily influenced by the ICT literacy of the teaching staff (eg. Carr, 1998). Students who learn in technology-enriched learning environments develop practical experience in the use of ICT technologies as a matter of course (eg. Davis, 1999). This practice becomes problematic when it is common, students across education sectors to frequently demonstrate higher levels of ICT literacy than their teachers. Consequently, many writers now express the view that an efficient way to improve the ICT literacy levels of students and school leavers is to firstly address the ICT literacy levels of the teaching staff.

It is clear that the ICT literacy levels of students is very much influenced by the level of ICT use in their educational programs and this in turn is influenced by the degree of confidence and competence of their teachers to appropriately integrate ICT applications within learning experiences. Across all sectors large differences exist in the use of IT in educational programs. The use of ICT technologies has long been seen (and proven) as a way to create enhanced learning outcomes in subject domains (Davis, 1999). Its capacity to provide important and useful generic skills for students' working and private lives is yet another reason supporting ICT technology use as a teaching and learning tool. The use of the ICT technologies in teaching provides a means to create meaningful learning experiences which can develop a range of generic and transferable skills, among which are those associated with ICT literacy (eg. Oliver & McLoughlin, 1999).

Summary And Conclusions

A reading of the extant literature in relation to computer and ICT literacy reveals that this topic is still an important issue for many stakeholders in the education process but that its scope is often underestimated by policy makers and education and training providers. As a consequence of the burgeoning use of the Internet and Web, ICT technologies are becoming integral parts of all facets of life, from education to work. We are seeing governments and industry pushing for graduates to demonstrate appropriate skills and knowledge in this area to enable them to retain and push their competitive edge in commerce and trade. And we are seeing learning enhanced through applications of ICT technologies as information and learning tools. We are seeing new ways of learning and new ways of communicating through these technologies. Among all this, however, there are examples of vastly differing levels of ICT literacy among students and graduates.

It is clear that ICT literacy is most effectively developed through relevant and contextual use of ICT technologies. Students with home computers regularly show higher levels of ICT literacies than their counterparts whose only access and use is through school and education. The key to improving ICT literacy levels would appear to be through an increased and targeted use of technologies in teaching and learning programs appropriately modelled by teachers. Impediments to this are the levels of available infrastructure and the capacity of teachers to make meaningful use of the technologies in their programs. There is a growing body of evidence which suggests that the rate determining step in moving along the path of ICT literacy is the general low levels of ICT usage in educational courses brought about by low levels of ICT literacy among teachers in general. The way ahead in all of this is clearly through the promotion of ICT literacy among teaching staff and by immersing students in technology rich and stimulating learning environments where information and computer literacy is both a learning enabler and a learning outcome.

References

American Library Association. (1999). Information literacy: a position paper on information problem solving. [Available on-line at]: http://www.ala.org/aasl/positions/PS_infolit.html

Bruce, C. (1998). The phenomenon of information literacy. *Higher Education and Development, 17(*1), 25-43.

Bruce, C & Candy, P. (1994). *Higher Education Contributions to Information Literacy Education: Towards a Checklist for Evaluating Curriculum and Institutional Culture.* HERDSA 1994 Annual Conference, Canberra.

Carr, J. (1998). Information Literacy And Teacher Education. *ERIC Clearinghouse on Teaching and Teacher Education* (ED424231).

Davis, P. (1999). How undergraduates learn computer skills: results of a survey and focus group. *T.H.E. Journal, 26(*9), 68-71.

Eisenburg, M, & Johnson, D. (1996). Computer skills for information problem-solving: learning and teaching technology in context. *ERIC Clearinghouse on Information and Technology, Syracuse, NY.* (ED392463).

Ertmer, P.A., & Newby, T.J. (1993). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly, 6*(4), 50-72.

Flew, T., (1998). New media and borderless education. *Australian Universities Review*, 1, 7-9.

Gibbs, G., Rust, C., Jenkins, A., & Jaques, D. (1994). *Developing students' transferable skills.* Oxford: The Oxford Centre for Staff Development.

Gilster, P. (1997). *Digital Literacy.* New York: John Wiley and Sons.

Harvard, M., Hughes, M. & Clarke, J. (1998). The introduction and evaluation of key skills in undergraduate courses. *Journal of Further and Higher Education, 22*(1), 61-688.

Karsten, R., Roth, R., (1998). The Relationship of Computer Experience and Computer Self-Efficacy to Performance in Introductory Computer Literacy Courses. *Journal of Research on Computing in Education. 31*(1), 14-24.

Mikulecky, L. & Kirkley, J. (1998). Literacy Instruction for the 21st –Century Workplace. Peabody Journal of Education, 73(3-4), 290-316.

McCormick, R. (1992). Curriculum development and new information technology. *Journal of Information Technology for Teacher Education, 1*(1),23-50.

Oliver, R. & McLoughlin, C. (1999). Using the Web and problem-based learning environments to support the development of key skills. *Proceedings of ACILITE, 99.* Brisbane, QUT Press.

Orlikowski, W. J. & Yates, J. (1994). Genre Repertoire: The Structuring of Communicative Practices in Organisations, *Administrative Science Quarterly*, 39, 541-574.

Shapiro, J. & Hughes, S. (1996). Information Literacy as a Liberal Art Enlightenment, *Proposals for a New Curriculum. 31*(2)

Simonson, M., Maurer, M., Montag-Torardi, M. & Whitaker, M. (1987). Development of a standardized test of computer literacy and computer anxiety index. *Journal of Educational Computing Research, 3(*2), 231-247.

Smith, B. & Necessary, J. (1996). Assessing the computer literacy of undergraduate college students. *Education (Chula Vista, California),* 117,188-193.

Talbot. S. (1999). Who's killing higher education? *Educom Review, 34(*2), 26-33

Tomei, L. (1999). Concentration and infusion: two approaches for teaching technology for lifelong learning. *T.H.E. Journal, 26*(9), 73-76.

Victorian University of Technology. (1998). *Going Online: A Research Report on Use of On-line Technologies by Adult Literacy Teachers and Learners*, Australian National Training Authority: Brisbane.

Warschauer, M. (1999*). Electronic literacies: Language, culture, and power in online education.* Mahwah, NJ: Lawrence Erlbaum Associates.

Watkins, P. (1986). Forecasting the technological future: Directions for education. *Unicorn, 12*(2), 8-86.

White, G., (1999). *Online Education Report.* Adelaide: Educationa.au.

Wills, S. & Yetton, P., (1997). *Strategy and Information Technology.* [Available on-line at:] http://www.detya.gov.au/highered/operations/eip9703/chapter2.htm#head16.

ASSESSMENT OF ONLINE INTERACTION: HELPING OR HINDERING THE GOALS OF EDUCATORS AND LEARNERS?

Meg O'Reilly
Teaching and Learning Centre
Southern Cross University, Australia
moreilly@scu.edu.au

Abstract: This paper considers new approaches to assessment in the online environment. Increased use of computer-mediated communications for teaching and learning is affecting assessment strategies across disciplines. Initial investigations are equivocal and point to the need for more questions regarding whether assessment of online interaction in a variety of formats is helping or hindering the goals of educators and learners. Data was collected in 1998 via interview and email questionnaire to discover the goals of educators in their approaches to assessing online interaction. Responses were received from nine educators across four continents – Australia, South Africa, Canada and the United Kingdom. Initial results demonstrate that the conditions for effective use of assessable online interaction rely upon matching educators' goals with their approaches to assessment. Questions around student responses to assessable online interaction were explored through the literature, yet further research is needed for a fuller picture.

Background

Over the past decade, discussions have proliferated on the educational use and effectiveness of computer-based technologies such as the World Wide Web and email. Most questions have focused on the nature and purpose of online communications; possibilities of this medium for education in general and learning outcomes in particular; opportunities for development of new teaching and learning strategies; and implications for changing roles of educators, learners, experts and novices.

Broad-ranging as these questions are, we can take some heart from recent reports on the effectiveness of online strategies for teaching and learning and the concomitant staff development responses (e.g. McNaught, 1995; Allen and Otto, 1996; Ellis, O'Reilly and Debreceny, 1998; Sherry, 1998). In regards to assessment, the online environment has promised to bring greater support to learners and educators alike through immediacy of feedback and availability of a collaborative learning community (Jonassen, 1995; Parry and Dunn, 1999; O'Reilly and Morgan, 1999).

When used effectively, online interaction has the potential to build communities of learners, foster the development of meaningful collaboration and support deeper levels of learning (Mason, 1990; Harasim, 1992; Yeoman, 1996; Holt el al, 1998). Coupled with assessment, online interaction is now being shown to be affecting individual student approaches to learning, students' motivation to collaborate and provide mutual support to peers, as well as influencing both group and individual learning outcomes (Rimmington, 1998; Thorpe, 1998). For example, Parry and Dunn (1999) found that:

> ...while collaboration can foster "deep" or "meaning" approaches to learning, it is important that meaning approaches to learning tasks are valued in the assessment regime; students are unlikely to invest much time and effort in any activity that is not rewarded by an assessment grade, and this applies equally to learning 'how to learn' strategies [in the online environment].

Methodology

Interviews were conducted in early 1998 with educational designers across seven Universities in Australia to determine the location and activities of educators who were experimenting with dialogue and assessment in the online environment. Similar questions were posted to four international email discussion lists seeking introductions to educators identified as innovative in their adoption of the online environment for student assessment. Approximately 30 contacts were made, though several of these proved to be 'blind alleys', where the online interaction of learners was not ultimately assessed. Through this 'snowballing' method of contacts (Roberts and Taylor, 1998), a small sample of educators reported to be using online interaction as a component of assessment was identified and surveyed by email questionnaire.

Nine educators from a total of four continents provided responses – six from Australia, one each from South Africa, Canada and the United Kingdom. The results of these surveys were processed according to a mixture of qualitative and quantitative approaches to the data. Responses to survey questions were viewed by frequency and specific comments were collated with the help of computer software to assist in the sorting processes. Making sense of the responses on email questionnaire – the verbal categorical data – was the crux of the task, since each of the responses were in respect to different discipline areas and reflected somewhat different objectives and strategies.

The principle question for investigation concerned the ways in which technologies helped or hindered the meeting of educators' goals. Further investigations are needed to complete the picture from students' perspectives as to whether assessment of online interaction is seen to help or hinder their own goals and learning outcomes.

Features of online interaction and assessment

Since commencement of this project, adoption of online technologies in teaching and learning has grown exponentially. Although the most common uses of online technologies are for communication and assignment submission via email or web-pages, there is an increasing adoption of structured online assessment processes. These include group discussion to support individual assignment preparation, collaboration on a common project or presentation, peer-review and self-review, and problem-based approaches to cases, scenarios and consultancies, to name just a few.

This paper considers only those features exemplified by respondents to the questionnaire and the resultant roles emerging for both educators and learners. Before moving onto the formal results section, let's take a brief look at the individual cases reported and their unique features.

Teaching and Learning Strategies for Interaction

(a) Group support for individual product – both formal and informal structures can provide learners with opportunities for discussion without full dependence on each other for a grade. For example, listserv discussions can provide collegial practice in developing professional discourse in a supported environment such as in "Discrimination and the Law" (Macquarie University, Australia). In this case students are required to (1) submit weekly critiques of a specified article to the group, drawing out the legal argument (2) participate in informal discussion with peers concerning these critiques, the evidence of legal argument or assumptions, and (3) continue to actively participate in online interaction.

(b) Collaboration for common product – students are asked to work together in teams to coordinate development of a conference and website ("Science and Communication" University of Melbourne, Australia) or a professional co-authored paper for publication ("Environmental Psychology", University of Pretoria, South Africa; "Nursing Honours", Curtin University of Technology, Australia). Development of skills includes teamwork, collaboration, negotiation, presentation, a shared sense of achievement and academic standing in the field.

The products in these examples each demonstrate elements of professional standards. Specifically, "Science and Communication" students experience the organisation and participation in a conference of professional standing where discipline based experts participate as keynote speakers, and these first year students present their own work to a mixed audience of peers, staff, experts in the field and family supporters. "Environmental Psychology" students publish a co-authored paper of suitable quality to submit for refereeing by professional journals. "Nursing Honours" students publish a refereed online nursing journal for access by peers and professionals alike.

(c) Peer review plus self-review – having worked together towards a common goal, students may then be asked to assess their own progress and to evaluate the contribution of their peers. This may be an assessment of group processes or the final product, but must be according to given or previously-negotiated criteria.

The projects for "Science and Communication" University of Melbourne; "Environmental Psychology", University of Pretoria; and "Nursing Honours", Curtin University of Technology have all been briefly described above. Students in these subjects follow up their project work with specific activities which lead to self and peer assessment. In another example from Curtin University of Technology, "Foundations and Issues in Science, Mathematics and Technology Education", students are acknowledged as co-professionals. As qualified teachers themselves, students have a rich resource in their own daily classroom experiences from which to draw upon in reflective exercises. The choice of a social constructivist approach to learning in this subject therefore readily lends itself to critical reflection, and assessment includes the journal-based input of students regarding their own learning-in-action as well as that of their peers.

(d) Debate – students may form teams and through negotiation select a topic and their position on the debating team. Following a given preparation period where work may be collegial, a debate can take place according to established protocols. A very sophisticated example of online debate is the international collaboration called "Communication and the Media" conducted between University of South Australia; Governors State University, Chicago; and University of Technology, Sydney.

In this instance, the debate is a particularly authentic genre of expression in such a subject. For students to formally research and develop a more-or-less provocative position, and then to challenge the arguments of members on opposite sides, is highly applicable in the vocational contexts of a range of media. Debating topics concerned with globalisation and the media, and to further be engaging in debate across cultural differences significantly enhanced students' learning, sometimes in the most poignant experiential ways.

New Roles

New roles for educators which can be gleaned from these examples include facilitation, moderation and the orchestration of a distributed community of learners. We have already seen how the educators involved with "Communication and Media", UniSA/UTS/GSU; "Science and Communication" University of Melbourne; and "Discrimination and the Law", Macquarie University, had the work of coordinating and facilitating students' activities in novel, applied and appropriate ways.

Another example is the subject "Designing Training for the Internet" from Open University, UK. Here students do just that, they are required to develop training materials in the web environment for their own organisation's purposes, using templates and asynchronous text based support from teaching staff. The resulting outcomes from this subject not only provide students with useful resources which they may implement in their workplace, but also provide the educators with new resources and a range of authentic approaches to build upon in future iterations of delivery and for future cohorts of students.

Additional online assessment methods illustrated in this study include the use of automated quizzes and exams ("Business Finance", University of Technology, Sydney; and "Microeconomics", University of New Brunswick, Canada). In these cases, the interaction demanded of students while online is their response to assessable questions presented within formative and summative activities. The new role of the instructor in these instances includes development of assessment tasks which support knowledge testing and reduce the likelihood of, or desire for cheating.

Learners now also find themselves developing a range of new skills simultaneously with their development of subject specific knowledge. These skills include – research and critical review of resources found online; experience in the formation of virtual groups, where dependence on non-verbal cues is unreliable or even impossible; publishing web pages; collaboration in either synchronous or asynchronous modes which take place across times zones and cultural contexts; and the review of peers which though anonymous must be ethical and constructive.

Results

Results show effective use of assessable online interaction where such interaction is an inherent objective and thus supports the educators' goals. Examples include areas which value development of communication skills, collaborative activities such as problem-solving and peer review. Figure 1 summarises (a) the technologies used in the nine case studies to facilitate interaction and (b) the educators' reflections on the impact of these technologies upon their teaching strategies and their goals as educators. It can be seen from this summary that in many cases educators are using both the capacity for dialogue and speed of the technology as well as the capability of students themselves to engage and support group and individual student learning.

Questions around student responses to assessable online interaction were explored through the literature, yet further research is needed relating students' perspectives of assessable online interaction to their own learning goals. A small glimpse of the student perspective is revealed in Figure 1 through feedback quoted by educators.

Online assessment approaches were identified as hindrances where the technology failed to be transparent and presented obstacles to learning. In some cases, for example the international debate between USA and Australia, breakdowns in technology were treated as inevitable and students were not penalised nor ultimately prevented from carrying out their assessment activities. Rather, students' motivation to collaborate and provide mutual support in the face of technical problems revealed approaches to learning which move away from an entirely competitive culture.

Hindrances were identified in the form of escalating workloads arising from the very appealing opportunities for dialogue. These hindrances were not however a fundamental drawback of the educators' goals but point to the need for careful design of teamwork, discussion and support for collaboration. Of note is the problem of keeping up with the changing environment of educational technology, identified when the study was conducted in 1998 and which continues today. Students' objections to mandatory dialogue and dependence upon fellow learners for assessable activities further challenges notions of flexibility and independence boasted by traditional print-based distance education.

Conclusions

Research such as this, which principally considers educators' goals, must further consider learners' goals. Hindrances identified in this study suggest appropriate educational design for teaching with reliable, robust technologies and through purposeful dialogue will ensure rich and rewarding teaching and learning experiences.

The study reinforces the work of John Biggs (1996) in identifying the need for a constructive alignment between objectives, teaching and learning strategies, and assessment as being fundamental to successful online teaching and assessment. Such a matching of goals with assessment is not only critical from the educator's perspective but is also essential to an effective learning experience by reflecting the process of learning in the strategies for assessing the outcomes of learning.

Used with care and consideration, it seems that assessment of online interaction can enhance group and individual learning outcomes and precipitate motivations.

"Interactive" Technologies Used	Helping or Hindering Educators' Goals
1. • Computer conference with tutors and trainees • Email • Javascript self-tests	Technologies defined the educators' goals.
2. • Listsever	It appears as though goals were achieved, students benefited

• Personal email contact • Individual feedback on assignments	significantly from this course, switching from being taught to becoming independent learners.
3. • Notice board discussion • Small group discussion • Formal debate	Technology helped a great deal in actualising much of the content e.g. cultural diversity (Australian students interacted with US students); 'new technologies' (subject considers impact of new technologies on the nature of communication). Only hindered by limits of the technology [organisational policy] e.g. no provision made by IT dept. for real time chat.
4. • Asynchronous conference • Journal for submissions • Email	WWW facilitated learning about information literacy in addition to enhancing learning in regards to objectives of the subject.
5. • MCQ self-assessment • Timed online exams • Email and group conference	Students appreciate one-to-one responses to email questions. On-screen graphics help illustrate key concepts and elucidate verbal arguments. Auto grading for tests and exams ensure immediate feedback, fundamental to successful learning.
6. • One-to-one and group email • Collaborative web publishing • Database searches on CDROM	We are moving quickly each year and the learning curve for revisions is always a problem. For example, electronic conferencing [systems] were at our disposal but simply no time to learn to use [them] effectively. Battle to find productivity tools e.g. drag-and drop web authoring packages that are affordable, always a dilemma. Extra instruction is needed to overcome the deficiencies of what we can afford
7 • Email (tutor-student, student-student) • Discussion Room or Notice Board • Course Materials on WWW	Our goals are about social constructivism and connected learning, so the older forms of distance education were very frustrating for us. It is so much more powerful for our (practicing teacher) students to be able to share ideas and experiences, tell 'war stories' from their school context and know one another (and us) as struggling co-professionals.
8. • Online Q&A discussion with 24 hour turnaround from staff • Self-assessment quizzes, auto graded • Package of CBL scenarios	[Online technologies] help to: – deliver opportunities for conversation – arrange relevant learning, practical and non-cheatable assessment tasks – reduce time spent answering repetitive questions and providing feedback – communicate in a caring and consistent manner to a very large and diverse student population (~ 1100 students)
9. • Assessable critique of article by each student • Assessable informal discussion among peers • Constant discussion with tutors on the listserv	The combination of printed study materials and listserv discussions enabled the students to learn with each other and from each other. Some students found the weekly contributions a bit much but it also meant that they studied regularly rather than in bursts.

Figure 1: Extracts from questionnaire demonstrating technologies used and their impact upon educator's goals

References

Allen, BS and Otto, RG 1996 'Media as lived environments: The ecological psychology of educational technology'. In DH Jonassen (ed) *Handbook of research for educational communications and technology* New York: Simon and Schuster Macmillan, pp199–225

Biggs, J 1996, Assessing Learning Quality: reconciling institutional, staff and educational demands' *Assessment and Evaluation in Higher Education* Vol 21, No 1, pp5–15.

Ellis, A, O'Reilly, M & Debreceny, R 1998 'Staff Development Responses to the Demand for Online Teaching and Learning'. In ASCILITE98 Woolongong: Woolongong University Press, pp 191–201

Harisim, L (1992) Foreword, in Paulsen, M F *From Bulletin Boards to Electronic Universities: Distance Education, Computer-Mediated Communication and Online Education* Pennsylvania: American Centre for the Study of Distance Education

Holt, ME, Rees, F, Swenson, JD, Klieber, PB 1998 'Evolution of Evaluations for Critical, reflective and Deliberative Discourse: National Issues Forum On-Line' http://www.coe.uga.edu/adulted/faculty/mholt/paper1.html

Jonassen, DH 1995 'Supporting communities of learners with technology: A vision for integrating technology with learning in schools' *Educational Technology* (July-August) pp 60–63

Mason, R 1990 'Computer Conferencing in Distance Education'. In Bates, A *Media and Technology in European Distance Education* Milton Keynes: European Association of Distance Teaching Universities, pp. 221–226

McNaught, C 1995 'Overcoming Fear of the Unknown! Staff Development Issues for Promoting the Use of Computers in Learning in Tertiary Education'. In JM Pearce and A Ellis (eds) *ASCILITE 95 Proceedings of the 12th Annual Conference of the Australian Society for Computer in Learning in Tertiary Education*, University of Melbourne: Parkville, pp410–416

O'Reilly, M and Morgan, C 1999 'Online Assessment: Creating Communities and Opportunities'. In S, Brown, J, Bull and P, Race (1999) *Computer-Assisted Assessment* London: SEDA pp 149–161

Parry, S and Dunn, L (in press) 'Benchmarking as a Meaning Approach to Learning in Online Settings' paper presented at 4th Northumbria Conference on Assessment, UK, September 1999

Rimmington, G 1998 'Some Useful Student Feedback on the Online Learning Experience'. In ONLINE-ED 20 March http://www.edfac.unimelb.edu.au/online-ed/mailouts/1998/march20.html

Roberts, K and Taylor, B 1998 *Nursing Research Processes: an Australian perspective* Melbourne: Nelson ITP

Sherry, L 1998 *Nature and Purpose of Online Discourse: A brief synthesis of current research as related to The WEB project* http://www.cudenver.edu/~lsherry/pubs/dialogue.htm

Thorpe, M 1998 'Assessment and 'third generation' distance education' *Distance Education* Vol. 19, No. 2, pp265–286

Yeoman, E 1996 cited in Haughey, M and Anderson, T 1998 *Networked Learning: The Pedagogy of the Internet* Montréal

Commercialization of Higher Education

Dan O'Shea, YouthStream Media Networks, USA

This panel will discuss the role of Internet advertising in higher education. Advertising on college and university campuses has long existed through sporting events, soft drinks, magazines, newspapers and bookstores and more. Yet with the introduction of the Internet in recent years, the impact and prevalence of ads on college and university campuses has changed. Computer savvy Generation Y is demanding schools provide costly Internet tools and resources and some universities are struggling to find ways to offer these tools to stay competitive. Collegiate Web sites offering these tools and resources are extending themselves to Universities free of charge with the condition that the schools allow the sites to present ads. Universities are now faced with a tough decision. Do they accept the free resources Internet companies are offering with advertising or do they try to create a comparable Internet offering or their own?

Explora: An Open Virtual Campus

Gilbert Paquette
LICEF Research Centre, Télé-université
Montreal, Quebec, Canada
gpaquett@licef.teluq.uquebec.ca

Ileana de la Teja
LICEF Research Centre, Télé-université
Montreal, Quebec, Canada
idelatej@licef.teluq.uquebec.ca

Aude Dufresne
Département de Communications, Université de Montréal
Montreal, Quebec. Canada
dufresne@com.umontreal.ca

Abstract. Telelearning research conducted in our research centre in the last five years has resulted in a Virtual Learning Centre (VLC) model and an implementation for Web-based training called Explora. This system is now in operation at Télé-université, in three professional corporations and in a company. Our VLC model focuses on the interaction spaces between five theoretical actors: the learner, the informer (content expert), the trainer, the manager and the designer. The Explora implementation supports learners and the other actors in their interactions. Each actor has a specific environment enabling him/her to manage his/her activities, consult and produce information, engage in collaboration and receive assistance from different sources. We will finally present a reengineering process that has been applied to transform a traditional distance education course into a web-based course within the Explora environment.

1. An Open Virtual Campus Model

In our societies, individuals and organisations are coping with an exponential growth of information and the knowledge management challenge. The rapidly evolving availability of multimedia telecommunication is an answer to this challenge but it has to be mastered, to mature, not mainly technologically but in the way people use it, in the way it is integrated to practice, conceptions and attitudes.

Behind terms like "distance education", "on-line learning", "telelearning" and "multimedia training", is a multi-facetted reality from which we can identify many paradigms. High-tech classrooms, virtual classrooms (Hiltz, 1990), multimedia Web-based training, on-line learning communities (Harasim, 1990 and Ricciardi-Rigault et Henri, 1994) and electronic performance support systems (EPSS) (see Gery, 1997) are all modalities that can be integrated in a truly open virtual campus. Such a virtual campus will enable individuals and organisations to manage transitions from the predominant classroom presentation to fully interactive telelearning.

We see a telelearning system as a society of agents, to use Marvin Minski's term, some of them providing information and explanations, others constructing new information, still others fostering collaboration between agents or providing assistance to the other agents on content, pedagogical process or organisation of activities.

A Virtual Learning Centre (VLC) is the central part of a Virtual Campus where instructional resources, learning events as well as technological and organisational infrastructure are created and assembled to forward the delivery of telelearning systems. Our VLC model (Paquette, 1997) emphasises the concept of a process-based learning scenario coupled with assistance resources. Basically, the learner proceeds to a scenario, a network of learning activities, using different kinds of information resources to help her achieve the tasks and produce some outcome: a problem solution or new information that can be used in other activities. The assistance resources for each task are also defined during design process. The assistance can be distributed among many agents: trainers interacting through e-mail or teleconferencing, other learners, contextual help or intelligent advisors.

2. The Explora Model: Actors, Roles and Agents

We have described elsewhere (Paquette et al, 1993 and Paquette et al, 1997) how we have built an object-oriented model of a Virtual Campus. In our Virtual Learning Centre architecture, we identify five actors, each personified by different persons or media agents.

The *Learner* transforms information into personal knowledge. " Knowledge " means the information that has been integrated by a cognitive entity into its own cognitive system, in a situated context and use. The learner achieves knowledge acquisition and construction by managing a learning environment planned by another actor, the designer, through collaboration with other learner agents, consulting and producing information, receiving assistance from other actors.

The *Informer* (the content expert) makes the information available to the learner. It may be a person or a group of persons presenting information, but also a book, a video, a software or any other material or media. Conversely, the learner will also produce information that can be made available to others through an informer agent, as a result of his/her production activities.

The *Designer* is the actor planning, adapting and sustaining a telelearning system (TLS) that integrates information sources (human informers or learning materials), and also self-management, assistance and collaboration tools for the other actors.

The *Trainer* provides pedagogical assistance by giving advice to the learner about his individual process and the interactions that may be useful to him based on the learning scenarios defined by the designer.

Finally, the *Manager* provides organisational assistance to the learner (and other actors) by managing actors and events, for example creating groups or making tele-services available in order to insure the success of the learning process, based on the scenarios defined by the designer.

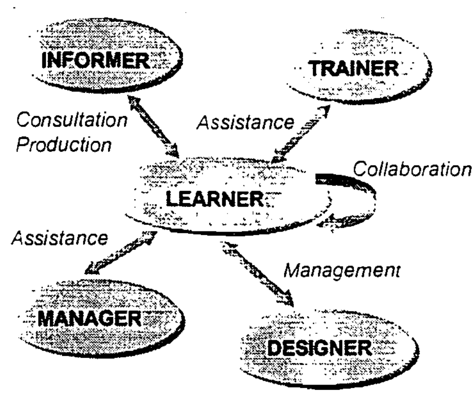


Figure 1 - Actors and interaction spaces

BEST COPY AVAILABLE

Figure 1 shows the five theoretical actors and their interactions with the learner. In our VLC model, there are five interaction spaces: management, consultation, production, collaboration and assistance, each giving access to a number of resources.

3. The Delivery System: the Hyperguide and the Explora Environments

At delivery time, the learner and the other actors interact within a computer-based learning environment called the Virtual Learning Centre. The Explora implementation of such a system is a web-based server that helps designers build a learning environment for each actor, adapted to their role in a certain course or telelearning event. Then the other actors can use their own Explora environment to intervene in relation to the course web site.

Each course can be any web site we called the *Hyperguide.* This web site describes the course structure, down to learning scenarios and learning activities distributed into modules or learning units. Each scenario gives access to specific resources to be consulted or productions to make.

Figure 2 shows such a HyperGuide for an introductory course in artificial intelligence. The main window here is one of the Hyperguide pages showing the scenario for module 3. Each oval shape represents a learning activity. A click on it brings the description of the learning activity: goal and type of the activity, expected duration, resources to consult, productions to make, proposed assignment steps.

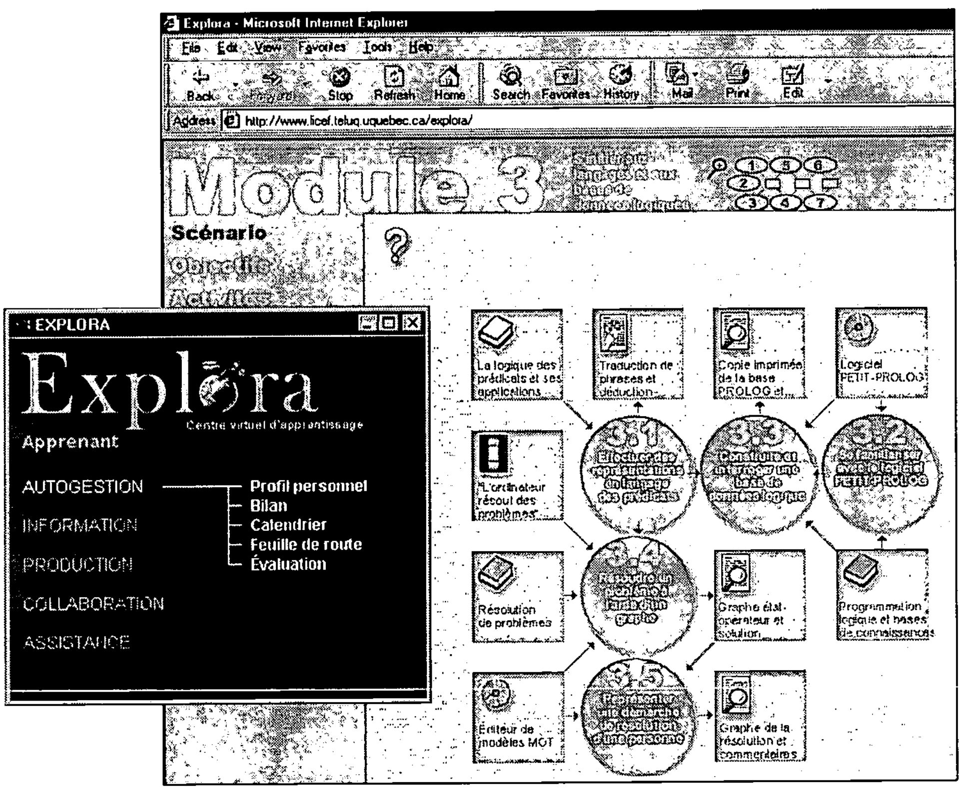


Figure 2 . A host HyperGuide within an Explora environment

The rectangular shapes give access to the input resources: a text to read, a video to watch, a CBT or a multimedia simulation to interact with. They also give access to output resources storing the learner's production for future use in other activities, exchange with other learners or submission to a trainer for evaluation.

Different actors need different points of view on the host system in each interaction space. For example, in the information space, a learner will need different input resources such as a list of related web sites, videos from a server or didactic software on AI content. In the same information space, a trainer needs other information resources: traces of the learners activities for diagnosis, information on the group of learners and on learner productions and annotation tools to identify and organise information for assistance.

These resources are made available through an external palette as shown in the floating window of figure 2. This is what we call an *Explora environment.* It is an actor's set of resources for a course or program supported by the Virtual learning centre. It groups resources into five interaction spaces (self-management, information, production, collaboration and assistance) according to an actor's role and course specifics. In the example here, if we open any one of the five menus in the Explora window, we can gain access to the following resources.

INTERACTION SPACE	*RESOURCE*	*TYPE*	*DESCRIPTION*
Self-management resources	Personal Profile	Java	Personal information accessible to all
	Progress status	Java	Bar graph displaying progress levels
	Calendar of events	Java	Dates where activities were looked upon
	Course schedule	HTML	Gantt distribution of activities
	Evaluation	HTML	Suggestions and course evaluation by learners
Information resources	Texts	HTML	Access to texts to be consulted or produced
	Videos	HTML	Access to video streaming
	Webography	HTML	Access to interesting web sites
	Search engines	HTML	To search for other web sites
Production resources	CBTs	EXE	Triggers seven CBTs illustrating IA concepts
	Text editor	EXE	Link to a recommended text editor
	Knowledge editor	EXE	Link to LICEF'S MOT knowledge editor
	Productions made	HTML	Simple file transfer to trainer for production evaluation
Collaboration resources	Group profile	Java	Display of other learner's progress and chat
	E-mail	EXE	Link to recommended email software
	Forums	HTML	Asynchronous teleconferencing system
	Showcase	HTML	Simple upload/download to a server to facilitate the exchange of productions
Assistance resources	Explora guide	HTML	Information on use of the environment
	Study guide	PDF	Access to a PDF description of the course
	Technical help	HTML	A frequently asked questions (FAQ) facility
	Resource persons	HTML	An e-mail list of persons: professor, tutor, manager, technician, etc.

Table 1. Example of the distribution of resources in an Explora Environment

These resources are all external to the web course. There are three types of resources:

- Java applets that we have developed mainly to exploit the learner's trace in the web course, to build individual progress reports, group profiles, advice generation or support to peer collaboration tools;
- Executables downloaded or resident on the user's workstation, that trigger CBTs, simulations, or generic software shared by the group so that file exchange is facilitated; this is particularly needed for some communication tools wherein the use of different software will simply not work.
- HTML generic services that sometimes have to be sometime adapted to the course content; examples of these are course evaluation questionnaires through which learners and trainers will give feedback to designers to improve the course, and also the webography which is a structured list of commented web sites.

4. Reengineering a course for a Virtual Learning Centre

We will now focus on four major steps in a process through which a distance learning course can be re-engineered into an HyperGuide within Explora environments. In the example above, we started from a distance course at Télé-université based on a package containing printed documents, a 500 page book, a study guide describing the course and its learning activities and a technical guide for the software material). The package also contained 8 small software on 3 diskettes to illustrate IA concepts and 8 videos on VHS cassettes for a total of 4 hours' viewing time.

1- *Engineering the telelearning system.* We have re-designed this course with MISA (Paquette et al 1997). The MISA method presents the ID processes and tasks according to an engineering perspective analogous to software engineering. This method innovates by using cognitive modelling techniques to represent knowledge, as well as pedagogical scenarios, learning materials specs and delivery plans. In this process, we have made all the fundamental decisions, separating the components specific to the AI content that must be integrated in the HyperGuide web site and the generic resources (documents, tools, services) that will be useful for this course in an Explora environment.

2- *Building the HyperGuide web site.* This second step was rather straightforward, based on the MISA models that provided precise orientations to the development team. They could then focus on the ergonomics of the web site and the presentations of the pages with very little interaction needed from the designers. Three other courses have been rapidly constructed afterward on the same model.

3- *Selecting actors and resources.* This task was achieved in parallel to the previous one, based on the MISA models. At this point, we have decided to have only two actors at delivery time: learners and trainers (called tutors here). An informer actor was not necessary, since all the content had been mediated. A manager actor may be added in the future. The learner's and the trainer's environments are quite similar but specific tools for the trainer have been designed to give them access to a more synthetic group progress profile, to maintain a FAQ, to animate teleconferences and to integrate their evaluation into the learner's progress results.

Linking a course HyperGuide and the Explora environments. This last step has been presented recently with more details in (Girard et al, 1999). Essentially, the designer is here using some of the Explora designer's tools to define progress levels for each learning activity or knowledge unit. Then these progress levels are updated according to the learner's actions in the HyperGuide web site by the system, according to conditions defined by the designer, or by the learner's direct action in a viewing interface. These progress levels form a user model employed by the system to give feedback and support to the learner. Support is given using help messages, avatars demonstrations, but also adapting the interface with graphical cues to guide the learner to aspects of his task or to resources that may be useful to him. This aspect is being developed in a new graphic adaptive interface described in (Dufresne et al, 1999).

Conclusion

There are many advantages to the open architecture that has been presented here. The Virtual Learning Centre is at the learning organisation's level, thus avoiding duplication and facilitating evolution and reuse of resources from one course to another. It also speeds up the design process because each individual web-course (the Hyperguide) is freed from all the generic resources and the information management load between different actors. Furthermore, each course can have a very different content, structure and presentation. In fact, it can be any web site, regardless of the software used to produce it. On the other hand, all of the Explora environments are similarly structured, thus facilitating their use in different courses by learners, trainers or managers. From an organisation's viewpoint, this architecture facilitates management through standardisation of resources, without constraining the design teams in a particular authoring software.

References

Dufresne, A., Cosmova, V., LeTran, T., & Ramstein, C. (1999). *Explora: An Interface to Support the Learner with Dynamic Graphs and Multimodal Goal Driven Explanations.* AIED'99, IOS Press, Maine.

Gery G. (1997). *Granting Three Wishes Through Performance-Centred Design,* NATO Communications of the ACM, volume 40, number 7, pp.54-59.

Girard J., Paquette G., A. Miara and K. Lundgren. (1999). *Intelligent Assistance for Web-based TeleLearning.* In S.Lajoie and M. Vivet (Eds), AI in Education – Open Learning Environements, IOS Press.

Harasim, L. (1990).*Online Education: An Environment for Collaboration and Intellectual Amplification*. In L. Harasim (Ed.), *Online education: Perspectives on a new environment*. Praeger Publishers, New York.

Hiltz, S. (1990). *Evaluating the Virtual Classroom.* In Harasim, L. (ed.) Online education: perspectives on a new environment. Praeger Publishers, New-York. pp. 133-184.

Paquette, G. (1997). *Virtual Learning Centres for XXIst Century Organisations.* In F. Verdejo and G. Davies (eds.). The Virtual Campus, Chapman & Hall, London. pp. 18-34.

Paquette G., Aubin C. and Crevier, F. (1997). *Design and Implementation of Interactive TeleLearning Scenarios*. Proceedings of ICDE'97 (International Council for Distance Education), Penn State University, USA, June.

Paquette G., Bergeron G., Bourdeau J. (1993). *The Virtual Classroom revisited.* TeleTeaching'93 Proceedings, Trondheim, Norway, August.

Paquette G., Ricciardi-Rigault C., Paquin C., Liégeois S. and Bleicher E. (1996). *Developing the Virtual Campus Environment*, ED-Media International Conference, Boston, June.

Ricciardi-Rigault, C., Henri, F. *Developing Tools for Optimizing the Collaborative Learning Process*, Proceedings of the International Distance Education Conference, Penn State University, USA, June.

Multiple Representations in Interactive Learning Environments: Two Case Studies

Alan P. Parkes, Constantinos Drakakis, & George Marselos,
Computing Department
Lancaster University
Lancaster LA1 4YR, UK
app@comp.lancs.ac.uk

Abstract: This paper discusses two systems that exploit multiple representations to facilitate learning. The *Programming Tutor* facilitates the acquisition of fundamental programming concepts through interaction with textual descriptions and flowchart simulations of program behavior. The *Electricity Laws Tutor* supports understanding of some of the basic laws of electricity through the use of co-operating representations: text, formulas, simulated circuits, and animated metaphors. Dimensions of multiple representations are discussed, as are their potential advantages and disadvantages. The paper discusses the evaluation of the two systems, and concludes with a brief discussion of the problems arising in attempting to evaluate multiple representations for learning.

Introduction

Most forms of learning involve information that is encoded into different representations. We can have "paraphrases" of information expressed in the same medium (e.g., a textual explanation of a corresponding mathematical formula, for example). Alternatively, we may find representations of some aspects of given information expressed in different media (a flowchart and a fragment of programming code representing the same algorithm, for example). Certain representations may be chosen in preference to others because they make otherwise abstract or hidden features and processes concrete and visible. Concepts that are usually formally expressed and can be difficult to conceptualize may benefit from being expressed in an alternative form. An obvious application of this is the drawing of metaphorical representations, such as rope and pulley diagrams, to capture salient details of an abstract notion such as force (Larkin & Simon 1987).

It is often the case that different representations exploit and express different properties of the represented thing. The diagrams used to express geometry problems are excellent for expressing the relationship between lines. There are conventions for indicating that two lines are parallel, for example. However, *reasoning* must also be applied to solve problems, observational evidence alone is insufficient. The incorporation of *multiple* representations into interactive multimedia learning environments presents exciting opportunities to support and enrich the learning experience, in three main ways. Firstly, representations can be *animated.* Secondly, the representation can be *manipulable* so the learner can control and explore the effects of changes to the representations. Thirdly, representations can *co-operate*, in the sense that the effects of changes in one representation can be seen in terms of corresponding changes in the other representations.

This paper describes the evaluation of two interactive learning environments. Both embody one or more of the above three dimensions of *animation, manipulability,* and *co-operation*. The domains featured are in one case, the learning of basic laws of electricity, and the other, the acquisition of basic programming concepts.

The structure of the paper is as follows. The next section outlines certain dimensions of multiple representations, and the advantages and disadvantages of multiple representations for learning. Section 3 briefly describes the two systems. Section 4 discusses their evaluation and the results obtained. The paper concludes with a brief general discussion of the evaluation of co-operating multimedia representations.

Multiple Representations in Learning Environments

This section considers some useful properties that can be use to analyze and categorize multiple representations, and then discusses the potential advantages and disadvantages of multiple representations.

Dimensions of Multiple Representations

The key dimensions of multiple representations have been identified as *perspective, precision, modality, specificity,* and *complexity* (van Someren *et al.* 1998).

The *perspective* taken by a representation may be *functional*, *behavioral* or *physical*, or some combination of these. A *functional* perspective of a program may describe its major components and the interface between them. A flowchart represents one possible *behavioral* perspective on the program. The code of the program itself represents, to some extent, a *physical* perspective.

The *precision* of a representation is the level of accuracy with which it represents the target entity. A representation may be precise in some ways and not in others. Consider a diagram of an electrical circuit showing the components (battery, lamp, etc.). The diagram precisely defines the relative placing of the components in the circuit, but the depictions may bear little or no resemblance to the components themselves.

The *modality* of a representation refers to its predominant form (text, graphics, video, and so on).

The *specificity* of a representation refers to its informational economy. Representations have *computational* properties (Larkin & Simon 1987). The computational properties of a representation refer to its support for tasks such as *inference* and *search*. For example, it is much easier to locate a component of a software system in a structure diagram than by scanning the code.

The final dimension of multiple representations, according to van Someren *et al.*, is *complexity*. Consider a flowchart for a program and the corresponding program code. Many of the same features are present in both representations (e.g., a given Boolean test), albeit in different forms (a loop, visually represented in the flowchart, may appear in the program as a a "WHILE" loop). In this sense, there is some *redundancy* in the representational scheme, which enables each representation to offer a unique viewpoint on the salient details.

In multiple representation schemes, the different representations are usually *conceptually* linked. However, they could also be *physically* linked, in the sense that operations in any of the representations result in the corresponding operation being carried out automatically, where appropriate, in the other representations. Such "co-operative" multiple representations have been considered in (Cox & Brna 1996), (Parkes 1991), (Parkes 1992), (Parkes 1994a), and (Parkes 1994b).

Advantages and Disadvantages of Multiple Representations

As indicated by the preceding discussion, to represent all of the salient details of the topic, several complementary representations may be necessary. Text may provide a detailed description, but an accompanying diagram may be indispensable in orientating the learner to the key elements to which the text refers. Moreover, for a complex domain, it is possible to separate key details out into different representations, which avoids overloading the learner with a single all-encompassing and highly complex representation.

Expertise in a given domain is often, at least in part, related to the ability to use several different representations as and when needed, and to be able to translate concepts into, and between, such representations as necessary. Co-operating multiple representations can support the learner in the task of integrating the different representations into a conceptual whole, as learning progresses. Such schemes can also help the learner to pace the learning process. In the initial stages, the learner focuses on one or more of the simpler representations (e.g., a circuit diagram). As knowledge and confidence increases, the learner can devote more attention to the more complex or abstract representations (the formula for Ohm's law, for example).

The redundancy present in multiple representation schemes reinforces the encoding of information in long term memory, by providing the opportunity for rehearsal of that information in different forms. Moreover, the fact that the redundant information can be acquired through several forms may provide several "memory traces" for that information, thus ensuring that the information is more likely to be retrievable from long term memory in the future. Multiple representations can provide a learner with access to a preferred representation. Learners can choose which representation to attend to. In a single representation system, a learner who encounters problems in understanding the sole representation must seek alternative representations outside of the learning environment in question.

A potential problem with the use of multiple representations is that each representation may be, in some senses, a statement in a different "language", and a learner may need to acquire its syntax and semantics, which may obstruct the learning of the target domain itself. Co-operative representations may help here: the user can observe the corresponding outcomes in several representations. The user will be able to learn about the unfamiliar representation by observing the translation of changes between an understood representation and an unfamiliar one. However, while such *positive transfer* of knowledge can take place, there is always the possibility that misconceptions about one representation may propagate misunderstandings throughout all of the representations.

A final potential disadvantage of multiple representations concerns development cost. Each representation is essentially an interface in itself, and must be designed, implemented and evaluated as such. Moreover, if the representations are co-operative, each representation must have an associated set of controls to manipulate it. As designers, we intend each representation to be effective and necessary. The provision of a representation that benefits no learner is a pointless exercise. This point is discussed futher in the concluding section of this paper.

The preceding discussion suggests that the potential advantages of the use of multiple representations for learning outweigh the disadvantages. We now describe case studies involving two interactive learning environments, both of which feature co-operating multiple representations.

Two Interactive Learning Environments

The systems described here were developed by the second and third authors as students on Lancaster's MSc in Distributed Interactive Systems (Drakakis 1999), (Marselos 1999). The target domains of the systems were, in one case, fundamental programming concepts and, in the other, basic laws and formulas of electrical circuits.

We now briefly describe the two systems, before considering their evaluation.

The Programming Concept Tutor

This system (Fig. 1) facilitates the acquisition by complete novices of basic programming concepts, such as *input*, *output*, *assignment, simple arithmetic expressions*, *conditional expressions*, and *loops*. The tutor uses animated flowcharts to express the programming concepts.

The learner can proceed through the lessons in a suggested order, but also has direct access to any lesson at any time. Interactive exercises are provided for each topic, as described later.

Each lesson occupies one complete screen. At the left of the screen is a textual description of the concept. In the center of the screen is a picture of the flowchart construct that represents the lesson topic. On the right of the screen is a flowchart representing a complete program featuring the lesson concept. This flowchart can be animated, so the user can watch the execution of the flowchart (continuously or via single stepping). Along the bottom of the lesson screen are other representations, such as a textual description of the current statement, and a small "display screen" showing output from the animated "program" as it executes. Clicking on any flowchart symbol anywhere in the system results in information about that symbol being presented to the learner.

The exercises involve the learner in identifying the errors in example flowcharts. They are answered by clicking on appropriate flowchart segments, which are then placed into the appropriate part of the flowchart, replacing the erroneous part. Explanations are provided for both correct and incorrect answers.

The Electricity Laws Tutor

The aim of this system (Fig. 2) was to facilitate an understanding of the basic concepts of electricity, and formulas for *Ohm's Law, Power (Wattage)*, *Serial and Parallel Resistors*, etc.

A main screen provides direct access to each lesson, and a suggested, but not enforced, order is given. Interactive exercises are provided for each topic, as described later.

Each lesson occupies one complete screen. A screen features a textual explanation of the law or concept, the actual formula of interest, an animated circuit diagram and a metaphorical animation exemplifying the topic concept. There are a number of (+ and -) buttons that are used to increase or decrease the values of one of the relevant properties (e.g., voltage). Typical examples of the metaphors used are water pipes with changing diameter to represent resistance, and a lorry carrying a varying size of load to represent electrical load.

When the buttons are used to change the values, the circuit diagrams, any dependent button values (according to the calculation of the formula) and the metaphorical animation, undergo corresponding changes.

All exercises involve the application of the lesson formula when one value is missing. The given values are randomly generated. Each exercise screen consists of a circuit diagram showing the problem, with the missing property indicated. The answer is chosen from a list of "radio button" options.

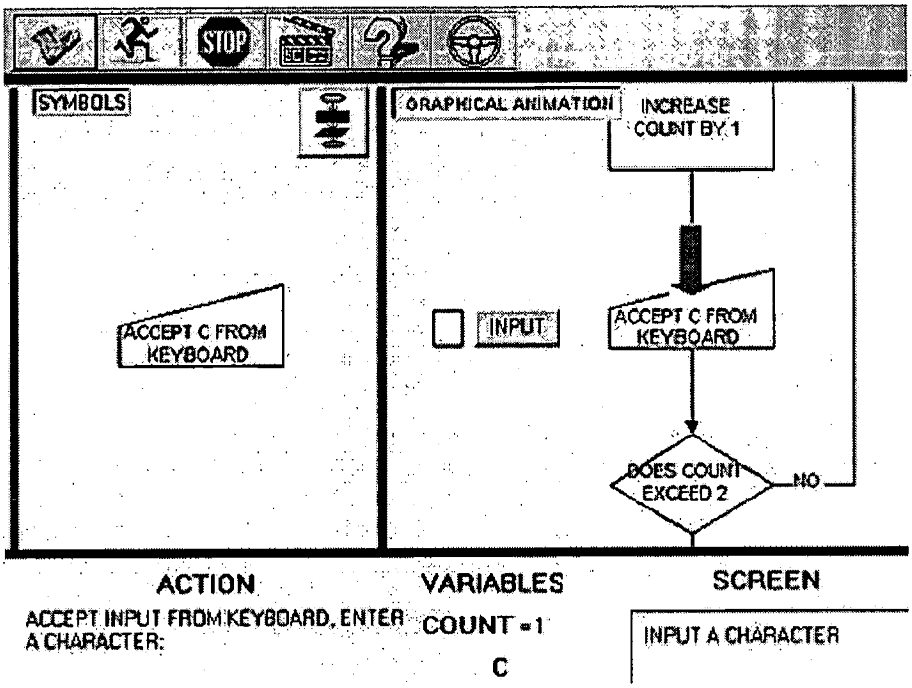


Figure 1: Part of a screen from the Programming Tutor, paused while a flowchart simulation is in progress.

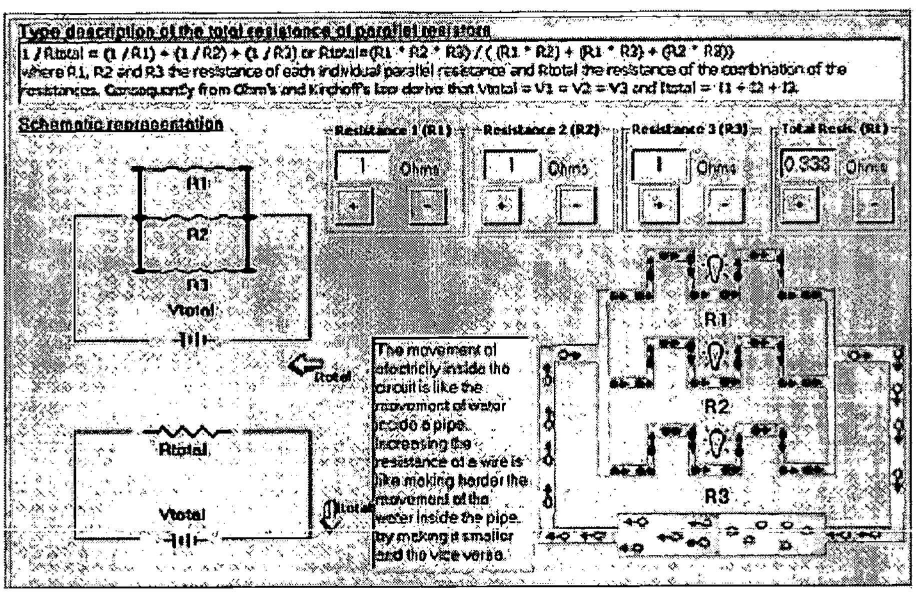


Figure 2: Part of a screen from the Electricity Tutor, showing the various co-operating representations involved.

Evaluation of the Two Systems

This section provides an overview of the evaluation trials conducted for the *Programming Concepts Tutor* and the *Electricity Laws Tutor* described in the preceding section. First, the evaluation methodologies are outlined, following which the outcomes of the evaluation trials are discussed.

The Evaluation Methodologies

Each system was empirically evaluated with a small number of adult users who were deliberately chosen for their lack of knowledge of the target domains. Eight subjects took part in the evaluation of the programming concept tutor. The electricity tutor was evaluated in trials using six subjects. We acknowledge the small scale of these trials. At this stage, our aim is qualitative analysis only.

In each case, subjects were presented with a pre-session questionnaire to establish their backgrounds and experience. Following their session with the system, subjects completed a post-session questionnaire. The post-session questionnaire featured questions on all aspects of the interaction with the system, such as usability, navigability, understandability, interactivity, enjoyment of use, and so on.

Each user's session with the respective system was video-recorded. The experimenter also observed the sessions and took notes. Subjects were encouraged to think aloud as they interacted with the system. Considerable effort was expended to ensure that subjects were relaxed and not intimidated by the evaluation process.

The rationale for the combined use of three evaluation methods was to attempt to exploit the effectiveness of each while overcoming its potential drawbacks. Direct observation is a simple and cost effective method, but notes taken by an observer may be incomplete, while video recordings are a permanent record that can be studied many times, and thus aspects missed by direct observation may be subsequently revealed. On the other hand video recording (unless done using many cameras from different angles) does not capture all aspects of the interaction (it may record the subject's body language, at the expense of what is actually happening on screen at the time -
aloud protocols" can be useful in indicating what the subject thinks they are trying to do. However, attempting to verbalize a complex task while actually trying to learn how to carry it out can actually interfere with the learning of that task. Similarly, interventions by the experimenter to ensure continued verbalization by the subject when a challenging task is being attempted would also impede effective learning. That a session is recorded in several forms makes it unnecessary for an unwilling subject to constantly verbalize. A more thorough discussion of evaluation issues can be found in (Preece *et al.* 1994).

With each system, a typical end-user session took around 1 hour 15 minutes.

For the programming concept tutor, subjects were also given a post-session test. This is discussed later.

Outcomes of the Evaluation

For both systems, evaluation results were very encouraging. Subjects performed very well in the in-system tests. For the electricity tutor, more than 90% of the first answers given were correct, while for the programming concept tutor, the corresponding figure was greater than 95%.

For the electricity tutor, the animated graphical circuit was the favored representation for all subjects. It should nevertheless be observed that learning the corresponding formula could only take place if the subject used that representation in conjunction with the formula description. The circuit diagram provides an *advance organizer* that facilitates the learning of the formula. The extent to which the metaphorical animation was effective is not so readily determined. Given that this representation has the highest cost in terms of design and development time and effort, the question of its effectiveness is highly significant. However, the users did state that the metaphor was useful in encouraging comprehension of the more abstract material.

As stated above, a specific post-test was undertaken by the subjects of the programming concept tutor. In this test, the subjects were first asked to define each of the programming concepts in their own words. Then the subjects were asked to solve four programming exercises, expressing their solution as a flowchart. The subjects did not have access to the training materials while taking the test. The four exercises were of increasing difficulty, the final exercise requiring a nested loop construct. Though only one subject answered all four exercises correctly, the errors made by the others were mostly of an extremely trivial nature (e.g. correctly represented logic, but expressed using the wrong flowchart symbol). This is impressive, given that no subject had previous programming or flowcharting experience. Moreover, the fact that they were able to define the programming concepts in their own words indicates that more than superficial acquisition of the concepts was fostered by exposure to the system. These results relate to Parkes' assertion (Parkes 1992) that an effective learning environment must do more than facilitate the acquisition of skills and techniques that can only be applied in the environment in which they are acquired.

Conclusions

The case studies described above lend some support to the hypothesis that co-operative multiple representations can be an effective facilitator of learning. In creating learning environments of the type described above, we would like to be confident that each representation is playing its part in providing enjoyable and effective learning. However, evaluating any of the representations in isolation may yield misleading results. The system exploits the interaction between the representations, and therefore results applying to a representation considered individually may differ from those pertaining to that representation when it is located in the multi-representational scheme. On the other hand, a representation within the scheme may not be realizing its potential if it is poorly designed, but the roles played by the other representations in the scheme may obscure the effects of this. Truly effective methods for evaluating the effectiveness of co-operative multiple representations for learning have yet to be devised. This is an important aim. Learning environments need to be multi-representational, because knowledge, skills and expertise are multi-representational. Co-operative multiple representation schemes provide the potential to reify the computational processes involved in expertise, so that learners can explore and subsequently acquire these processes as part of an engaging and effective learning experience.

References

Larkin J.H,. & Simon H.A. (1987) Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science*, 11, 65-99.

Cox, R. & Brna, P. (1995). Supporting the Use of External Representations in Problem Solving: the Need for Flexible Learning Environments. *Journal of Artificial Intelligence in Education*. 6 (2/3), 239-302.

Drakakis C. (1999) *Multiple representations in learning environments*. Unpublished MSc Dissertation. Lancaster University, Lancaster, UK

Marselos G. (1999) *Learning basic electricity laws through multiple representations*. Unpublished MSc Dissertation. Lancaster University, Lancaster, UK

Parkes A.P. (1991) Manipulable inter-medium encodings for information retrieval. *RIAO '91 Recherche d'Information Assiste par Ordinateur: Intelligent text and image handling*, Barcelona, Spain, 300-319.

Parkes A.P. (1992) The inferential appropriateness of a manipulable inter-medium encoding. In M. Blattner & R. Dannenbeg (Eds.), *Interactive Multimedia Computing*, Reading, MA: Addison-Wesley.

Parkes A.P. (1994) Hypermedia representations for learning: formal and informal observations on designs and directions. *Educational Multimedia and Hypermedia, 1994*, Vancouver, Canada, June 25-29, 1994. Association for the Advancement of Computing in Education., Charlottesville, VA, 438-443.

Parkes A.P. (1994) A study of problem solving activities in a hypermedia representation. *Journal of Educational Multimedia and Hypermedia*, 3 (2), 197-223

Preece J., Rogers Y., Sharp H., Benyon D., Holland S., & Carey T. (1994) *Human Computer Interaction*. Reading, MA: Addison-Wesley.

van Someren M.W., Reimann P., Boshuizen H.P.A., & de Jong T. (1998) *Learning with Multiple Representations*. Amsterdam, Netherlands: Pergamon Press.

Acknowledgements

This research was supported by the Computing Department of Lancaster University.

Students' engagement behaviors in computer-assisted mass lectures.

Nopphol Pausawasdi and Dr Lyn Henderson
School of Education, James Cook University
Townsville, Australia 4811
Nopphol.Pausawasdi@jcu.edu.au
Lynette.Henderson@jcu.edu.au

Abstract: This paper presents findings from a research project that examined students' behaviors during mass lectures that utilized interactive multimedia. Students' engagement behaviors and disengagement behaviors during the computer-assisted mass lectures were influenced by three types of lecture elements: interactive multimedia (IMM), the lecturer, and student-idiosyncratic factors. The significance of these lecture elements and factors that triggered the student's behaviors are categorized and discussed. Being able to understand what influences students' behaviors and attention in computer-assisted mass lectures can provide guidelines for promoting effective learning in computer-assisted mass lectures.

Introduction

There is increasing use of interactive multimedia (IMM) in university lectures for teaching and learning. Yet IMM does not guarantee better content learning than do traditional instruction methods. Studies report that IMM is most effective when learners work with IMM individually or, better still, in pairs or small groups (Park and Hannafin, 1993; Simpson, 1994). However, in a mass lecture, the IMM is controlled by the lecturer. Learners play a passive-receiver role. As they do not have direct access to control the IMM, what do they do during lectures? What triggers their attention? What causes their behaviors? Are they focused on the content?

There is still too little research concerning how students engage with the new computer mediated technologies, particularly the increasingly popular use of PowerPoint and IMM in mass lectures. Most research on the increasingly popular use of IMM in lectures has focused on "how-to-tips" and critiques (for example, Broughton, 1997; Paldy, 1997; Seaman, 1998). There were few qualitative or empirical research studies. One by Nowaczyk, Santos, and Patton (1998) examined student perceptions of various characteristics of multiple media such as color transparencies, video, and IMM in the undergraduate classroom, mainly in terms of gaining and holding attention. Others (Jackson, 1997; Van-Meter, 1994) sought student perceptions of the effectiveness of PowerPoint presentations rather than IMM presentations to support note taking, interest, attention, and clarity of content organization. Faraday and Sutcliffe's (1996) empirical study tracked eye movement and ascertained memorization of content during a short medical IMM presentation. Research by Putt, Henderson, Patching (1996) and Henderson, Putt, Ainge, and Coombs (1997) examined teachers' thinking processes about the academic content of IMM and WWW courseware, respectively. However, these did not focus on a mass lecture context. None investigated students' behaviors triggered by a combination of the features of IMM and the lecturer in mass lectures.

Heeding current literature in the field, the study does not aim to ascertain whether learning with the new technologies produces better learning or test outcomes than traditional lectures. Rather, it utilizes qualitative methodologies to ascertain the students' behaviors as they learned in the authentic context of a lecture theatre. Thus the study sought to identify, categorize, and analyze the engagement and disengagement behaviors that were reported by the students.

Methodology

The research context and methodology capitalize on authenticity. The students' behaviors were obtained in realistic, ecologically-valid situations as the data were collected from students working in their regular mass lecture environment, a medical school setting. The research was conducted with a physiology class in a mass lecture theatre, Faculty of Medicine Siriraj hospital, Mahidol University, Bangkok, Thailand. The lecturer used A.D.A.M. (A.D.A.M. Software, Inc., 1995) in two one hour lectures. The lecture sessions were video recorded. Six students volunteered to participate in stimulated-recall interviews. There were four males and two females with ages ranging from 17 to 19 years. They were in the third semester of a six-year medical degree. The six participants self selected into 2 male pairs and 1 female pair. The first male pair was interviewed after the first lecture session; the others after the second lecture session. The content of both lectures was the same topic and used the same IMM application. All six participants attended both lectures.

Data Collection

The participants were interviewed using the stimulated recall technique that follows strict guidelines (Putt, Henderson, & Patching, 1996). The interviews were conducted with one pair at a time. The interviewer and each pair of participants together viewed a videotape of the lecture and a synchronized computer screen showing the IMM that was used in the lecture. The video picture included the lecturer's verbal and nonverbal behaviors and the content of the computer-assisted lecture. The computer screen showed the IMM (A.D.A.M.) content which appeared on the videotape. Both videotape and computer screen facilitated the participant's recall and verbalization of their thinking and behaviors during the lecture. The three stimulated recall interviews, one hour duration for each interview, were conducted immediately after the lecture sessions and were audio taped for later transcription and analysis.

Results

From the interview transcripts of the students' stimulated recall interviews, their behaviors were jointly identified and categorized on the first transcript by the researchers. The remaining transcripts were analyzed individually and the data from each researcher were compared and discussed. Consensus was achieved when disagreement occurred. The behaviors reported by the participants were classified as those that involved their engagement with the content and those that indicated disengagement with the content. These two major categories were then subdivided according to what influenced their engagement and disengagement: the "IMM" product (A.D.A.M), "The Lecturer", and "Student-Idiosyncratic Factors" that were not specifically triggered by either A.D.A.M. or the lecturer (see Table 1).

The frequencies for each of these types of behaviors were tallied. A total of 203 reported behaviors were identified from the transcripts. The engagement behaviors were reported 158 times (78%) while the disengagement behaviors were reported 45 times (22%). For the factors of engagement, students' behaviors influenced by the IMM, the lecturer, and student-idiosyncratic factors were 68%, 23%, and 9% of the total reported behaviors, respectively. For the factors of disengagement, students' behaviors influenced by the IMM, the lecturer, and student-idiosyncratic factors were 47%, 15%, and 38% of the total reported behaviors, respectively. Each of the mass lecture elements, IMM, the lecturer, and student-idiosyncratic factors, that triggered each of the behaviors are tabulated in Table 1. Features of the IMM influenced the highest number of engagement behaviors. However, it influenced the highest number of disengagement behaviors as well.

Discussion

Engagement

Interactive multimedia (IMM)

Because IMM played a major role in the computer-assisted mass lectures, it is not surprising that IMM is the factor that most influenced students' engagement and disengagement behaviors. From students' reports, IMM influenced 68% of their engagement behaviors and 47% of their disengagement behaviors.

(a) Focusing

Focusing on the IMM presentation was the highest reported engagement behavior during the computer-assisted mass lecture. These behaviors were influenced by animations, pictures, text, sound effects, voice-overs, graphs, and color changes. The findings show animation was the feature to which students paid most attention. "Animation has a strong effect on attention" (Faraday & Sutcliffe, 1996, p.270) because it simultaneously contains pictures, sound, and movement concerning the concept being explained (Hillstrom & Yantis, 1994). Because the animations were replayed immediately, the students paid more attention to the detail during the second or third time it was shown. The benefit is that all students received the correct information. They might have had different understandings if they had had to imagine the animations by themselves as they would have had to do, if the graph or picture was on an OHT or if the lecturers' verbal explanations had been the medium of delivery.

	Influenced by	Behaviors	Frequency	Triggering Factors
Engagement	IMM	• focusing (looking, reading, listening)	39	• pictures, animations, text, sound effects, voice over, graphs, zoom, color changes
		• note taking	19	• text on screen, graph
		• anticipating/waiting	19	• pictures, animations, text, graphs, color, sound, zoom, other topics shown on screen
		• linking	10	• pictures, graphs
		• understanding	6	• pictures, animations, color changes
		• affective	4	• animations, computer problems
		• generating (ideas)	3	• pictures, IMM usage, IMM laboratory
		• using textbook	3	• graph, data
		• not sleeping	3	• exciting, fun and interesting medium
		• recall	1	• picture
		total	107	
	Lecturer	• focusing (listening, following)	17	• explanations
		• replying	9	• explanations, questions
		• note taking	3	• explanations
		• imaging	3	• explanations
		• anticipating	2	• lecturer-computer interaction
		• understanding	1	• explanations
		• not sleeping	1	• voice
		total	36	
	Student-Idiosyncratic Factors	• generating	4	• content
		• anticipating	3	• content
		• reviewing	3	• content
		• focusing	3	• of own accord
		• affective	1	• correct answer
		• understanding	1	• content
		total	15	
Disengagement	IMM	• unfocused (not looking, missing or not listening)	16	• small text, listening, focused on other element • graph, sound, pictures
		• linking	4	• picture
		• sleepy	1	
		total	21	
	Lecturer	• unfocused	3	• lecturer's IMM usage (e.g., kept clicking), lecturer's speech
		• sleeping	2	• explanations
		• affective	1	• lecturer's speech
		• perplexing	1	• lecturer's IMM usage (passed many screens)
		total	7	

	Student-Idiosyncratic Factors	• unfocused	9	• absent-mind, thinking about something else
		• not understanding	2	• content
		• bored	2	• same content
		• perplexing	2	• new topic, answer
		• lost	1	• question-answer
		• sleepy	1	
		total	17	
		total	203	

Table 1: Students' engagement and disengagement behaviors influenced by IMM, the lecturer, and other factors and the factors that triggered their behaviors.

Text was the second highest ranked IMM feature that influenced students' attention. The reason for this finding is text is readable and notable data, that is, it lends itself to note taking. Graphs were the third highest ranked IMM feature that influenced students' engagement behavior. The graphs contained statistical data that helped explain the content. However, the findings show graphs were reported less than text. This could be that graphs were presented on screen less than text. It is interesting that pictures were the fourth highest ranked IMM feature that influenced students' attention even though they had been used many times during the lecture. According to Levie (1987), a possible explanation is that students have to spend more time decoding information from animations and text compared with pictures. Therefore, they paid more attention to those features than pictures.

(b) Note taking

Note taking is the second highest ranked (17.7%) engagement behavior influenced by IMM. Note taking is one thing that student would do to record information for review, especially for the exams. However, note-taking behaviors were reported less than focusing on the IMM presentation. A possible explanation is that students may learn by remembering the combined features of IMM such as animation, pictures, and sound without need for note taking. In other words, the animations made the information more memorable and understandable (Nowaczyk, Santos, & Patton, 1998) and, therefore, students may not need written "evidence" (notes) that help them recall the content. Also it is not easy to take notes of animations and pictures. Students reported they took notes from computer-assisted mass lectures less than traditional lectures and lectures that used OHTs and PowerPoint. Less note taking could help students focus more on the content and not worry about writing. They may engage with the content more by learning with computer-assisted mass lectures.

(c) Anticipating

Anticipating includes predicting, looking forward to, and speculating about, the likelihood of encountering problems, types of content, and features of the medium. Anticipation is also the second highest ranked engagement behavior. A possible explanation for this finding is that the lecturer was the only person who controlled the IMM, thus the students anticipated and predicted what the lecturer would present. Students' anticipations concerned animations, graphs, pictures, text, color, and sound in descending order of reported occurrences. Predicting what would happen next in the animation influenced 47% of the reported anticipating behaviors. A probable reason for the high percentage for animations is because they knew (after the first showing) that the animations provided information that showed, for example, how the muscles contracted and expanded and how this affected the rest of the body, and they therefore attempted to second-guess the consequences of subsequent animations.

(d) Linking

"Linking" is a mental activity in which students associate or bring together two or more ideas, topics, contexts, personal experiences, etc. It is the third highest ranked engagement behavior. Students reported linking from pictures and graphs to their past experiences with the content of the lecture, such as experiments in the laboratory. However, linking behaviors were reported as disengagement behaviors as well. Students, sometimes, linked pictures and graphs to objects and images that were outside the content, for example, the movie, "Titanic".

(e) Understanding

"Understanding" is the fourth ranked engagement behavior. Students may have understood more than the six reported comments suggest; however, given the number of reported engagement-with-the-content behaviors, it seems that students distinguished between understanding (6 reports) and focussing (39 reports). Research in this area could be worthwhile. Students reported that some of their understanding was influenced by pictures, animations, and color changes. The possible explanation for this finding is that pictures, animations, and color changing indicated the points that the lecturer or the IMM voice-over was discussing and thus highlighted aspects of the concept, for example, by changing the color of the text or graph.

(f) Generating, using textbook, and not sleeping

"Generating", "using the textbook", and "not sleeping" have the same frequency. There are several reports of using the textbook during the lectures. The students reported that they wanted to follow the lecturer's explanations in the textbook. This was also a reason given for not taking notes of what the lecturer was saying. The A.D.A.M. IMM software that was used in the lecture had a beneficial effect in terms of maintaining students' engagement. Students reported not sleeping during the lectures. Their reason was that the IMM was an exciting, fun, and interesting medium. The males also reported that they did sleep more during lectures that used OHTs or traditional lectures. Their reasons point to the advantage of using IMM in mass lectures.

The Lecturer

The lecturer influenced engagement behaviors as well. From the students' reports, the lecturer influenced their listening, replying to whole class questions, following his explanations, note taking, imaging, anticipating, focusing, understanding, and "not sleeping" behaviors. Most of these behaviors were triggering by the lecturer's explanations. Listening was reported 3 times as being influenced by IMM but was reported 10 times as being influenced by the lecturer. The reason for this finding is that the lecturer provided verbal information in Thai whilst A.D.A.M. had English voice over explanations. Therefore, the students chose to listen to the lecturer rather than IMM voice over. Generally, engaging with the lecturer's explanations was also because he explained and clarified the content being shown in A.D.A.M. Because the students reported that they might not be able to comprehend the information from IMM, partly because they had no control over pacing or reviewing, they therefore focussed on the lecturer's explanations in order to understand the content. Their "not sleeping" behavior was triggering by the lecturer's voice as well.

Student-idiosyncratic factors

Beside IMM features and the lecturer, there were other factors that influenced engagement behaviors. The most frequent factor that influenced engagement behaviors was content. Students reported that some generating, waiting, reviewing, focusing, and understanding behaviors were influenced by the content itself (rather than the IMM or the lecturer). Engagement with the content naturally depends on the individual. Students who perform well would engage with the content without the IMM. However, engagement with the content that was not triggered by IMM or the lecturer's keying devices (for example, "note this" statements) represented just 9% of the students' idiosyncratic behaviors. Compared with the percentage of engagement behaviors influenced by IMM (68%), IMM was a significant factor helping students engage with the content.

Disengagement

Interactive multimedia (IMM)

IMM also triggered student disengagement behaviors that were reported 21 times. This number is higher than disengagement behaviors that were influenced by the lecturer (7 times) and student-idiosyncratic factors (17 times). Not looking at the IMM software projected on the screen was the highest ranked disengagement behavior. Small text was the main factor that made students decide not to look at information on the screen. This finding shows the significance of presenting readable text data on the screen in mass lecture situations. Moreover, readability problems could affect note-taking behaviors as well.

Lecturer

The findings show that students did not focus while the lecturer was searching for the information and paid less attention when the lecturer stopped interacting with the computer and adopted the traditional lecture style of talking to the students. This also caused students' sleeping behaviors; this was confirmed from the authors' observations of the students during the mass lectures. Therefore, the lecturer's explanations were the triggering factor that most influenced listening behaviors yet it also caused disengagement behaviors as well, particularly when the students had become used to the combination of IMM and lecturer explanation.

Student-Idiosyncratic factors

The "student-idiosyncratic factors" influenced disengagement behaviors more than the lecturer did. Student-idiosyncratic factors that triggered disengagement behaviors were varied. Not focusing on the content, in terms of being absent-minded and thinking about something else, was the first ranked disengagement behavior. This relies on individual differences that could be dependent on attitudes toward content and motivation to learn (Reeves, 1998).

Conclusion

According to the findings, IMM features triggered students' engagement with the content more than the lecturer and other features did. However, most engagement behaviors influenced by IMM were triggered by visual effects. The first ranked IMM feature that triggered engagement behaviors, animation, has a strong effect on engagement (Hillstrom & Yantis, 1994). Students' attention will be locked when processing the animations (Faraday & Sutcliffe, 1996). The replay function of the animation feature gains more students' attention. Color changes indicate the important points. It can shift students' attention to other elements on the screen that the lecturer wanted to emphasize. Changing screens also create movement on the screen, thereby influencing students to refocus on the content. Leaving the information on one screen for a long time may cause disengagement behavior such as day dreaming. Sound effects may focus students' attention but they might not be able to provide better understanding (Bradey, 1997). Students paid most of their audio attention to the lecturer's explanations. At this point, this research shows that, in a computer-assisted mass lecture environment, the students' engagement could be triggered by IMM visual effects and the lecturer's instruction (Paivio, 1990). The "collaboration" between IMM and the lecturer in computer-assisted mass lectures should encourage engagement behaviors. However, inappropriate visual information may trigger disengagement behaviors. Small text is an example in this study. This may lead to difficulties in comprehension (Faraday & Sutcliffe, 1996).

Even though this study cannot be generalized, the results should help lecturers and IMM designers understand some of the factors that influence engagement and disengagement behaviors during learning with computer-assisted mass lectures.

References

Bradey, S. (1997). The impact of digital audio on students' perceptions of learning through interactive multimedia courseware. *B.Ed (Hons) thesis*. Townsville: James Cook University.

Broughton, P. (1997). Designing dynamic PowerPoint presentations. Paper presented in *Partnerships for workforce development in business and marketing education. Annual Atlantic Coast Business and Marketing Education Conference Proceedings*, February 21-22, Greenville, North Carolina.

Faraday, P., Sutcliffe, A. (1996) *An Empirical study of Attending and Comprehending Multimedia Presentations*. City University, London, pp 265-275.

Henderson, L., Putt, I., Ainge, D., Coombs, G. (1997). Comparison of student thinking process when studying with WWW, IMM, and Text-based material. Paper submitted to *IFIP 3.3 and 3.6 Joint Working Conference*, Madrid.

Hillstrom, A. & Yantis, S. (1994). Visual motion and attentional capture. *Perception & Psychology, 55*(4), 399-411.

Jackson, S. (1997). Case study: The use of PowerPoint in teaching comparative politics/ [online] http://horizon.unc.edu/TS/featured/1997-05a.asp Accessed 27 July 1999.

Levie, W. (1987). Research on Picture: A guide to the literature. In D. Willows & H. Houghton (Eds.). *The psychology of illustration*. Vol. I (pp. 1-49). New York: Springer-Verlag.

Nowaczyk, R., Santos, L., & Patton, C. (1998). Student Perception of Multimedia in the Undergrad Classroom. *International Journal of Instructional Media*, 25(4), 367-382

Paldy, L. (1997) Graphic in the lecture hall. *Journal of College Science Teaching*, 27(1), 4-5.

Paivio, A. (1990). *Mental representations: A dual coding approach.* New York: Oxford University Press.

Park, I., Hannafin, M. (1993). Empirically-based guidelines for the design of interactive multimedia. *Educational Technology Research & Development*, *41*(3), 63-85.

Putt, I., Henderson, L., & Patching, W. (1996). Teachers' Thinking Elicited from Interactive Multimedia Professional Development Courseware. *Educational Technology Research & Development, 44*(4), 7-22.

Reeves, T. (1998). User characteristics. [online] http://mime1.marc.gatech.edu/MM_Tools/analysis.html, Accessed 6 April 1999.

Seaman, M. (1998). Developing visual displays for lecture-based courses. *Journal of Psychology. 25*(2), 141-45.

Simpson, M. (1994). Neurophysiological consideration related to interactive multimedia. *Educational Technology Research & Development*, *42*(1), 75-80.

Van-Meter, D. (1994) Computer-aided lecturing. *Journal of Natural Resources and Life sciences Education. 23*(1), 62-64

The Essen Learning Model – a Multi-Level Development Model

Jan M. Pawlowski
Information Systems for Production and Operations Management
University of Essen, Germany
jan.pawlowski@wi-inf.uni-essen.de

Abstract: The Essen Learning Model is a generic development model supporting development processes on three levels: development of curricula, learning sequences, and learning units. We focus on finding an adequate combination of didactical methods and educational technologies. Secondly, we focus on interoperability, reusability, and ease of use, using standards on the modeling level (ARIS), architecture level (LTSA, IMS), and implementation level (XML). The approach will enable educators, project managers, and authors to efficiently develop and implement Computer Supported Learning Environments.

Introduction

The Essen Learning Model is a development model to ensure the overall quality of the development process of learning environments on different levels. New technologies in the educational sector require a well planned and controlled development process. Our experience has shown weaknesses of current development models for the utilization of new technologies in the educational sector.

The use of new technologies is often seen as a universal solution to all problems and challenges in the educational sector. Educational concepts like Virtual University, Multimedia, or Edutainment have gained an increased attention. Despite of extensive research efforts, many immature and unsuitable products and concepts can be found. Quality management is not yet a natural part of educational projects.

The use of development models, originating from the field of software engineering, is a first step towards quality management and assurance. Nevertheless, several restrictions remain: software development models do not include didactical concepts adequately. Specific models for the development of hypermedia systems or CBT-systems require the selection of didactical methods before the start of the project. To overcome those weaknesses of most development models, a multilevel development model was designed, supporting educational processes on three levels: the design and implementation of curricula, learning sequences, and learning units.

I present basic concepts of learning environments and the Learning Technology Systems Architecture which is the base for the development of learning environments. By following this standard architecture, systems implemented using the Essen Learning Model can easily be integrated and coupled with other systems, reducing the development effort significantly. Thereafter, I describe design principles and the levels of the Essen Learning Model together with a sample implementation for the development of a learning sequence on "Simulation".

Computer Supported Learning Environments

Our development model is based on the Learning Technology Systems Architecture. I will briefly describe this standard and our implementation.

Classification of CSLE

According to (Euler,1992), Computer Supported Learning Environments might be classified into five classes: *Drill & Practice Systems*, *Intelligent Tutoring Systems*, *Hypermedia Systems*, *Cognitive tools*, and *Simulations/Micro Worlds*. Those criteria only describe trends of developments. They cannot be used for evaluating or selecting a certain learning environment. In contrast, the Essen Learning Model uses a detailed multi-dimensional classification including attributes like learning objectives, strategies, learning contents, temporal aspects, location, interaction, and users.

Architectures of CSLE

Concepts like the Virtual University or distance learning are based on the exchange and combination of courses and learning contents distributed world-wide. Unfortunately, the majority of learning environments and authoring systems do not use standardized methods in order to support exchange of materials or courses. This leads to an enormous number of isolated systems, not utilizing and being utilized by other systems. To overcome

those weaknesses, several standardization projects have been started. The Essen Learning Model uses an implementation of the proposed standard architecture by the Learning Technology Standards Committee of IEEE.
The Learning Technology Systems Architecture (LTSA) is an abstract model describing the architecture of learning environments (Fig. 1). It contains the following components: *Processes* describe the main subsystems of learning processes: Learner, Delivery, Evaluation, System Coach. *Flows* describe in- and outputs of the processes: Behavior, Assessment, Performance, Query Index, Content Index, Locator Index, Learning Content, Multimedia, Learning Style. Finally *Stores* store relevant information: Records Database, Knowledge Library.

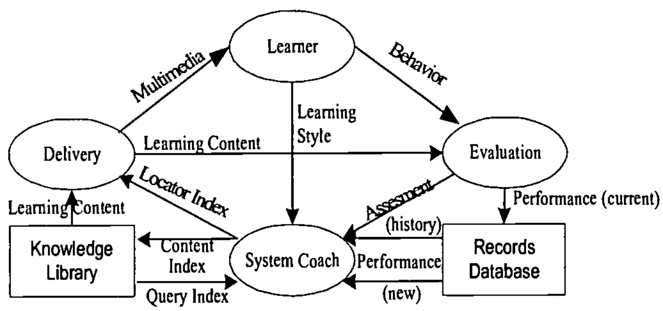


Fig. 1: Learning Technology Systems Architecture

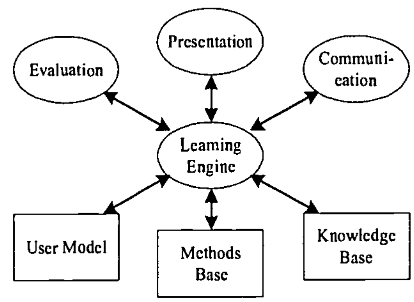


Fig. 2: Architecture of ELM

Furthermore, the LTSA defines formats for the communication and interaction of systems. The implementation of ELM (Fig. 2) uses the standards of the LTSA specification in order to combine and integrate different learning environments.
The main element of a CSLE is a *Learning Engine* for the steering, control, and co-ordination of the components. The *Knowledge Base* contains learning objectives and contents used by the CSLE. The *Methods Base* of a Learning Environment contains different didactical methods and concepts, supporting authors and educators. A *User Model* is designed in the development phase. This model contains attributes, characteristics, and knowledge of a user. In collaborative learning environments, additional information about the group and the group process is modeled (Kinshuk, Patel, 1997). The *Presentation Component* allows the generation and presentation of learning contents in different ways. The *Communication Component* determines the level of interactivity of a Learning Environment. It contains methods for communication, co-operation, and its technical realization. Communication between learner, teacher, and system is to be co-ordinated in different forms (Heeren, 1996). The *Evaluation Component* determines the performance of the learner, providing tests or ratings.

Development Models in Software Engineering

The main function of a software engineering model is to establish the phases in which major tasks are performed within a project, and to establish the transition criteria for proceeding from one task to the next. A software development process model supports the implementation of software projects together with the planing, scheduling, and controlling of time and budget constraints. According to (Balzert, 1998), a development model specifies the following issues: *Processes* (scope, activities, work breakdown structure, schedule, prioritization), *Organization* (competencies, responsibilities, roles, budget), *General Issues* (standards, guidelines, methods, techniques, tools, reporting). There are various software development models, following different strategies.
For many years the *Waterfall model* (Royce, 1970) was the most popular process model. It is a highly structured approach, breaking down the development process into multiple phases. Each phase creates a result which triggers the next phase after approval. If the result is rejected, the performed phase is repeated. Backtracking is limited to successive stages due to complexity reasons and to minimize expensive re-work. In general, the model is transparent and easy to understand, however, there are essential disadvantages. Requirement changes during the development are hard to handle because of the limited backtracking mechanism. Involvement of the users is only provided during the requirement specification in a very early phase. Especially for learning environments, the lack of motivational factors leads to acceptance problems. Due to the sequential approach, concurrent activities are not supported, hence extending the duration of a project.
Prototyping (Balzert, 1998) is a popular method to provide „user friendly" software. It is based on the development of executable models and patterns, defining software characteristics and requirements successively during the development process. These basic steps are repeated until all requirements are well defined. The

prototype itself is discarded and the real system is build, based on the prototype. In comparison to the Waterfall model, the development effort is higher due to the additional development of prototypes. The main advantage of Prototyping is early user involvement. Because of this important advantage, the Essen Learning Model incorporates prototypes into the development process.
The *Spiral model* (Boehm, 1986) combines positive aspects of the Waterfall model and the Prototyping approach. It can be used for rapid development of incremental versions. The definition of the software product and software process is elaborated in a series of repetitive steps. These steps are represented as a spiral progression through a project. Each cycle of the spiral elaborates product and process objectives and constraints, alternative product and process solutions, identifying and resolving major risks. The disadvantages are concerns about the high level of control and negotiation difficulties caused by the amount of control. High expertise in risk management is required. Advantages are the match of changing requirements in the whole development process, and the consideration of risks at all stages of the development. Especially for learning environments these characteristics are significant: therefore this approach was chosen for the Essen Learning Model.

Development Models for CSLE
There are various models specifically designed for the development of CSLE. Major approaches are: models based on *Didactical Frameworks,* e.g., on the „Berliner Modell" (Heimann, Schulz, Otto, 1965). They do not consider to use technical innovations. Therefore, they can be used for didactical planing but not be applied to new methods and technologies. *Specific CSLE* models for certain instances, e.g., CBT development (Steppi, 1997) or *Hypermedia Development Model* (Garzotto, Paolini, Schwabe, 1993). The weaknesses of these models are obvious because didactical decisions must be made before the selection of the CSLE. *Instructional Design* models (Issing, 1997) describe the structured development process of the educational systems, courses, and teaching products. They fulfill the requirements much better than the above described models, however, they support authors and teachers only insufficiently because the conceptual phase lacks flexibility.
As a conclusion, all the above mentioned models do not consider technological and didactical aspects sufficiently. Either they lack flexibility, or developers and users are highly restricted in their creativity. The Essen Learning Model is an approach which integrates and improves positive aspects of different development models.

The Essen Learning Model

The Essen Learning Model was developed at the University of Essen. It is currently being evaluated to be used in several departments of our university. I will describe the design principles and the general flow of the approach.

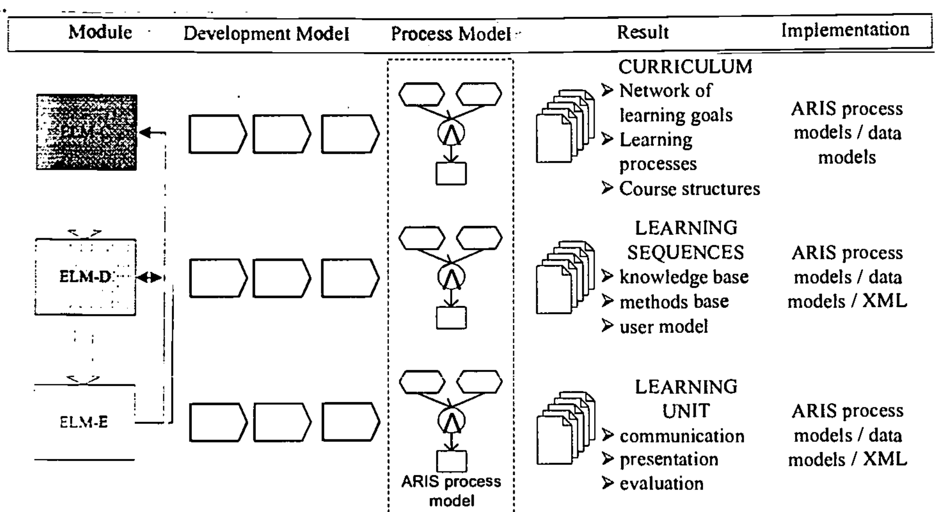


Fig. 3: The Essen Learning Model

The Essen Learning Model (Fig. 3) is a multi-level development model. The complex development process is divided into modules supporting both, the development process and the use of the system on different levels. The support of curriculum development and design (C-level), planning and implementation of learning sequences (D-level), and the design and implementation of learning units (E-level).

We distinguish three abstraction levels: The *development model* provides generic knowledge for a variety of contexts. This generic model is customized depending on the user's needs and preferences, and transformed into a *specific process model* for each project. The process model provides a framework for educational technology projects, specifying the timeline of the project, involved participants, and information technologies. It supports conceptual and implementation decisions. Furthermore, it can be used to integrate learning processes and business processes to close the traditional gap between education and every-day-work (Adelsberger, Körner, Pawlowski, 1998). The third level is the *result* of the development process, resulting in certain implementations on each level. The result of ELM-C is a detailed network of learning objectives and goals. The structure and relations of learning sequences (courses) are determined. Based on these results, learning sequences are developed in ELM-D. The focus of this phase is to find an adequate didactical method including the right technology depending on learning objectives and the user group. Single learning units are designed and implemented in ELM-E.

ELM follows the approach of the *spiral model*. By using this approach, changes concerning the needs, requirements, and wishes of the project participants can be integrated dynamically. Furthermore the user is involved in the development process, evaluating prototypes and contributing actively to the development. By using this approach we ensure the quality of the product from the beginning to the final implementation.

One of the most important goals is the interoperability with other systems. The architecture of the learning environment is consistent to the Learning Technology Systems Architecture of the Learning Technology Standards Committee of IEEE and to the specifications of the Instructional Management Systems Project (EDUCAUSE, 1999). Furthermore, we used standard tools and formats for both, the development and the implementation. The learning processes are modeled in ARIS, a process modeling tool (Scheer, 1998). Our approach is not limited to this tool, process definitions in IDEF (Adelsberger, Körner, 1995), UML (Booch, Jacobson, Rumbaugh, 1998), or object oriented modeling languages can be integrated easily. We have implemented a web based learning environment in XML. XML (Extensible Markup Language) is a text-based language, describing, exchanging, and presenting structured data objects (e.g., data, applications) (W3C, 1999). Using this approach, web based learning environments can be combined and integrated with other resources.

In the following I present the modules of ELM in detail and a successful implementation: a learning environment for students of Business Computing at the University of Essen. A learning sequence on "Simulation" was implemented and is being evaluated.

ELM-C – Curriculum Development

The ELM-C module starts with an analysis of the context. Educational and structural aspects are investigated in this phase. First of all, overall policies and strategies are investigated. This is necessary to determine the role of education for a specific company or institution. Then existing educational concepts and the corresponding business processes are analyzed. To acquire knowledge about the future users, the organizational structure is investigated, determining roles, stereotypes, and responsibilities of the users. As another important aspect, the structure of existing technologies has to be analyzed. This leads to conclusions about which resources can be utilized for learning processes. Furthermore, potential changes of the existing structure are identified.

After this first phase, the generic development model is customized, resulting in a specific process model for the development process. The actual project planning, including team building, scheduling, and guidelines are determined. Furthermore, the main processes for the design, implementation, and evaluation of the curriculum (Fig. 4) are included into the process model.

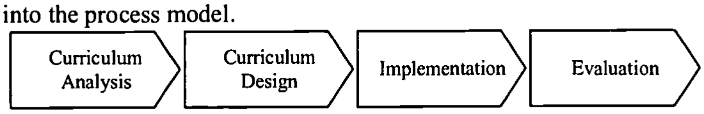


Fig. 4: Main processes of ELM-C

In the design phase, learning goals are determined. Documents gathered during the analysis phase, business processes, and external sources (such as reports on domain trends) are examined. Educators and domain experts are questioned, both formally and in creativity sessions. The results are mapped into a scheme, which is a matrix of the learning goal dimension (Bloom, 1956, Krathwohl et al., 1964, Simpson, 1966) and the abstraction level, represented in an ARIS data model. Furthermore, relations between the learning goals, such as prerequisites and conceptual similarities, are modeled. As mentioned before, a learning sequence on "Simulation" has been developed based on our approach. Fig. 5 shows a simplified excerpt of a network of learning goals. Based on the network of learning goals, a possible structure of learning sequences (courses) is determined, serving as a prototype for user evaluation and as input for ELM-D.

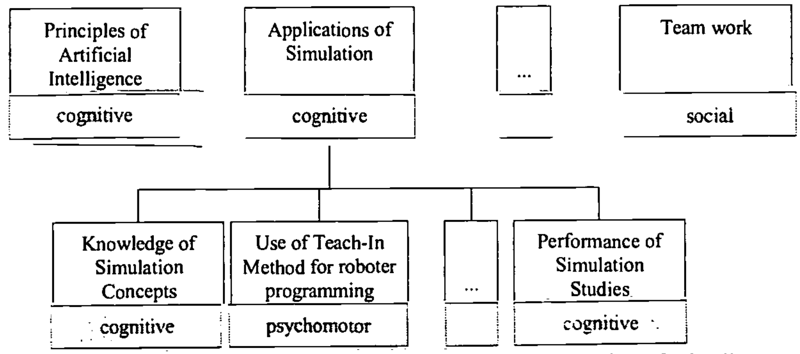


Fig. 5: Network of learning goals for a course on "Simulation"

ELM-D – Development of Learning Sequences

The focus of ELM-D is the development and implementation of learning sequences. Based on the specified learning goals from ELM-C, the most important concepts of a certain topic are specified in the phase "knowledge acquisition". Those concepts are modeled as a data model in ARIS (or the chosen modeling tool). Furthermore a user model describes the proposed group of users. It contains personal and job related data (role, competencies), learning preferences, characteristics, and a history of learning activities. This data is also modeled in ARIS and used for an individual adaptation of learning sequences.

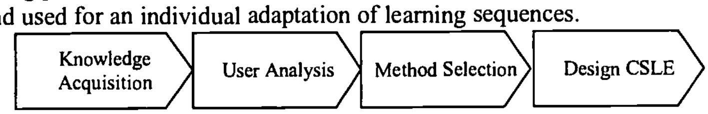


Fig. 6: Main processes of ELM-D

The crucial part of this phase is the selection of a didactical method, using educational technologies. This selection process is rule based, depending on learning goals, contents, and user characteristics. The selection generates alternatives, serving as a suggestion and support for the author. The ARIS process model furthermore supports the author in designing a specific learning sequence. Fig. 7 shows a sample model from the implemented learning sequence "Simulation". In this context, the method "Simulation Game" has been chosen based on the complexity of the cognitive learning goals, the experiences of the user group, and the goal "teamwork". Our methods base contains the "Goettingen catalog of didactical models" (Flechsig, 1991) and the didactical models from (Paulsen, 1995). Thereafter, the conceptual and implementation design of the specific CSLE is generated.

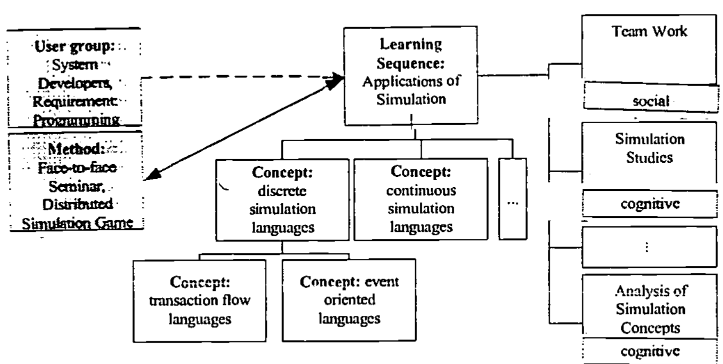


Fig. 7: Learning sequence on „Simulation"

ELM-E – Development of Learning Units

Finally, single learning units are designed and implemented in ELM-E. A pattern for the unit is generated, not limiting the user in the sense of Drill & Practice approaches, but serving as a guideline. Depending on the learning content, user group, and the selected method, structures for presentation and interaction/communication are suggested and implemented.

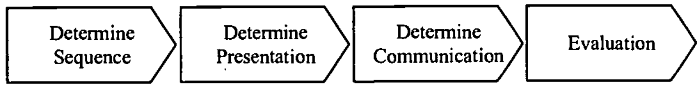


Fig. 8: Main processes of ELM-E

A process model of each unit is generated, serving as an orientation for the author and the users. Furthermore, this model can be integrated in other systems or, as suggested in (Adelsberger, Körner, Pawlowski, 1998) combined with business processes. The author is responsible for the consistency and final evaluation. Finally, the CSLE is implemented using standard authoring tools, or, in our university, in XML.

Conclusion

The multi-level approach of the Essen Learning Model leads to a variety of supporting features for both, developer and user. All phases of the development process are supported, using standard methods and formats (ARIS, LTSA, XML). This approach leads to several synergy effects: reusability, integration, and coupling with other resources. These effects are essential for future developments in the educational sector, helping project managers, designers, and authors of cooperative educational programs. The use of a development model will ensure the quality of educational technologies, helping companies and institutions becoming learning organizations and meeting the requirements of the future.

References

Adelsberger, H.H., Körner, F. (1995). Data Modeling with IDEF1X, In: Adelsberger, Lazansky, Marik (Eds.): Information Management in Computer Integrated Manufacturing, *Lecture Notes in Computer Science*, 973, Springer: Berlin.

Adelsberger, H.H., Körner, F., Pawlowski, J.M. (1998). A Conceptual Model for an Integrated Design of Computer Supported Learning Environments and Workflow Management Systems, *Proc. of Teleteaching '98: Distance Education, Training and Education*, XV. IFIP World Computer Congress, IFIP, Vienna.

Balzert, H. (1998). *Lehrbuch der Software-Technik: Software-Management, Software-Qualitätssicherung, Unternehmensmodellierung*. Spektrum, Akademischer Verlag: Heidelberg, Berlin.

Bloom, B.S. (1956). *Taxonomy of educational objectives, Handbook I: Cognitive Domain*. David Mc Kay: New York.

Booch, G., Jacobson, I., Rumbaugh, J. (1998). *The Unified Modeling Language Reference Manual*. Addison-Wesley: New York.

Boehm, B. (1986). A Spiral Model of Software Development and Enhancement, *ACM SIGSOFT*, 11.

EDUCAUSE (1999). *IMS Learning Resource Meta-data Best Practises and Implementation Guide. Version 1.0*, http://www.imspropject.org/metadata/mdbest01.html, Download 1999-10-12.

Euler, D. (1992). Didaktik des Computerunterstützten Lernens. In: Holz, Zimmer (Ed..): *Multimediales Lernen in der Berufsbildung*, 3, BW Verlag: Nürnberg.

Farance, F., Tonkel, J. (1999). *LTSA Specification - Learning Technology Systems Architecture, Version 4.0*. http://www.edutool.com/ltsa, Download 1999-08-01.

Flechsig, K.-H. (1991). *Kleines Handbuch didaktischer Modelle*. 3, Göttingen: Zentrum für didaktische Studien e. V.: Nörten-Hardenberg.

Garzotto, F.,Paolini, P., Schwabe, D. (1993). HDM: A model-based approach to hypertext application design, *ACM Transactions on Information Systems*, 11(1).

Heimann, P., Schulz, W., Otto, G. (1965). *Unterricht - Analyse und Planung*, Schroedel: Hannover.

Heeren, E. (1996). Technology Support for Collaborative Distance Learning. *CTIT Ph.D.-thesis series*: Enschede.

Issing, L. (1997). Instruktionsdesign für Multimedia. In: Issing, L., Klimsa, P. (Ed.): *Information und Lernen mit Multimedia*. 2, Beltz Psychologie-Verlags-Union: Weinheim, Basel.

Kinshuk, Patel, A. (1997). A Conceptual Framework for Internet based Intelligent Tutoring Systems, *Knowledge Transfer*, Vol. II, S. 117-124, London.

Krathwohl, D.R., Bloom, B.S., Masia, B.B. (1964). *Taxonomy of educational objectives. Handbook II: Affective Domain*. David Mc Kay: New York.

Paulsen, M. F. (1995). *The Online Report on Pedagogical Techniques for Computer-Mediated Communication*. http://www.hs.nki.no/~morten/cmcped.htm, Download 1999-10-10.

Royce, W.W. (1970): Managing the development of large software systems, *IEEE WESCON*, August 1970.

Scheer, A.-W. (1998). ARIS. In: Bernus, Mertins, Schmidt (Eds.): *Handbook on Architectures of Information Systems*. Springer: Heidelberg.

Simpson, J.S. (1966): *The classification of educational objectives, psychomotor domain*. Office of Education Project No. 5-85-104, University of Illinois, Urbana.

Steppi, H. (1997). *CBT- Computer Based Training: Planung, Design und Entwicklung interaktiver Lernprogramme*. Klett: Stuttgart.

W3C, Word Wide Web Consortium (1998). *Extensible Markup Language (XML) 1.0*. W3C Recommendation, 02-10-1998.

A Constructivist Framework for WWW-based Learning Environments that Combine Streaming Media and WWW functionalities

Oscar Peters and Betty Collis
Faculty of Educational Science and Technology, University of Twente,
P.O. Box 217, 7500 AE Enschede, The Netherlands
o.peters@edte.utwente.nl

Abstract: Technical developments in the compression and streaming of audio and video over networks commonly available to instructors is leading to a new cycle of interest in the educational applications of audio and video. In this new cycle, the traditional benefits of audio and video are given a wider audience through their access via WWW browsers, but also more forms of learning resources and activities are emerging. In this paper we first discuss some of the educational possibilities that come from the combination of asynchronous audio/video and WWW functionalites, particularly with respect to a constructivistic learning context. Secondly, we discuss a theoretical framework based on a constructivist learning approach for the use of asynchronous audio and video in WWW-based learning environments. Following this we illustrate how these sort of environments have been realised in the course *Tele-Learning* at the University of Twente.

WWW-Based Learning Environments and Streaming Audio and Video

WWW-based learning environments allow the integration of hyperlinked information systems, databases, interactive learning resources, communication tools, publication tools, and tools to support collaborative and individualised learning. Each of these types of activities can be supported in a variety of modalities, including text, images, animations, audio, and video. New technical developments in WWW-based technologies allow the use of video and audio *on demand* (as opposed to the two-way video and audio communication streams that occur in conferencing situations). These developments mean that *asynchronous digital video and audio* sequences, even of considerable size, can now be integrated into WWW-based learning environments, and used, in whatever segments that are wished and whenever desired, for appropriate learning goals (Collis & Peters, 1999). The technical advances that allow video and audio to be integrated within WWW environments and to be available on demand to learners are of educational consequence if they lead to learning experiences that are perceived as valuable and appropriate for particular learners, subject areas, and learning conditions.

In particular, with the integration of asynchronous audio and video in an WWW-based learning environment different types of constructivist learning activities can take place. Simons (1998) describes constructivistic learning environments as environments where students are being challenged to learn actively together, with a clear focus on the functionality of learning and the learning content. Within such environments the learning is situated in a concrete context where the authenticity of that context is as high as possible. For example, a didactical model based on principles of situational cognition (Brown & Duguid, 1994) could be realised through the capacity of video and audio learning resources to connect a learning task with a realistic context. A didactic approach based on anchored instruction (Ward, 1998) could offer information-rich simulations and case studies with which the learner could interact. A didactic model reflecting principles of cognitive apprenticeship (Collins, Brown, & Newman, 1989) could be facilitated by presenting groups of learners a variety of information-rich resources that show an expert in action in related problem areas. A didactic approach representing *crisscrossing landscapes* (Simons, 1998) could be enriched by making available a large variety of audio and visual views of a problem domain. A didactic approach reflecting reciprocal teaching (Scardamalia & Bereiter, 1989) could be supported by students creating their own audio and video resources and making them available as learning materials for their peers.

In each of these approaches, students are expected to steer and control their learning as independently as possible. The teacher is more a coach and guide than a transmitter of information.

Audiovisual and simulated realities offer the student the possibility to come closer to the concrete reality and thus to learn in a practical and experiences-centered perspective. We believe that these learning approaches can be attractively supported in WWW environments that combine the strengths of streaming video with the capabilities of the WWW to support communication, offer links to associated resources, and allow re-use of video segments in other learning contexts. In Table 1 we indicate five forms of learning activities which can reflect constructivist approaches and the possibilities that come from the combination of asynchronous audio and video with WWW functionalities in those learning contexts. Following Table 1, each of these forms will be further discussed and their relationship to constructivist learning illustrated.

	Video aspects	**WWW aspects:**		
Learning activities		Support communication	Link to other information	Re-use in other contexts
1. Capturing & re-using a communication event (such as a lecture or student presentation or discussion)	Can be locally captured during a presentation	Add forms to send questions to the presentor; collect frequently asked questions	Add links to course material, to external resources (students/users can also add the links)	Portions of the material can be ULMs (see below) for use in other settings
2. Giving access and depth to real events	Specialised capture of original material	Add forms to send questions and e-mail to experts; participate in discussion groups	Add links to external and up-to-date information (students/ users can also add links)	Re-use in courses, for professional development, for personal learning
3. Supporting a learning process	Small tutorial sequences, documentary type sequences, interviews with specialists, etc., can be available	Add forms for contacts with others involved in the process, with experts, with resources persons; Add tools to support collaborative learning if process involves a group	Add links to examples, to support materials; Products resulting from the process can be also entered as objects of study in the database	Re-use products made previously as examples or models for those starting out on a process
4. Developing and accessing a library of cases or units of learning material (ULMs)	Cases or ULMs including video segments can be captured in a variety of ways, such as action with commentary (Goodyear & Steeples, 1999)	Add forms for e-mail contacts	Store in a database; provide links on the ULMs to relevant supporting materials and/or to other items in the database	Re-use in courses, for self-study, for professional development, for personal learning
5. Constructing and sharing one's own resources (ULMs)	Video capture and handling is now available to the layman	Add forms for e-mail contacts	Link products made to a WWW site, so that accessible and useful to others	If added to a database, re-use by others

Table 1: New forms of learning activities, related to video aspects and WWW functionalities (Collis & Peters, 1999)

Capturing & re-using a presentation

There are many examples now of how a classroom or lecture-hall presentation can be captured as it is delivered (usually digitally), stored as digital video on a video server, and then made available for re-view or re-use via a WWW site. The intended users include: students and non-students who could not be present at the actual presentation and students who were present but wish to review portions of the presentation. The presentation may be made available in linear form (with a controller to slide forward or backward within the video sequence), but most usually is also synchronised with slides or presented along with an index relating to different portions in the video sequence, so that the user can jump immediately to the portion desired. While the captured sequences can be planned and executed by the instructor, they can also be captured in less-formal communication settings, such as when students discuss different points of view relating to an issue or articulate their ideas and reactions to a complex learning situation. Students can easily do such capturing themselves with a digital video camera. These reflections can then be revisited, commented upon, and extended in asynchronous print communications and added to course resources available via a course WWW site for reuse, such as in Categories 4 and 5 in Table 1 (see examples to follow).

Giving access and depth to real events

There are many examples of WWW sites which focus on particular real events, as they are happening or extended in time before or after they happen, in which video segments play a major role. One example is the is the site of *America's Health Network* (http://ahn.com/liveevents/default.asp), aimed primarily at health professionals or medical students, but also for the layman with a particular medical interest. At regularly scheduled intervals, via real-time video streaming, users can watch an operation as it is occurring and hear the comments being made by the medical team as they carry out the operation. Following this, the operation segments in edited form are available as asynchronous streaming video segments via the WWW site, as well as other video segments including interviews with the patients and their doctors, discussions among medical specialists, and interviews. Any event can be captured as a digital video stream, and then used as basis for students to add elaborative materials and reflective comments via a WWW page. Such a page can start as a template that students then fill with appropriate extension resources, or students can construct such a page themselves with an html editor.

Supporting a learning process

When the focus of a learning activity is a process, rather than the learning of pre-defined content, WWW sites integrated with video segments can play a major role in learning support. An example is the site *Biological Timing Online Science Experiment* (http://www.cbt.virginia.edu/Olh/exp.html) from the University of Virginia. This site is designed to help students in the process of carrying out scientific experiments by showing them, when they have need of the information, (via video fragments) many examples of aspects of an experiment, including aspects relating to the reasons for carrying out the process and aspects relating to the setting up and conducting of experiments.

Developing and accessing a library of cases or units of learning material (ULMs)

The site *Learn & Live* (http://www.glef.org/learnlive/toolkit/clearview.html) is an example of how a collection of video segments, with voice overlay, can serve as cases, or units of learning materials, related to a particular theme or context. In the *Learn & Live* context, the target group is teachers and the focus is on how 4th- and 5th-grade students conduct a research project when they have the opportunity to work collaboratively with university scientists. In each of the cases linked to the site, a video segment showing the children carrying out various learning activities is available, with voice-over comments by either the teacher or the scientists. The intention of the site is that others (teachers, teachers-in-training, scientists, and those who design such special collaborative projects) can see what actually occurs in the classroom during such an interaction.

Constructing and sharing one's own video & WWW resources

From a constructivist perspective in which learning by doing is emphasised, the possibilities for learners to create their own video segments as well as the surrounding WWW environments through which those segments are available, can be an example of a new type of collaborative learning activity. Such creation can relate to any and all of the other four categories of learning activities in Table 1. In the next section, an illustration is given of how all five of these types of learning activities have been realised in the course *Tele-Learning* at the University of Twente.

Illustration: The course *Tele-Learning* at the University of Twente

The course Tele-Learning in the Faculty of Educational Science and Technology (see http://education2.edte.utwente.nl/98193524.nsf/framesform?readform) at the University of Twente in The Netherlands is a senior-level elective course focusing on the educational use of network applications. A major way in which the learning takes place in this course is through the students working together in groups on a project for a real context and audience and in response to a real need of that audience. In the 1999 cycle of the course, the audience was instructors in our own faculty and the context was to help them become aware of opportunities in their own classes (all of which make use of a WWW-based course-support system, called TeleTOP, http://teletop.edte.utwente.nl) in which video integrated with their WWW sites could bring added value to their courses. Each of four groups of students in the class had to develop a different WWW-based performance-support site for the instructors, in which a form of streaming video use integrated within an educational WWW site was illustrated and described and defended from an educational perspective. The forms chosen by the groups included video as part of WWW-based tutorials for various learning processes and video used for action with commentary to help students work together to handle a particular problem situation. Thus the students themselves participated in a learning experience as indicated in the fifth row of Table 1 (constructing their own uses of video), but with a focus on showing examples of the third and fourth rows in the table (video to supporting a process, and video to illustrate examples from practice). In addition, during the final meeting of course, each group of students presented their WWW sites and reflected upon their own impressions of the educational value of video integrated in WWW environments and were captured on digital video during the presentation. These captured presentations (Category 1 in Table 1) will add to the meaningfulness of the performance-support sites for the instructors who subsequently use the sites. The students captured their own video sequences rather than using professionally prepared video, using only a handheld digital video camera and simple video-editing software. They learned the html necessary to insert a streaming video segment into a WWW page and were responsible for the design and construction of the overall WWW-based performance-support environment.

A video-illustrated case as part of WWW-based tutorials

An example of one of the performance-support sites made by the groups of students in the *Tele-Learning course* for instructors in their faculty is shown in Figure 1. This group of students chose to develop a video-illustrated case study as part of WWW-based tutorial. They developed a WWW-based tutorial with video that combines the benefits of video, self-study activities, and the WWW. The tutorial mode of instruction guides the learner throughout the material, the video adds visualisation, and the WWW environment allows more flexibility in time, place, sequence, and pace of learning as well as adding communication support relating to the content of the video. The site has the following generic structure that all the four groups in the class used: (a) a hyperlinked set of pages containing the instructional example itself - in this case, the example of a WWW-based tutorial integrated with streaming video; (b) educational issues - an essay on learning-related issues surrounding the use of this sort of WWW environment for situated learning, anchored instruction, and other forms of constructivist-oriented learning as well as instructivist learning; (c) design issues – a discussion of guidelines for designing a WWW site that uses video in a WWW-based tutorial; (e) technical procedures - steps to be taken when making video for the WWW; (f) external examples - links to other, external, examples of WWW-based tutorials with video; and (g) group members – information about the students that worked on the project. The topic used for illustration purposes of the performance-support site shown in Figure 1 was 'Shooting a good video!' The students designed an environment that contained resources for learners to explore the characteristics of video, as well as, how to take these characteristics into account when creating good educational videos for the WWW. The study materials include an option, called ''Common problems'' where instructors can find out what students usually don't like about educational videos. A second option is a case study where instructors are prompted to think about how to shoot a good video for the WWW, followed by a presentation where the instructors have the chance to study the lesson materials and a quiz to test themselves. Other options available are links to resources for further learning and a forum where instructors can share their ideas about making video for the web.

Action with commentary

An another example of a performance-support site made by the groups of students in the Tele-Learning course for instructors in their faculty is shown in Figure 2. This group of students developed a WWW environment with asynchronous video to show how such an environment can assist students learning to handle a complex learning task. In this case, the illustration chosen of such a task was the experiences of a foreign student coming to study at the University of Twente. The environment includes the audio of a moderator, who gives comments about the most important things that foreign students have to know about the campus in order to handle problems that arise when the student first has to negotiate using the library, the computing center, the system for using swipe cards to get in and out of buildings, etc.

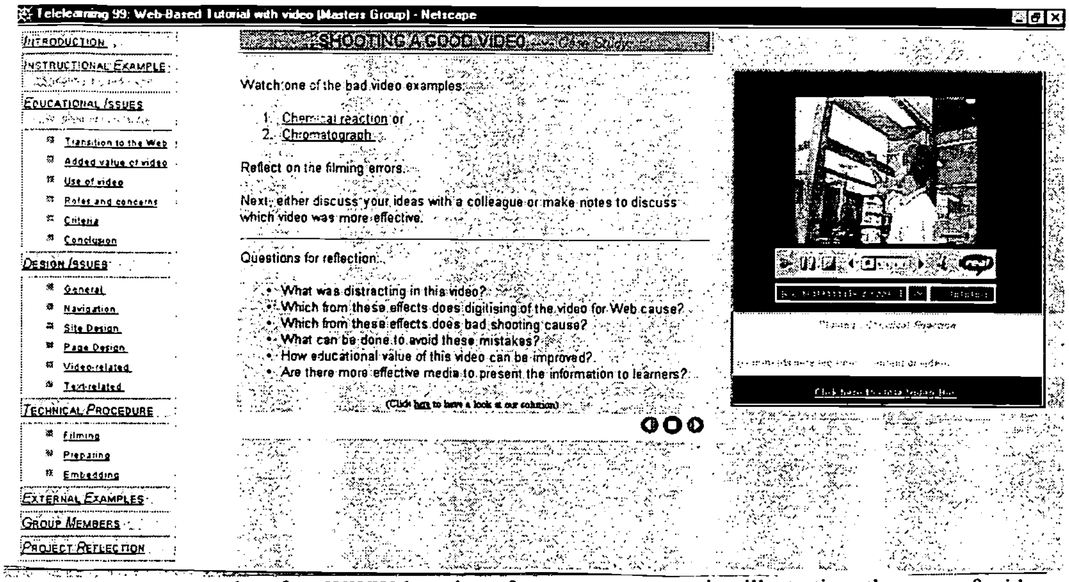


Figure 1: An example of a WWW-based performance-support site illustrating the use of video integrated with self-study resources, made by a group of students in the *Tele-Learning* course

The purpose of the embedded video segments in the site is to help students learn about various complex situations by having a voice-over commentary guide the student through visualizations of those situations. Links are available for additional information, campus maps, contact names and email addresses, and other resources to help the student in the problem situations. As four of the five members of the group were in fact foreign students for whom the *Tele-Learning* course was their first course at the University of Twente, they had a personal context for the problem situation. The video in this case captured the information that had to be communicated to the learner in a practical and illustrative way. In their reflections, the students indicated that they believed that this type of learning resource involves a number of educational benefits for the learner. The first scene of the video generates interest and motivation. The video supports a situated-learning environment that includes several complex themes: the arrival, procedures for using food and drink automates, the computer lab, the cafeteria, and some general information about the faculty. The video and WWW site combined facilitates the possibility of exploratory learning. The use of knowledge is increased by the different contexts. The students also felt that the process of making the site themselves was a valuable learning experience for them as well as being of potential value for others.

In addition to designing and producing their own WWW-sites integrated with video as examples for instructors, the students in the *Tele-Learning* course also made use of video in many other ways within the course. Video integrated within educational WWW sites was the content of the course as well as a medium for the content of the course; thus the students used the course WWW environment as a framework in which to place their links to examples of external WWW sites making good educational use of video (in all of the categories in Table 1); their evaluative and reflective comments about the use of video in WWW sites for learning purposes; and for the study of captured presentations of the students in the previous cycle of the course. These presentations captured the students during the final class session of the 1998 cycle, and made these comments available to the 1999 students as asynchronous video synchronised with presentation slides made by the students related to different aspects of the course. The students in the 1999 cycle of the course could thus see and hear their peers in the 1998 cycle comment on their own work (the work was also available to the students in the 1999 cycle as learning resources, another example of re-use of video segments). During the last session of the 1999 cycle, this same process of capturing on video the presentations and reflections of the students and making these immediately available for re-view and re-use was continued.

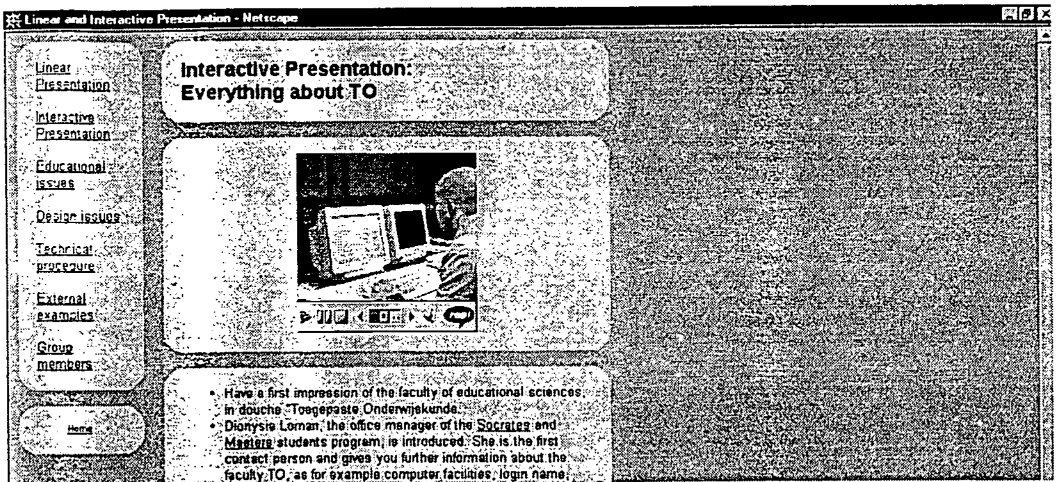


Figure 2: An example of video in the form of action with commentary site made by a group of students in the *Tele-Learning* course

Conclusion

Many of the new technological developments in education involve convergences: of the learner as both consumer and producer of his or her own learning resources; of linear and interactive media in a single WWW environment; of communication, collaboration, and learning within contexts that integrate theory and realistic applications. These trends can be seen in the uses of asynchronous video within WWW environments that are now emerging, particularly when the video is developed or captured by the learners themselves as a study resource and used, on demand in an interactive manner by other learners. These sorts of learner-captured video resources are now becoming easily available with advances in desktop video technologies and the WWW; what is only just emerging is an assessment of their educational potential. The promising technical developments are creating a strong technology push, which needs to be confronted by an even stronger educational rationale.

References

Brown, J.S., & Duguid, P. (1994). Practice at the periphery: A reply to Steven Tripp. *Educational Technology, 34*(8), 9-11.

Collins, A., Brown, J.S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the craft of reading, writing, and mathematics. In: L. B. Resnick (Ed.), *Knowing learning, and instruction: Essays in honor of Robert Glaser* (pp. 453-494). Hillsdale NJ: Lawrence Erlbaum.

Collis, B., & Peters, O. (1999). At the frontier: Asynchronous video and the WWW for new forms of learning. In G. Weidenfeld & D. Keegan (Eds.), *Distance learning at the dawn of the third milliennium* (269 - 288). Futuroscope Cedex: CNED. ISBN 2-7463-9000-0

Goodyear, P., & Steeples, C. (1999). Creating sharable representations of practice. *Alt-J* (Advanced Learning Technologies Journal), *6,* (3), 16-23.

Scardamalia, M., & Bereiter, C. (1989). Conceptions of teaching and approaches to core problems. In: Reynolds, M.C. (Ed.), *Knowledge base for the beginning teacher.* Oxford: Pergamon Press.

Simons, P.R.J. (1998). De rol van ICT in het onderwijs: een constructivistische visie [The rol of ICT in education: a constructivist perspective]. *COS, 10,* (6), 4-10.

Ward, R. (1998). Active, collaborative and case-based learning with computer-based case scenarios. *Computers in Education (30)*, 103-110.

An XML-based Approach for Web-based Self Assessment

Nathalie Poerwantoro, Bernd Krämer
FernUniversität Hagen
LG. Datenverarbeitungstechnik
Philipp-Reis-Gebäude
Feithstrasse 140
D-58084 Hagen-Germany
(Nathalie.Poerwantoro@fernuni-hagen.de, Bernd.Kraemer@fernuni-hagen.de)

Abstract: In this paper we describe an effective way to create a web-based self assessment tool. Our approach uses an exercise applet that reads and extracts questions from their descriptions in XML format and presents them to the students depending on students' preferences. A simple authoring tool is used for adding questions and corresponding hints to the exercise environment. Questions can be accompanied by additional media such as video, picture, sound or animation applets.

Introduction

In the past, distance education has always suffered from a lack of opportunities for hands-on experimentation and access to physical objects, models, simulations and instruments in computer and engineering labs. Today, computers in education and networked learning environments offer new ways of discovery learning through some unique forms of interaction with virtual objects, online laboratories at home, learner-directed animation of realistic processes, and light-weight software tools. In networked learning environments interactivity allows students to manipulate input data, parameters and thresholds of real-time simulations or animations. Learners may also influence the progress and output of process or algorithm visualizations. The project group at FernUniversitaet Hagen is exploiting some of these possibilities with the development of a series of exercise environments (Mogey 1997) that let students apply and experience what they have learned to predefined problems or problems of their choice. Thereby we expect to raise the attractiveness of the learning material and enhance the students' motivation, especially that of distance learners. In the design of these environments we have attempted to associate learning objectives with appropriate multimedia solutions (Williams 1997) with respect to different teaching functions such as motivation, presentation of new structures, practicing new behavior, modeling, exploration by trial use and error, or application of new techniques. To achieve a high degree of platform independence, ease of use and portability and to remain independent from proprietary formats, it was decided to rely on HTML, XML (Harold 1998, Idris 1999) and Java (Horstmann 1998, Sun 1998) as core technologies for implementation of the exercise labs.

Since the introduction of Java programming language we can see the use of applets in traditional hypertext systems as well as in an Intelligent Tutoring Systems. Java applets are employed very often to explain complex processes to deepen the understanding of difficult parts of educational documents. However, the use of Java applets does not have to be restricted to simulations or visualizations of specific problems. Many examples show that applets can be used for exercises and tests and therefore offer more flexibility than common media. Another advantage of applets is the possibility to accept parameters so that they can be tailored to different learner types. It should be possible to find common learning oriented descriptions for different users of the exercise applet and to make the exercise applet itself adaptable to specific needs. That way only one version of the applet would be necessary for many different kinds of users.

A Generic Exercise Environment

After having developed several exercise environments by hand, we realized that we need many more exercises for the students to make the self assessment effective. Developing an exercise applet for each specific topic was not very effective if we want to generate a lot of questions for different topics. Another possibility is to create HTML based questions with applets as companion, which are often found in web-based exercises. The downside of these HTML questions is that they are static, which means each time the exercise is restarted the students will receive the same set of questions. What we were looking for is the ability to create a dynamic exercise environment, that can pick a random set of questions from a question pool, adapt to the student's preferences and that is easy to use for the tutors creating the questions. This approach would also separate the questions from the applets and use the applets in conjunction with the questions in an exercise environment. The applets should show an animation or a simulation of a certain topic, and the question can be asked in relation not only to an applet but can also relate to other media such as video, picture, sound. We chose to develop an XML based exercise environment since XML is ideal to describe the question structure, the exercise structure and the structure of a student's profile. The idea was to describe each question in XML and let those questions be parsed by the exercise environment applet and be presented in an appropriate format depending on the question type and companion media during the exercise. That way a large amount of question pool can be generated more easily. The configuration of an exercise, such as how many sections or how many questions, what kind of question, etc. is also described in XML and parsed into an exercise specification object used by the exercise environment applet at the beginning of an exercise. The exercise environment covers both formative and summative assessment types (Bull 1996, Williams 1997). This approach provides flexibility to authors, since any applets that the authors find useful for the exercise can be added any time to the applets pool as a companion to the questions. The same rules apply to pictures and video clips. With this flexibility comes a big task of putting a lot of questions into the exercise environment. To give a picture of it let's take an example of an exercise for one topic with one difficulty level, five question types (true/false, multiple choice, text gap, set ordering, matching) with five questions for each type. That will result in at least 25 question files and 50 picture files and not to forget the hints and explanations for errors and companion applets. In order for the exercise environment to select a different set of questions each time the students restart the exercise, more than 25 questions have to be provided to enable a random pick out of the question pool. As soon as enough questions are available, the exercise environment can give the students an adaptive and interesting platform to do self assessment. Currently for evaluation purposes we have created about 150 question files, 150 pictures, a VRML scene, some companion applets and JavaScript animations for 6 topics, which in turn consists of several subtopics.

The exercise environment consists of 3 modules or applications:

a) Question generator

   A Java application with forms to create a question. Five of the most common question types in Computer Based Training (CBT) can be generated such as: true/false, multiple choice, fill text, matching and set ordering. An XML Document Type Definition (DTD) was defined to describe the structure of questions. Important parts in a question description include:

   - Domain: defines to which domain or topic the question belongs.
   - Create: defines the date of creation.
   - Level: defines the difficulty level of the question. 5 levels are currently supported.
   - Language: defines the language for the question.
   - Subtopic: defines the subtopic or subchapter of a question.
   - Question type: defines the question type which has to bc one of the 5 described above.
   - Question: defines the elements that describe a question such as
     - Problem statement: defines the question asked.
     - Answer options: defines the answer options in question types multiple choice, matching.
     - Keys: defines the answers to the question.
     - Hints: defines the hints, each hint is related to an answer option and the hints consist of 3 levels, starting from a general hint to a detailed hint. The exercise environment will show the hints depending on the selected difficulty level. All 3 levels of hints will be shown for exercises in the first 2 lower difficulty levels, 2 levels of hints will be shown to those in the medium difficulty level and 1 hint will be shown to those in the last 2 higher difficulty levels. Hints are only available in formative mode of the exercise. If the student chooses to do the exercises in exam mode (summative), no hints will be shown.

   - Reason: defines the 'why' explanation of the answer
   - Show media: defines the media related to the question. The media can be a picture, a video clip, audio , applet.
- Picture list: defines a list of picture needed for the question type matching and set ordering.

Example of a question description:

```
<?xml version="1.0"?>
<!DOCTYPE QUESTIONSPEC SYSTEM  "questionspec.dtd" >
<QUESTIONSPEC>
   <ID>MQnetwork_medium0</ID>
   <TITLE>test question chapter 14.2</TITLE>
   <CREATE>25/07/99</CREATE>
   <DOMAIN>network</DOMAIN>
   <LEVEL>medium</LEVEL>
   <LANGUAGE>de</LANGUAGE>
   <SUBTOPIC>networks</SUBTOPIC>
   <QUESTIONTYPE>MQ</QUESTIONTYPE>
   <QUESTION>
      <PROBLEMSTATEMENT>Match the correct FFDI-components to the pictures. Click on the pictures
      to view a larger version of them.</PROBLEMSTATEMENT>
      <ANSWEROPTIONS>PHY</ANSWEROPTIONS>
      <ANSWEROPTIONS>SMAP</ANSWEROPTIONS>
      <ANSWEROPTIONS>SMT</ANSWEROPTIONS>
      <ANSWEROPTIONS>MAC</ANSWEROPTIONS>
      <ANSWEROPTIONS>PMD</ANSWEROPTIONS>
      <KEYS>2</KEYS>
      <KEYS>3</KEYS>
      <KEYS>0</KEYS>
      <KEYS>4</KEYS>
      <KEYS>1</KEYS>
      <HINTS KEYNUMBER="1" HLEVEL="1">
         <HINTTYPE>text</HINTTYPE>
         <HINTTEXT>Physical Layer Protocol</HINTTEXT>
         <HINTMEDIA>none</HINTMEDIA>
      </HINTS>
      ....
      <REASON>The tasks of the Station Management (SMT) are control, monitoring and administration of
            the connected stations and the network. </REASON>
      <SHOWMEDIA MEDIATYPE="none">none</SHOWMEDIA>
      <PICTLIST>
         <PICTFILE>test/pictures/fddi1.gif</PICTFILE>
         <PICTFILE>test/pictures/fddi2.gif</PICTFILE>
         <PICTFILE>test/pictures/fddi3.gif</PICTFILE>
         <PICTFILE>test/pictures/fddi4.gif</PICTFILE>
         <PICTFILE>test/pictures/fddi5.gif</PICTFILE>
      </PICTLIST>
   </QUESTION>
</QUESTIONSPEC>
```

b) Exercise generator

A Java application for creating the overall exercise specification. The exercise is described using the following fields:

- Domain: defines the topic of exercise.
- Level: defines the difficulty level of the exercise.

- Number of sections: defines the number of sections in the exercise, 5 is the maximum since there are only 5 question types available.
- Section Description: specifies each section by defining:
  - Section type: defines the question type of this section.
  - Number of question: defines the number of questions in this section.
  - Total question: defines the number of available questions in the question pool. If the number of questions needed in an exercise section is smaller than the available questions in the question pool, the exercise tool will select the questions randomly from the question pool. The exercise is less predictable and becomes more challenging since the students do not get the same questions each time they start the exercise.
- Description of test mode:
  - Maximum error in relation to minimum solved questions. These 2 numbers are needed to define the maximum error rate allowed to pass the exercise in exam mode.
  - Time limit can be defined for exam mode.

c) Exercise environment applet

A Java applet which is the environment (Fig. 1) that the students will work with. A student profile is loaded by the applet at the beginning of the exercise. The student's profile gives the information of selected exercise topic, subtopics, language and difficulty level. The applet then loads the selected exercise scenario and parses it using the IBM XML parser. Using the extracted information about the exercise, the applet prepares the exercise and loads the defined questions one after another. The exercise environment creates a random number for each question category in order to provide variation each time the exercise is restarted. In order to create a correct random number, the exercise environment checks the number of available questions on the server. If the number of available questions is less than requested in the exercise specification, then the exercise environment adjusts the question number for this exercise by reducing it to the number of available questions. Thus preventing the error of creating a random number of a non-existent question. The XML file describing the exercise will not be modified, since more questions can be added to the question pool in the future, so next time the exercise is started , there could be more questions available than requested in the specification. After all random numbers for each question category have been calculated, each question is loaded, parsed and shown when the student arrives at the specific question. There are two methods to navigate in the exercise: sequential navigation using the forward and backward buttons and free navigation by using the navigation tree. The navigation tree gives more freedom to jump from one question to any other question in the exercise. If a certain media is related to a question such as an applet showing an animation or a simulation, a video clip, an audio file or a picture, then it is shown together with the question. Questions can either be answered or skipped. Skipped questions are counted as unanswered errors. Hints are also provided and can be called during the exercise. Each possible answer option has 3 levels of hints starting from a general one to a more detailed one. The number of hints that can be shown to the student depends on the difficulty level of the exercise. No hints are available in exam mode. In exam mode a time limit can be activated which limits the time given to the student to finish the exercise. When the time is up the exercise will automatically end and no further answers will be accepted. Students can submit the exercise any time and get the result of the exercise. The result of the exercise has an HTML format and is shown in a separate window. Student's answers are listed together with the correct answer. If the question author provides the question with reason, in case of error, this reason text will be shown. A summary is provided at the end the result report showing error rate and achieved points. Each question number on the result window is linked to the exercise environment applet through an interface. That way students can reload the corresponding question by clicking on the question number in the result window, instructing the exercise environment applet to reload and parse that particular question. A log file is created at the end of the exercise and the student's profile is also updated. This profile shows how many exercises a student has done and how well.

Example of a student's profile:

```
<?xml version="1.0"?>
<!DOCTYPE STUDENTPROFILE SYSTEM "studentprofile.dtd">
```

```
<STUDENTPROFILE>
    <ID>jw12345</ID>
    <FIRSTNAME>John</FIRSTNAME>
    <NAME>Washington</NAME>
    <PROFESSION>teacher</PROFESSION>
    <AGE>35</AGE>
    <LOGIN/>
    <PASSWORD/>
    <MEDIAPREFERENCE>image</MEDIAPREFERENCE>
    <STEREOTYPE>hierarchical</STEREOTYPE>
    <LEARNINGGOAL>consult</LEARNINGGOAL>
    <KNOWLEDGELEVEL>low</KNOWLEDGELEVEL>
    <LANGUAGE>de</LANGUAGE>
    <DOMAIN>
        <TITLE>communication</TITLE>
        <SUBTOPIC>layer3</SUBTOPIC>
        <SUBTOPIC>QOS</SUBTOPIC>
    </DOMAIN>
    <EXERCISEACTIVITY>
        <HOWMANYEX>2</HOWMANYEX>
        <EXRATE>0.8</EXRATE>
        <EXRATE>1.0</EXRATE>
        <EXPOINT>0.2</EXPOINT>
        <EXPOINT>0.0</EXPOINT>
    </EXERCISEACTIVITY>
    <TESTACTIVITY>
        <HOWMANYTEST>1</HOWMANYTEST>
         <TESTRATE>0.4</TESTRATE>
        <TESTPOINT>0.6</TESTPOINT>
    </TESTACTIVITY>
</STUDENTPROFILE>
```

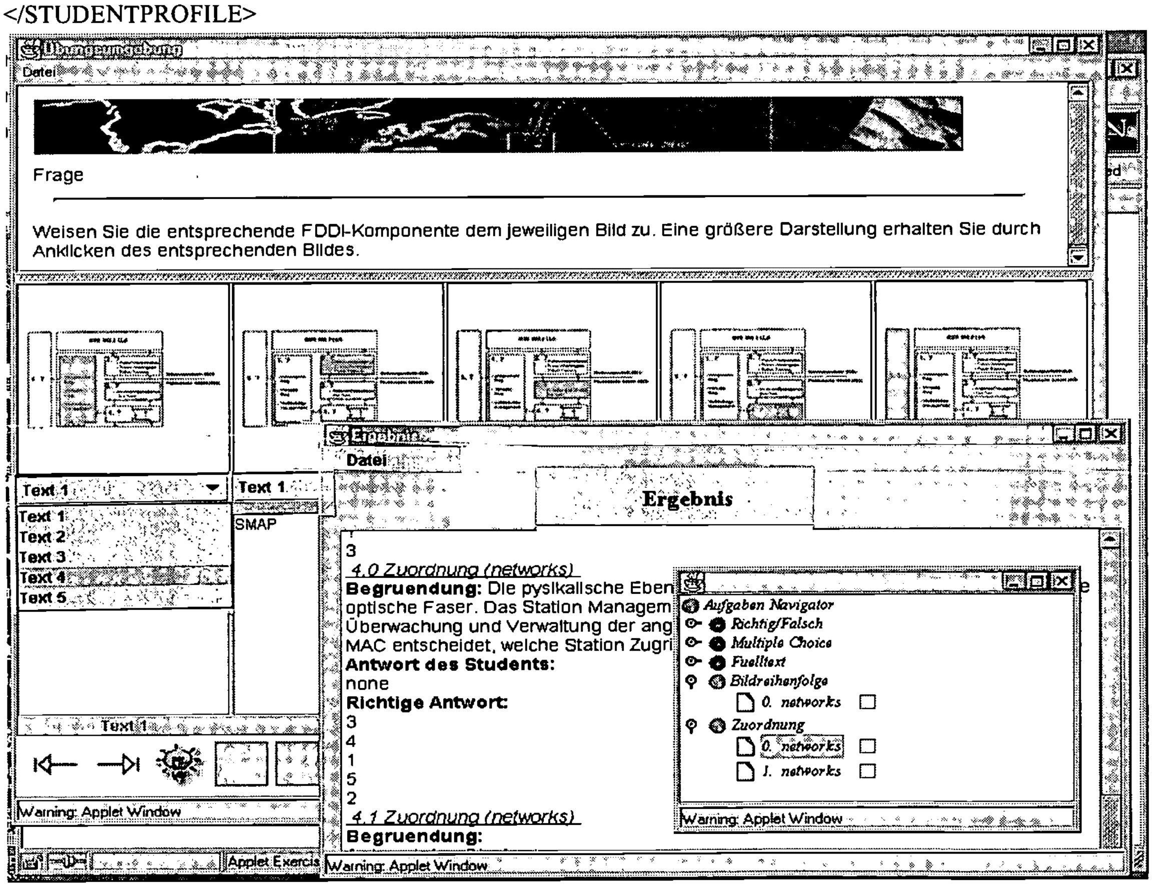



Figure 1: a screenshot of the exercise environment applet

Conclusion and outlook

In this paper we described an XML based exercise environment applet, a simple question generator tool and an exercise specification generator tool to create interactive web based exercises for self assessment. Our approach extends the usual static HTML-based exercises and provides more variation and a higher number of questions in an easy and efficient way. At the moment the exercise environment is being integrated into a CD-ROM based multimedia technology lessons. This material will be distributed to buyers of the book and students of the course *Multimedia-Technologie* (Steinmetz 1998) and will be evaluated for usability and learning effectiveness.

References:

Cay S. Horstmann, Gary Cornell (1998). *Core Java 1.1 Part I* , Sun Microsystems Press, Mountain View, Calif.

Cay S. Horstmann, Gary Cornell (1998). *Core Java 1.1 Part II*, Sun Microsystems Press, Mountain View, Calif.

Elliotte Rusty Harold (1998). *XML Extensible Markup Language*, IDG Books Worldwide, Foster City, CA.

Gary Williams, Liz Smith, Tom Lawson, Bill Lord, Deri Hadler, Roger Murphy, John Merkel (1997). *Choosing the type of assessment*, Center for Enhancing Learning and Teaching (CELT).

Gary Williams, Liz Smith, Tom Lawson, Bill Lord, Deri Hadler, Roger Murphy, John Merkel (1997). *A guide to the educational use of multimedia*, Center for Enhancing Learning and Teaching (CELT).

Joanna Bull (1996). *Computer based assessment: some issues for considera*tion, CTISS Publications.

Nazmul Idris, Sun Koh (1999). XML and Java Tutorial, The Bean Factory, LLC.

Nora Mogey, Helen Watt (1997*). The use of computers in the assessment of student learning*, Learning Technology Dissemination Initiative.

Ralf Steinmetz (1998). *Multimedia-Technologie*, Springer-Verlag, Berlin, Heidelberg, second edition.

Sun Microsystems Inc. (1998). *Java Media Framework Programmer's Guide.*

A Learning Experiment Using A&O Open Learning Environment

Seppo Pohjolainen, Katja Pesonen, Vesa-Matti Hartikainen, Heli Ruokamo, Ossi Nykänen
Tampere University of Technology, Digital Media Institute
Department of Mathematics, Hypermedia Laboratory
P.O. Box 692, FIN-33101 TAMPERE, FINLAND
seppo.pohjolainen@cc.tut.fi, katja.pesonen@cc.tut.fi, vmh@cc.tut.fi, heli.ruokamo@cc.tut.fi, ossi.nykanen@cc.tut.fi

Abstract: This paper describes some design principles, main actors and functions of an open learning environment called A&O. A&O is an open learning environment which can be used via computer networks, especially over the Internet. It supports both self-paced and collaborative learning. A&O is open to various learners and different contents and it offers an opportunity to study independently of time and place. The main goal of the A&O environment is to be both pedagogically appropriate and technically functional. It is designed on the basis of modern learning theories that emphasise the construction of new knowledge on the basis of previous knowledge, the learners' active role and collaborative learning. In addition to these, learner's intentions, meaningful contexts, transfer and reflection play an essential role. The system architecture of A&O consists of data management facilities including data acquisition tools, tools for communication and collaboration, course-dependent cognitive tools and authoring tools for producing hypermedia courseware. In this paper the first learning experiment in Matrix Algebra with A&O-learning environment is reported.

1 Introduction

The purpose of this article is to present the design principles, implementation and evaluation of the hypermedia-based A&O learning environment (see also *Pohjolainen, Ala-Rantala, Nykänen & Ruokamo 1999*). The design of the learning environment is based on the exploitation of the broadband information networks' characteristics, on hypermedia-based learning materials and modern learning theories (see *Ruokamo-Saari & Pohjolainen* 1997; *Ruokamo & Pohjolainen* 1998, 1999). In order to achieve optimal exploitation of the possibilities provided by modern information technology, theories of learning must be incorporated into planning of the learning environment. In the research on technology-based learning environments constructivism has gained ascendancy among theories. According to constructivist theory learning is a constructive process in which the learner has an active role and learning is based on the learner's own cognitive activity. Students construct new knowledge on the basis of previous knowledge, on their own activity in constant interaction with the surrounding reality. The A&O learning environment was planned to be applicable to different students and different content fields and to be used independent of time and place. Such an open learning environment supports lifelong learning. Open and distance learning (ODL) based on the information networks and on hypermedia can be utilised in schools and universities, in organisations offering education and in entrepreneurial education - from childhood to mature students. This article presents the objectives and design premises of the research and development work of the A&O environment. The article describes the A&O spaccs, actors and tools, and partly its technical realisation. Finally the first learning experiment in A&O environment is described and the results are presented.

2 Objectives

The A&O open learning environment refers here to a hypermedia-based environment which can be used via the information networks, especially the Internet, and which supports self-directed and collaborative learning. The learning environment is open to different students and different content areas. It moreover provides the opportunity for study via the information networks, independent of time and place and for lifelong learning. In the learning environment an attempt has been made to cater for mental, physical and social activity and it is intended to be both pedagogically appropriate and technically functional.

3 Premises in Planning an Open Learning Environment

This section presents the basic structure of A&O: actors, spaces and tools and offers a description of the functions of the Office and Study.

3.1 Actors

In planning A&O an effort was made to cater for all those actors who operate in a conventional learning environment. Thus it is possible to ensure that the environment enables and supports the contribution of the various actors in the learning process. The main actors in the open learning environment are: *the student, the student tutor, the teacher, the teacher tutor, the expert, the content provider, the director or rector, the secretary, the researcher, the system administrator and the visitor*. The role of *the student* is to function as a learner on the courses. S/he is a main actor in the learning environment and is also responsible for his/her own learning. The role of *the teacher* and other actors is to support the student in his/her learning process. The teacher on the course functions as the teacher responsible, as supervisor and in the role of evaluator. The *student tutor* is a student who has already completed the course in question. S/he may counsel the students and advise them in matters pertaining both to study and practical problems. The *teacher tutor* is an assistant teacher whose function is to assist the teacher responsible for the course and to supervise, and further to support and guide the student in his/her studies. The *expert* is a person who has particular knowledge or skills related to the content area of the course. The task of the expert may be to offer advice, to participate in discussion groups, to propose subjects for project work or to give special supervision for doing these. The *researcher* is a person possibly along on the course who examines the students' learning and learning processes. The *content provider* is a person who produces hypermedia-based learning materials for the learning environment. In principle a person external to the A&O environment may also act as a content provider. The *administrative personnel* of the learning environment includes the *director/rector* and the *secretary*. They are responsible for decision-making and practical measures related to the courses of the open learning environment, eligibility to study, registration, and entering credit points in the academic record. The *person maintaining the system* is a person who is responsible for maintenance and the updating of the system and for administration at system level. There may also be *visitors* to the learning environment: a visitor may be anyone using the Internet who has browsing access and can get to know the courses at a certain level.

3.2 Spaces

The A&O learning environment structure is based on a space model comprising four spaces. These are 1) *Office*, 2) *Study*) 3) *Media Centre* and 4) *Gallery*. Figure 1 presents the front page of the learning environment. There is a noticeboard on the front page of the A&O learning environment where Internet users can obtain information about the courses included in the environment. All matters pertaining to administration of studies are taken care of through the A&O *Office*. When beginning and ending their studies students are in contact with the Office, where they enrol on courses and have entries made for courses completed. *The Study* is a working space for students, teachers, tutors and experts. Its functions vary depending on the role of the actor. Via the Study students can study courses independently or collaboratively with other students: they can obtain supervision from teachers, tutors or other students and experts and also feedback. The students' log data accumulated in the A&O environment is accessible to the student, the teacher and possibly also to the researcher for the duration of the course. Via the Study all actors can collaborate with one another. The *Media Centre* serves all actors in the learning environment. In addition to courses this also contains materials related to study. The material in the Media Centre may, for example, include text, sound, image, video and animation material. In future it will be possible to locate video-on-demand services in the Media Centre, too. The implementation of the Media Centre is comparable to a database, which makes structural access possible. There is also a *Gallery* in the A&O environment, and here the practical assignments and final projects of the students are displayed complete with evaluations. The Gallery is to have an option to vote such that Internet users will be able to elect their own favourite. The technical realisation of the Gallery is also as in a database.

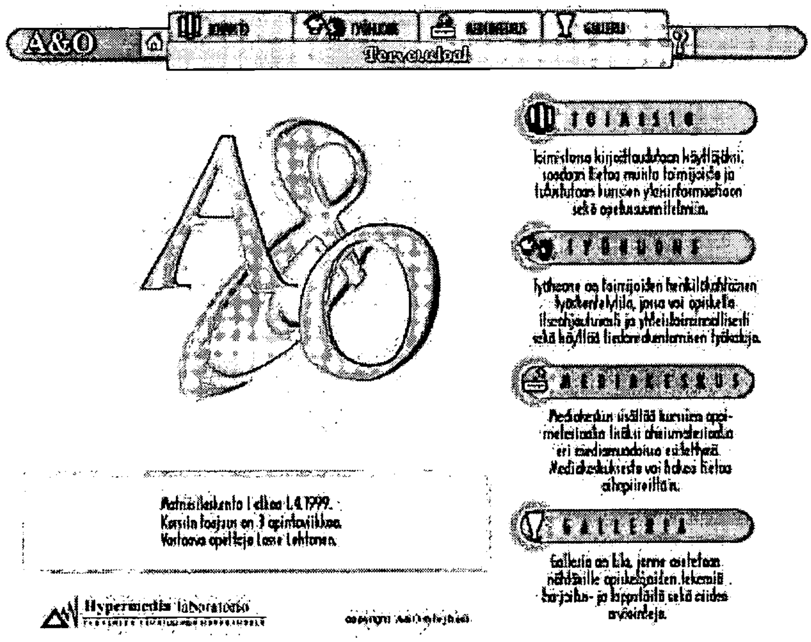


Figure 1: Front page of the A&O learning environment

3.3 Tools

The actors in the A&O learning environment have tools at their disposal for the *creation of content*, *cognitive tools* for each course, *communication tools*, *tools to support collaborative learning* and *management tools*. The tools for creating content are important, as course content is primarily created using these. The course material may include hypertext-based material, images, animations, video, links to external sources and readymade programmes and elements supporting self-evaluation. The structure of the course material to be produced is an important delineating factor in learning, its effects extending to the organisation of the A&O communication and collaboration tools. Naturally the tools for creating content are also available for students' use as in the open learning environment students, too, are producers of content. Constructing knowledge is accomplished through the cognitive tools among others. Such cognitive tools include various tools for information seeking and ordering, navigation tools, question-making tools, problem solving tools, and special tools for use on certain courses. The present article describes the Maple program in the field of symbolic mathematics as a cognitive tool. The A&O communication tools comprise e-mail, discussion groups and real-time discussion. E-mail can be used by the actors to send information in the form of correspondence in their own words. The discussion groups render possible supervised discussion group by group. The real-time discussion supports collaboration between students on the course at the time of studying. The administrative tools are used to administrate the environment. Administrative measures include the granting of the right to study, acceptance as an actor, acceptance of the course and entering the course or parts of it in the academic register.

3.4 Functions

Students enrol as actors in the A&O learning environment through the Office. The Office noticeboard carries general information on courses and details of all actors on the courses. A system-specific *ID card* is made for every student, teacher, tutor and expert. This ID card contains personal details, role on the course, contact information, photograph, link to the individual's homepage and an open space for the individual to introduce him/herself and his/her hobbies to other participants. The aim of the ID cards is to help course participants to get to know each other and to support collaborative activity. The Office also has course curricula, which include course objectives, schedules, contents, information on course materials, teaching methods, evaluation, teachers, tutors, experts and researchers possibly involved with the course. In A&O all these actors have their own Study. Figure 2 presents such a student Study. It contains the course to be studied and also a whole lot of tools for planning studies, study management, communication, constructing knowledge, monitoring studies and resource management.

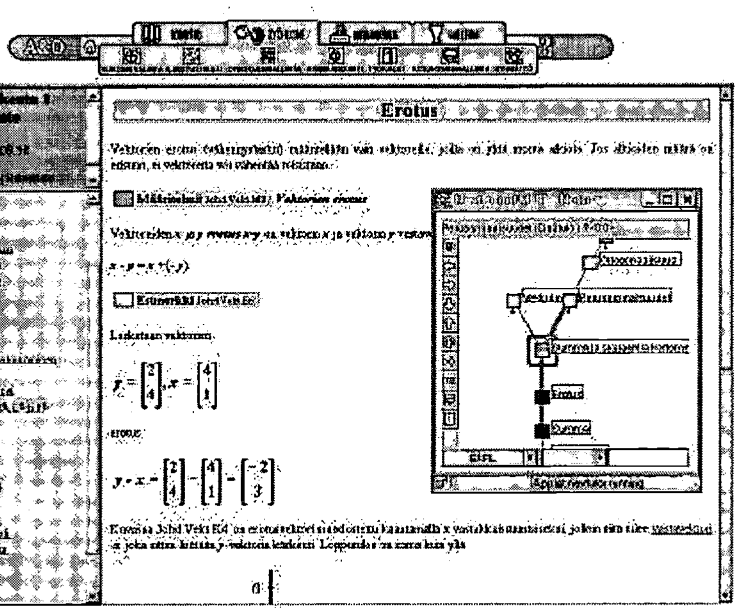


Figure 2: A student Study and part of its functions

In A&O the student may participate in several courses, and the selection of each of these is made in the Study. The Study has a noticeboard for the course and a curriculum on the basis of which students can make their own personal curricula. The A&O learning environment also collects log data about students' activities in the course of study. This data can be utilised in students' self-evaluation, in teachers' evaluation work and as a support for researchers' analyses. A student can take a look at the matters to be dealt with on the course in a given week. This information is obtained from the noticeboard and the course discussion group. S/he selects a subject for his/her practical exercise and seeks for further information in the Media Centre. The selection of the subject can be narrowed down by e-mailing the teacher. After selecting the subject s/he forms a workgroup. For this purpose s/he goes through the ID cards and puts a notice on the course noticeboard. The workgroup presents the plan for the practical exercise to the teacher in a public discussion group, accomplishes the work using as aids the e-mail, the real-time discussion group, the discussion group set up for the workgroup. Finally the workgroup submits the work to the teacher by e-mail and comments and further develops it as necessary. At the end of the course some of the group work may be displayed in the Gallery.

4 A Learning Experiment on Matrix Algebra in A&O

In order to test the A&O learning environment a learning experiment was organised at Tampere University of Technology. The students studied using A&O environment an introductory part of the course of Matrix Algebra at TUT during three weeks in September 1999. The A&O-learning environment contained: Introduction to Matrix Algebra as hypertext, interactive exercises generated and checked by the symbolic algebra program Maple, noticeboard, internal E-mail, real time discussion (chat).

In the beginning all the students filled in their ID-cards. The theory to be studied as well as well as weekly exercises were announced weekly on noticeboard. The students were asked to study the theory, to study the interactive exercises, to solve easier theoretical exercises by themselves, and to solve more demanding problems in groups. The results of group work were presented in the weekly noticeboard so that other students could study them. As all the proposed solutions were not correct, it turned out that some students started to make comments about weaknesses in the proofs and to present ideas how to improve the solutions. This was interesting to the teachers, as they had not planned to use noticeboards as a media to constructing the correct solutions. At the end of the experiment the students' opinions about the learning experiment were collected. The feedback consisted about pedagogical, content-based and technical matters. Part of the results is shown in Table 1.

Pedagogical parts of the learning experiment emphasized self-directed learning and the learner's own activity. That is partly because teachers chose consciously the passive role in the students learning processes. In the results the students seemed to be motivated to take responsibility for their own learning. They preferred the A&O learning environment because it gave freedom to learning for example by delivering course from timetables and from the structures of the course material. The students were responsible for setting the goals to their learning process and also for achieving them.

Students felt that A&O made self-directedness in learning possible by providing cognitive tools needed in learning processes. Learning environment supported contextuality by offering exercises helping to understand the theory. Examples given in A&O helped students to apply the theory into practice. Partly caused by the teachers' passive role in the students' learning processes, interaction between the participants of the learning environment wasn't too active. Only few students actively participated in discussions in the noticeboards. That is why students felt that the learning environment supported only slightly collaboration between them. Students followed noticeboards actively, but they seldom commented conversations.

One main problem which arose in results is that there are still conservative attitudes concerning studying. Students are used to conventional, teacher oriented learning and also this was seen in results. Students preferred conventional lectures to self-directed learning. Many of them told that they studied mainly using printed lecture notes.

Pedagogical issues	mean
I felt myself to be responsible for learning instead of course instructors	4,39
I enjoyed the freedom in learning provided the environment	4,04
The knowledge and skills that I learned can be transferred to other fields	4,00
The A&O environment provided the necessary tools to support learning	3,50
Interactive exercises helped to understand concepts	3,46
Exercises, solved by myself, helped in understanding the material	4,36
Self-directed learning is more useful than traditional lectures	2,71
I mainly used printed lecture notes in studying	4,04
I studied groupworks, made by other students in the net	2,53
The learning environment encouraged to collaborate and to study with others	2,11
Technical issues / User Interface	
I think graphics were good, clear and there was a good amount of it	3,68
The system's performance was acceptable and the loading times weren't too long.	2,75
The system didn't make errors and was reliable	2,71
The functions were placed logically to A&O's taskbar and they were easy to find	3,43
Utilities (email, news client ..) were clear and using them was easy	3,39

Table 1: The students feedback from pedagogical and technical issues from the learning experiment. The scale was 1 = strongly disagree, 2 = disagree, 3 = do not know, 4 = agree, and 5 = strongly agree.

From the technical point of view the results of the experiment were good. The server program didn't break down during the experiment. The server's performance was a bottleneck, but it will be significantly boosted by fine tuning the program code. Users liked the graphics of the environment. The placement of functions was considered to be fine and the user interface of utilities was thought to be acceptable too. Altogether, the design of the user interface was good, but there's still need to improve it. The performance and the reliability of the client were known to be problematic since thorough testing of the environment wasn't done in forehand. The results of the test confirmed some of our doubts although the problems weren't too bad. The environment was updated three times during the experiment. The updates improved performance and reliability. The performance in general is not bad but some functions are bit too slow (e.g. drawing the tree structure of noticeboards). As a result, the problematic functions have been pinpointed. They will be improved to an acceptable speed. Reliability has already been improved much, thanks to the feedback from the students during experiment.

5 Conclusions

The present article presented the A&O learning environment. The open learning environment is based on a space model which is divided into Office, Study, Media Centre, and Gallery. The article presented the main actors of the learning environment, the functions and the production of content for the open learning environment. The planning and realisation of the A&O learning environment proved to be a very challenging task, considering the learning theories and rapid development in the field of information technology. In the learning environment the student is the most important actor learning is the most important process - every effort has been made to take this into account in the planning and realisation of the A&O learning environment. However, there is so far no empirical knowledge available as to how well the open learning environment, the structure of the learning material and the tools developed do in practice support learning and the activity of the learners, their collaboration and objectives, contextuality, transfer and reflectivity. The first learning experiment in Matrix Algebra, was carried out and the results were presented. Further experiments and data collection during the ongoing Open Learning Environment-research project will be performed.

References

Pohjolainen, S., Ala-Rantala, M., Nykänen, O. & Ruokamo, H. (1999). *On the Design and Evaluation of an Open Learning Environment.* Special Issue D. Dicheva & P. Kommers (eds.): Micro Worlds for Education and Continuous Learning. International Journal of Continuing Engineering Education and Life-Long Learning (IJCEELL), ISSN 0957-4344. Volume 9, Nos 2/3/4, 249-261.

Ruokamo-Saari, H. & Pohjolainen, S. (1997). *Pedagogical issues for the design of a Hypermedia-Based Learning Environment (HBLE).* In D. Dicheva & I. Stanchev (Eds.) Proceedings of the IFIP WG 3.3 Working Conference, Human Computer Interaction and Educational Tools (HCI-ET), Sozopol, Bulgaria, May 27-28, 1997, 82-91.

Ruokamo, H. & Pohjolainen, S.(1998). *Pedagogical Principles for Evaluation of Hypermedia-Based Learning Environments in Mathematics.* In JUCS – Journal of Universal Computer Science [online], Vol. 4 No 3, 292-307. Available in www-form: <URL: http://www.iicm.edu/jucs_4_3>.

Ruokamo, H. & Pohjolainen, S. (1999). (Eds.) *Etäopetus multimediaverkoissa - ETÄKAMU.* Digitaalisen median raportti 1/1999 (in Finnish) . Teknologian kehittämiskeskus. Helsinki. Available in www-form: <URL: http://matwww.ee.tut.fi/kamu/loppuraportti>.

The TOMUS Model of Multimedia: an empirical investigation

Helen C. Purchase
Department of Computer Science and Electrical Engineering
The University of Queensland
St Lucia, 4072, QLD, Australia
hcp@csee.uq.edu.au

Daniel Naumann
Department of Computer Science and Electrical Engineering
The University of Queensland
St Lucia, 4072, QLD, Australia
danieln@csee.uq.edu.au

Abstract: Models of multimedia communication attempt to classify the numerous types of media objects available, and to provide a basis for unambiguous terminology in a new and expanding field. Many of these models are products of theory, rather then practical investigation, and few have been empirically studied to assess suitability. This paper reports on an experiment which investigated the understandability of a recently proposed multimedia model, TOMUS. The experiment entailed subjects classifying various media objects according to the TOMUS model. Error and perceived difficulty data were collected; analysis revealed which of the categories are the most difficult to comprehend. Suggestions are made as to the causes of these difficulties, and recommendations as to how the model might be correspondingly altered are proposed.

Introduction

The concept of "multimedia" suffers from inadequate standardisation of terminology, and the lack of commonly agreed definitions results in much ambiguity both within and between articles written on the topic. Recognising this lack of consistency, many authors have provided classifications, definitions and models, attempting to create a theoretical basis for the study of multimedia communication. The fine-grained model proposed by Arens et al (1993) is based on the characteristics of perceiver, producer, information and media, and has a set of rules associated with it which determine matchings between information and media. The taxonomy used by Heller and Martin (1995) is based around common (potentially ambiguous) terms "text", "graphics", "sound" and "motion". Its aim is to enhance students' understanding of the range of possible media types in their production and evaluation of multimedia software. Vetere's model (1997) includes the notion of interaction, relating to the goals of the user and the goals of the system, and uses 3D vectors to represent complex media types. Bernsen's (1995) input and output modalities define forty-eight low-level "unimodalities" in a hierarchical model.

Empirical studies are rare in the area of multimedia definition: the afore-mentioned models are products of thought, rather than practical experiment. Lohse's model (1994) is based on data taken from subjects' grouping of objects, but only in the visual domain. While Heller and Martin (1995) tested their model by observing its use in student projects, the outcomes were as much indicative of student skill as of model suitability. Theoretical multimedia models need to be empirically tested for their suitability. This suitability may be with respect to suitability for use for a particular multimedia task, ease of understanding of the model definition, or correspondence between the model and human cognition and perception. The aim of this paper is to present the results of an empirical investigation of the TOMUS multimedia model (Purchase, 1998), from the perspective of its understandability. A theoretical model that is based on definitions that are difficult to understand is not useful for any task.

The TOMUS model

The TOMUS model was devised as an attempt to categorise the many types of simple media objects that may comprise multimedia texts. Its intention was to provide an unambiguous theoretical model that could be used to avoid vague and inconsistent terminology: it offers a means for producing a consistent definition of the terms associated with multimedia communication (multimodality, hypermedia, etc.).

This paper presents results of an investigation into the understandability of the TOMUS dimensions. The aim of this paper is not to present the TOMUS model in detail, nor to propose an unambiguous definition of multimedia communication: this has been done more completely elsewhere (Purchase, 1998).

The TOMUS model consists of three dimensions: sign, syntax, and modality.

The *sign* dimension determines the nature of objects used in multimedia communication, and is based on semiotic categories of sign: symbol and icon (Bruner, 1966). (The enactive category included by Bruner does not form part of the TOMUS model, as it is concerned with physical movement, rather than communication.) An iconic object is perceptually similar to the concept it represents (eg. a "no smoking" sign), while a symbolic object has no perceivable similarity to the concept it represents (eg. the olympic rings). In the TOMUS model, the iconic category is divided into two: concrete-iconic (the object is perceptually identical to the represented concept, as in a photograph), and abstract-iconic (the object is perceptually similar to the represented concept, as in a cartoon character). This distinction follows Arnheim's proposal of a continuum of abstraction for visual signs (Arnheim, 1969). The sign dimension thus has three values: concrete-iconic, abstract-iconic and symbolic.

The *syntax* dimension determines the manner in which single media objects may be arranged in a multimedia document. There are five syntax categories in the basic TOMUS model: individual, augmented, temporal, linear and schematic. (The complete TOMUS model includes a network syntax value, used in order to distinguish between multimedia and hypermedia; its inclusion in this TOMUS description is beyond the scope of this paper.)

- The individual syntax describes documents comprising a single object in a single moment of time (eg. a road sign).
- The augmented syntax describes documents that comprise a single object, where the object is augmented with additional information (eg. colour or font) essential to its interpretation (eg. a red traffic light).
- The temporal syntax describes documents where the same object is repeated over time, and only a single concept is represented (eg. a fire alarm, a pendulum). The concept cannot be comprehended without transmission over time.
- The linear syntax describes documents which, like the temporal syntax, are transmitted over time. Unlike the temporal syntax, the concepts change over time, as part of a narrative (eg. a novel, a film).
- The schematic syntax describes documents where the relationship of the objects to each other in an additional spatial dimension is important (eg. a map or graph, a family tree). In the aural dimension, this additional dimension is the frequency dimension, representing complexity of sound.

The *modality* dimension distinguishes between the senses used for perceiving the multimedia document. Currently, this dimension has two values: visual and aural.

Within these three dimensions, thirty different media objects can be classified (Figure 1).

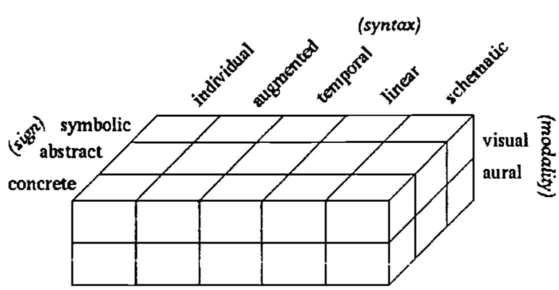


Figure 1: The TOMUS model of multimedia

An important attribute of the TOMUS dimensions is that they are all defined independently of technology, and are based on the nature of the text, rather than the device that communicates it. This approach recognises that linking the model to technology may mean that it will soon be out of date, and acknowledges that multimedia need not be the exclusive domain of the computer. This technology-free approach sets TOMUS apart from other multimedia classifications.

Empirical investigation

While TOMUS was primarily intended to provide unambiguous terminology, it also aimed to be a useful model for multimedia tasks, by clearly defining the range of multimedia objects. However, it is a purely theoretical model, the product of thought rather than practical investigation. While the sign dimension is based on semiotic definitions, and the modality dimension is based on the senses, the syntax dimension is merely based on the experiences of TOMUS' designer. There is no guarantee that the model will be easily comprehensible to other people. It was therefore important that the model be evaluated empirically, to determine its understandability, and to dictate any essential changes.

To this end, an experiment was conducted where twenty subjects, having knowledge of TOMUS, were each presented with a single example of each of the TOMUS categories, and were asked to identify the correct TOMUS category. The aim was to determine whether there were any categories that subjects were having particular difficulty understanding.

The research questions

A desirable property of a theoretical model of multimedia, is that the dimensions, and the values on the dimensions, are easy to understand.. Subjects were asked to identify the TOMUS category of each of thirty different media objects. Two types of understandability were measured in terms of misclassification of given media objects:

- Dimension understandability: the extent of correct classification of media objects according to their value on each dimension. Thus, if the [concrete,linear,aural] object were classified as [concrete,schematic,aural], a linear-dimension error would be counted, but not a concrete-dimension error nor an aural-dimension error.
- Composite understandability: the extent of correct classification of media objects within their values on each dimension. Thus, if the [concrete,linear,aural] object were classified as [concrete,schematic,aural], a linear-composite error, a concrete-composite error and an aural-composite error would all be counted.

In addition, the "perceived difficulty" of the values along each dimension was collected by way of a questionnaire.

Three questions were therefore considered for each of the three TOMUS dimensions (sign, syntax and modality):

- Are the values along the three dimensions equally easy to understand? (dimension errors)
- Are the values along the three dimensions equally easy to classify within? (composite errors)
- Are the values along the three dimensions perceived as equally as difficult to understand? (perceived difficulty)

Methodology

The subjects interacted with an online system, the display of which comprised buttons labelled with the values of each of the thirty TOMUS categories, and a display area. For each of thirty media objects that were presented, subjects were required to indicate to which TOMUS category the object belonged.

A within-subject experimental design was used, with all subjects being shown all thirty media objects. To reduce any learning effect, the order of presentation of the objects was randomised for each subject, and six "practise objects" were presented at the start of each session: the subjects were not aware that these six initial objects were not experimental.

The online system recorded the TOMUS categories selected by the subjects for each media object, and identified misclassifications. The independent variable for the experiment was the TOMUS category; the dependent variable was errors. Twenty third year computer science students participated voluntarily.

After the classification task, subjects completed a questionnaire. For each TOMUS dimension they were asked to "rate the difficulty [they] had in deciding the [sign/syntax/modality] of the examples", 1 representing the most difficult value on each dimension. This data was collected in the form of rankings.

The media objects

Each media object was accompanied by a sentence defining its meaning (Figure 2). These concept definitions were necessary in providing a context for the categorisation: without a context, the TOMUS category of an object may be ambiguous. For example, a picture of a lightbulb might mean "lightbulbs" (abstract-iconic) if seen on a packing box, but may mean "an idea" (symbolic) if seen in a cartoon.

	Media object	Concept definition
CIV	A photograph of an airplane	An airplane
CAV	A photograph of a male and female parrot	A male and female bird distinguished by colour
CTV	Animation of a bouncing ball	A bouncing ball
CLV	Film clip of a rally car racing	A rally car racing
CSV	An aerial photograph of a city	A city
AIV	A drawing of a cartoon character	A person
AAV	A picture of a weather map	A weather map with clouds distinguished by colour
ATV	Animation of a computer generated insect walking	A walking insect
ALV	An animated file moving from one folder to another	Moving a file
ASV	An iconic chart representing birth rates	The relative birth rates of males and females
SIV	A picture of a peace symbol	Peace
SAV	The words "express" and "slow", in different fonts	Words denoting speed, distinguished by font
STV	Animation of a circular spinning cursor	Indication of a computer processing
SLV	Words forming a sentence	A sentence
SSV	A picture of a parse tree of a sentence	A parse tree
CIA	The sound of a glass breaking	Breaking glass
CAA	The loud sound of a slamming door	A door slammed in anger
CTA	The sound of running water	Running water
CLA	The sound of a car driving past	A car
CSA	The sounds of a military attack	A war time battle
AIA	The sound of a cartoon "boinnnngggg"	A spring
AAA	A cartoon sound of being hit by an anvil	Being hit by a metal object
ATA	The sound of laser gunfire	A laser gun
ALA	The sound of a synthesised heartbeat changing pace	A heartbeat
ASA	The sound of a synthesised car crash	A car crash
SIA	The sound of a doorbell ring	Someone requesting entry to a house
SAA	The sound of a high pitched error beep	A severe error
STA	The sound of an air-raid siren	Warning of an air-raid
SLA	The sound of a tone that changes pitch	The amount of traffic on a computer network
SSA	The sound of a fire alarm with two tones	A fire alarm indicating severity and location

Figure 2: The experimental media objects. The first column is the TOMUS category: sign (Concrete-iconic, Abstract-iconic, Symbolic), syntax (Individual, Augmented, Temporal, Linear, Schematic), and modality (Visual, Aural).

Data Analysis

The error data was analysed using a standard ANOVA test based on critical values of the F distribution; in the case of significance, a Tukey pairwise analysis was performed, to determine which values on the dimensions proved most difficult. The perceived difficulty data was collected by way of ranks; thus, a non-parametric statistical analysis was required. The Friedman analysis of variance test was used; in the case of significance, the Kruskal-Wallis test identified where the differences lay. Figure 3 shows the outcome of this statistical analysis, and figures 4, 5 and 6 show graphs of the average dimension errors, composite errors and perceived difficulty rankings. Figure 7 shows where pairwise differences lay. (NS indicates a non-significant result.)

	dimension errors (ANOVA)	composite errors (ANOVA)	perceived difficulty (Friedman)
sign	F(2,38, alpha=0.05)=6.44	F(2,38, alpha=0.05)=4.01	F(2,38, alpha=0.05)= 7.03
syntax	F(4,76, alpha=0.05)=12.37	F(4,76, alpha=0.05)=13.80	F(4,76, alpha=0.05)= 8.52
modality	F(1,19,NS)=0.32	F(1,19, alpha=0.05)=36.51	F(1,19, alpha=0.05)= 6.33

Figure 3: Analysis of the data for dimension and composite errors, and perceptions of difficulty

Discussion

The sign dimension

The data is significant for all three tests, and the pairwise analysis shows significant differences between abstract and the other two categories in almost all cases.

The abstract-iconic category was added on to Bruner's semiotic definitions (Bruner, 1966). It produces a "grey area" that the subjects may have had difficulty distinguishing. Informal preparatory experiments revealed that symbolic objects tend to be classified with respect to function (e.g. # has the function of sharpening a note in music) while concrete-iconic objects tend to be classified according to form (e.g. a photograph of a pie on a menu merely shows what the pie looks like, and is therefore classified according to its visual form as a pie.) On the other hand, many abstract-iconic objects may be classified according to function or form, depending on their context, and thus may have ambiguous TOMUS classification. For example, a diagram of a pair of scissors may represent scissors in a pictorial representation of items to be included in a first aid kit, but may mean "cut here" if found on a dress pattern. It is this ambiguity that requires the association of concept definitions with media objects when they are categorised within TOMUS. And it is perhaps for this reason that the abstract-iconic category produced the worst performance.

The aural distinction between concrete and abstract is awkward (as the difference between synthesised sounds and real recordings), making it a less useful distinction than in the visual modality. Further analysis of the data may reveal whether a significant number of abstract errors were made within the aural category.

Following Arnheim (1969), we believe that a continuum between symbolic and iconic is necessary, particularly in multimedia texts where photographs (which are concrete-iconic) are used extensively. Removal of the abstract-iconic category due to bad performance is not appropriate. A more suitable proposal would be for the definition of abstract-iconic to be clarified, or for a form/function distinction to be introduced.

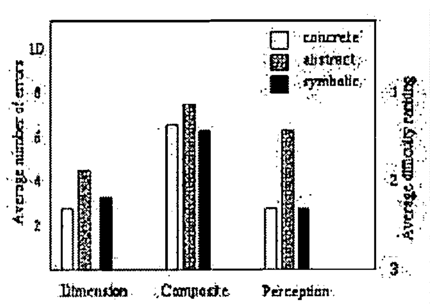


Figure 4. Average values: sign

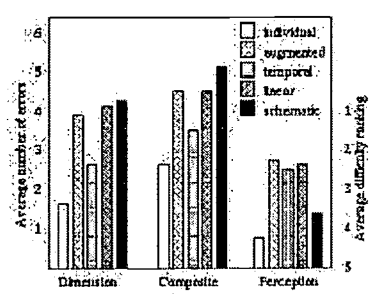


Figure 5. Average values: syntax

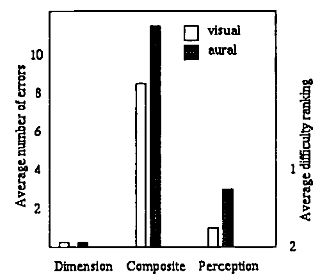


Figure 6. Average values: modality

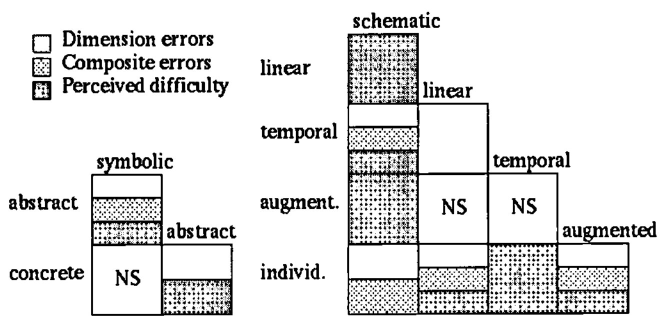


Figure 7. Pairwise differences. Each cell shows whether significant differences were found in the three tests. Thus, eg., the differences between the responses for schematic and individual were significant for dimension errors and composite errors, but not for perceived difficulty.

The syntax dimension

The data is significant for all three tests, with best performance in the individual and temporal categories. The pairwise analysis confirms that, for the error tests, augmented, linear and schematic are more difficult than individual, and that linear and schematic are more difficult than temporal.

It is not surprising that individual and temporal are easy to understand and distinguish, as they both represent only a single concept. But it is a surprise that the linear category proved difficult, as the notion of narrative is common. The TOMUS stated definition of this category needs to be reassessed, and clearly distinguished from temporal.

The schematic category is awkward in the aural modality: more tests are required to see whether most schematic errors were aural. Most surprising is the fact that the subjects did not perceive the schematic category to be difficult, despite their poor performance. The subjects seemed to understand the concept of schematic, but were less sure when to apply it. The schematic definition needs to be reassessed so that it more closely relates to its use in the model.

The augmented syntax is concerned with comparisons: the font or colour of an augmented object is only important when compared with a different font or colour. This comparative property of augmented objects adds to the complexity of their TOMUS definition, and to their classification. It is recommended that the augmented category be removed from the model. The process of adding extra information (e.g. font, colour) to a media object can be acknowledged, but can be applied outside the TOMUS model categories, in a separate part of the multimedia process.

The modality dimension

There is no significance for dimension errors: the subjects understood the visual/aural distinction. The composite error data is highly significant, indicating that classifying within the aural domain was difficult: subjects had less difficulty understanding the other dimensions in the visual domain than in the aural domain. This is not surprising, as our visual sense dominates the others.

What is surprising is that subjects thought it more difficult to determine whether something was aural than visual: we would have expected this data not to be significant. It is possible that the students were projecting their difficulty in classifying within the aural dimension onto their response to this question.

There is no reason why this dimension should be altered: a predictable extension would be a tactile category.

Conclusion

The problem with this model, is the assumption of equal priority for each of the classification cells. No consideration is made for the fact that some types of media objects may be more common or more important for multimedia tasks. For example, redefining "schematic" so that it better relates to the aural modality assumes an equal priority of [schematic-visual] objects with [schematic-aural] objects. It does not acknowledge that the [schematic-aural] category may not be useful, nor that [schematic-aural] objects may be rare in practise.

This observation does not mean that it is irrelevant if less important or less common categories are less easy to understand, but it does suggest that tweaking model definitions to force media objects to unambiguously fit one category may not be a useful process.

We anticipate that a well balanced model, with equal priority for each value on each dimension, would be difficult to propose, and may not be any more useful in practise than TOMUS as it stands. While investigating TOMUS understandability has been a useful start in assessing its worth, it is more important that its practical use be investigated: how useful are these classifications to designers and evaluators of multimedia texts? Assessing practical use will avoid issues regarding the relative priority or frequency of occurrence of the values on the dimensions, and will rather focus on the benefits of models like TOMUS in action.

References

Arens Y., Hovy E., and Vossers M. (1993). On the Knowledge Underlying Multimedia Presentations. In Maybury M.T., editor, *Intelligent Multimedia Interfaces*. MIT Press, Cambridge, Mass. 280-306.

Arnheim R. (1969). *Visual Thinking* .University of California Press.

Bersen N.)., Jensager F., Lu S., and Verjans S. (1995) *A Toolbox of Output Modalities*. Amodeus Project Deliverable D15.

Bruner J.S. (1996) On cognitive growth. In Bruner J.S., Olver R.R., and Greenfield P.M., editors, *Studies in Cognitive Growth*. New York, Wiley. 1-67.

Heller R.S. and Martin C.D. (1995). A Media Taxonomy. *IEEE Multimedia*, 2(4): 36-45.

Purchase H. C. (1998). Defining Multimedia. *IEEE Multimedia*, 5(1):8-15.

Vetere F., Howard S., and Leung Y. (1997) A Multimedia Interaction Space. In Hammond J. and Lindegaard G., editors, *Proceedings of INTERACT97*. Chapman and Hall. 205-211.

Building Electronic Catalogs and Retail Storefronts: Enlivening the Electronic Commerce Course with Cooperative Learning-Based Projects

Rebecca Angeles
Montclair State University
Information & Decision Sciences Dept., School of Business
Upper Montclair, New Jersey, USA 07043
Angelesr@mail.montclair.edu

Dennis M. Adams
Montclair State University
Department of Reading and Educational Media, College of Education and Human Services
Upper Montclair, New Jersey, USA 07043
Adamsd@mail.montclair.edu

Abstract: This paper features a study on the use of electronic catalogs and retail storefronts as a concrete collaborative class project for the Electronic Commerce Course in the Business curriculum and a survey of the MBA students that undertook this project in response to the course requirements. The survey results provide positive indications for the achievement of the goals of collaborative inquiry, team-based and active learning, constructivist pedagogical approach, and learning by doing. The technical details of the project are also described in the study.

Introduction

The Internet is providing an extraordinary environment for designing teaching and learning experiences. This paper will focus on how the World Wide Web (WWW) could be utilized for teaching Electronic Commerce (E-Commerce) in Management Information Systems (MIS) program of the Business curriculum. The opening of the Internet to businesses in the early nineties initiated the E-Commerce phenomena that has not only revolutionized the conduct of business online but also overhauled the way E-Commerce-related business courses need to be taught. The unusual aspect of these courses is that the WWW is primarily the environment in which online establishments also conduct their business. This means students can actually simulate the conduct of business via the same environment where their learning takes place. Not only that---the instructional setting can also take advantage of web hosting services used to support online businesses to supplement if not entirely replace inadequate university information technology infrastructure that needs to undergird the activities of electronic merchants.

This paper reports the experiences of the MBA students at the School of Business, Montclair State University, in building electronic storefronts using Merchandizer software, which is a requirement in their Management Information Systems course that has an E-Commerce theme. Using the survey technique, student feedback was gathered from two MBA classes that took the course during the summer and fall 1999. Data was conducted to measure students' perceptions of the quality of their overall learning experience and their ability to gain collaborative team work skills, discipline-specific skills in building an electronic storefront and catalog, skills in using the Merchandizer software, and various forms of thinking skills.

The E-Commerce course could be taught by combining the pedagogical principles that surround a number of appropriate teaching strategies: cooperative learning, constructivist approach, active learning, and learning by doing. These strategies can be used to structure and coordinate electronic learning spaces. In a cooperative learning environment, the instructor organizes content and topical activities around tasks, problems, and projects that student teams with a balanced mix of abilities and backgrounds are designed to undertake (Adams and Hamm, 1996). Cooperative learning also provides valuable opportunities for students to work together across gender and ethnic lines as long as communication skills, prior achievement, expectations, friendships, and group status are factored in (Chizhik, 1999). A meta-analysis of university-level and adult-learning courses found that use of collaborative learning concepts promoted higher achievement, higher-level reasoning, more frequent generation of ideas and solutions, and greater transfer of learning than did individualistic or competitive learning strategies (Johnson et al., 1991). Team members' social skills, also called "interpersonal intelligence" according to Howard Gardner, encompassing interpersonal communication, task management, group interaction, and conflict resolution are constantly honed throughout the process.

The constructivist pedagogical approach invites students to build personal meanings out of the material taught and encourages them to reflect on how new knowledge builds on their previous base of understanding (Pankratius and Young, 1995). In a group setting, the constructivist approach could lead to the social creation of knowledge as a basis of learning.

"The yeast of knowledge, openness, and enterprise raises the need for a multiplicity of learning media and technological tools "(Adams and Hamm, 1996). The very wealth of Web site building tools that is now available allows students to experiment and "play" through "learning by doing" activities and significantly changes the whole instructional experience. Students have more control over the end product via the software tools and they assume greater responsibility over their learning process (Adams and Hamm, 1996). MIS instructors are strongly encouraged to move towards the "learning by doing" mode which is, by far, the most effective way of teaching students "how to" skills. While this is clear to most teachers, it is not easy to do unless certain prerequisites are in place: professional development, teacher preparation, technological infrastructure support (hardware, software, and helpline service), an appropriate incentive system that will reward the countless hours that will go into a more technologically-oriented class (as opposed to a traditional lecture-style one), and above all, an overarching plan that clearly defines the role of technology in the pedagogical process (Adams and Hamm, 1995).

Merchandizer Software Features

Students are asked to build an electronic retail storefront for either consumer-to-business or business-to-business commerce. What this means is that the store can sell a product that individual consumers may be interested in buying such as an Amazon.com for books or a CdNow.com for musical CD-ROMs. Or, the storefront could be an electronic catalog for firms interested in buying materials they need in running their business such as office supplies, for instance---staplers, bond paper, paper clips, etc.---in other words, these will be businesses buying from another business. The product used in the project is Merchandizer Software, which is an online solution that allows users to build and manage an electronic storefront with just a browser software such as Netscape Communicator or Microsoft Internet Explorer and an Internet connection which an Internet Service Provider (ISP) or web hosting service can provide for a fee. In designing the site, students could either enter all product information using a step-by-step wizard or they could work directly with hypertext markup language (HTML) forms to both make and modify their sites. In building the electronic catalog itself, students either enter information manually using the wizard templates or they may import extensive information using Microsoft Access database tables which are loaded onto the servers.

Merchandizer software makes use of frames or windows appearing within the browser's display area, each of which displays the contents of a different HTML file (Carey, 1998). The software also allows storebuilders to divide their product lines in a hierarchical fashion, first into groups, then, into subgroups, and finally, into catalog items. The group and subgroup headers become navigational links in one frame, displaying product pages or other HTML pages or entire web sites altogether created by the students. The frame concept facilitates the navigation of the customer through the storefront.

Once groups, subgroups, and catalog items have been defined, students enter product information either of two ways. They can enter the information using simple electronic forms that allow them to submit information like product name, code, description, and price. Alternatively, they could use preformatted Microsoft Access tables that essentially mimic the wizard online templates. These tables are more convenient to fill out when merchants have hundreds or even thousands of product items to enter. Since students are building only prototype stores with a limited product line, they end of using the forms, although the use of the Access table is demonstrated to them should they be interested in trying it.

Merchandizer has features like a search function that will allow hypothetical customers to search the storefront using any word or phrase related to the products on sale. Merchandizer also incorporates a shipping table for UPS directly into the software so that the students do not have to be concerned with this. They need to specify the appropriate sales tax, though. Merchandizer keeps track of all sales transactions, customers, and prospects (those who visit but do not buy). A report generating facility gives students information on the most saleable products, customers who buy most from the store, aggregate sales figures for the week or the month, and areas of interest of prospects, among other things. The software can also autogenerate email messages to prospects about special promotional activities the store is conducting.

Version 3.0 of Merchandizer offers students a wide range of features to play with to simulate a real online store even more realistically: easy translation of the web site into any language; ability to insert forms with special buying instructions before the shopper checks out; offer global coupon numbers to shoppers so that they can accumulate their purchases and eventually received discounts on items; ability to submit the store site to top search engines; more managerial report forms that can be generated from the sales transaction data; a personalization field for each catalog item for shopper input that will be carried over to the order tables; ease of uploading and downloading Access tables, among other more advanced features.

HipHip software, the company behind the Merchandizer storefront building tool, is also a web hosting service. A merchant that does not have networking facilities to support the store could subscribe to this service and pay a one-time setup fee and monthly maintenance fees that vary depending on the number of catalog items supported in the store. HipHip software offers educational pricing for universities interested in using their hosting services for the purpose of instruction. This arrangement is a boon for universities and colleges that do not have adequate information technology infrastructure to allow E-Commerce instructors to mount interesting student projects.

The web hosting service is important because of the backend office component of the online store. Sales transaction information submitted by customers and personal information keyed in by interested prospects who do not purchase during their visit to the store need to be stored in web servers so that the order could be processed and sales prospects could be reached through promotional email messages in the future. Backend office processing requires the availability of web servers that can store order transaction data in databases that can later be accessed using some form of structured query language so that reports and statistics could be generated for managerial decision making. The extensive requirements of the storefront make the storefront project too challenging for the normal capabilities of a typical university's academic technology support group. It is far better to sign up with the web hosting service---if reasonable fees could be negotiated with the company---and have their technical support staff provide the services necessary for optimizing all functionalities and features of the storefront.

Methodology

This study used the survey technique using a written questionnaire, which was administered to two classes of the MIS 503, Management Information Systems course at the MBA level. Data was gathered during the Summer and Fall of 1999. Both classes had the theme of "Electronic Commerce" and the project assigned to the students was the construction of an online retail storefront for either consumer-to-business or business-to-business commerce. Students were assigned in teams of four to five students. Each team was in charge of a storefront web site, which was maintained and supported by HipHip Software. The technical support staff that advises the students and oversees the web servers that host the software and product information entered by the students is located in Miami, Florida. Survey data was analyzed using descriptive statistics, correlations, and simple regressions among key variables.

Findings

The sample size consists of 43 students in the MBA program of the School of Business, Montclair State University, who all took the INFO 503 class in Management Information Systems, with special emphasis on Electronic Commerce. The students were at various stages in the MBA program and majority of them hold full-time jobs in industry.

Students were asked to respond to a five-point Likert scale for different items where 1=Strongly disagree, 2=Disagree to some extent, 3=Uncertain, 4=Agree to some extent, and 5=Strongly agree. Most of the students felt that the retail storefront project was an important learning experience overall (mean=4.44). Students found the project instructive in terms of teaching them new ways of doing business over the World Wide Web (mean=4.35). They also thought that the project taught them skills they could use after the completion of the course, particularly the setting up of an online Web site for a product or service (mean=4.30). They also felt the project gave them a chance to create Web site content that was meaningful to the entire team (mean=4.30). In the construction of the storefront site, they thought that they learned the following specific skill sets in decreasing order of importance: design issues for creating an online catalog (mean=4.30); overall planning issues for preparing an online retail web site (mean=4.14); web site product information and content issues (mean=4.07); advertising (mean=3.84); and product/service promotional activities (mean=3.74).

The next important set of findings relate to the students' perceptions of how this project enhanced their ability to collaborate with peers in a team setting. Most students found the project a good venue for encouraging collaborative teamwork (mean=4.40). Communication skills were paramount in getting the work done (mean=4.33). While standards for personal accountability were set within the team setting (mean=4.30), members made sure they also helped each other out (mean=4.28). The project clearly taught the students a variety of group process skills: (a) looking out for the best interest of all concerned over and above one's own personal interests (mean=4.26); (b) arriving at mutually acceptable solutions (mean=4.26); (c) dividing the work equitably among members (mean=4.23); (d) practising interpersonal social skills (mean=4.21); (e) learning from members' different ways of thinking (mean=4.21); (f) learning positive interdependence (mean=4.21); (g) respecting a diversity of opinions (mean=4.16); and (h) striving for goals as a team rather than as individuals (mean=4.12).

They gained a better understanding E-Commerce as a subarea of Management Information Systems (MIS) in the School of Business curriculum (mean=4.07). The storefront project, which is a natural cross-over between marketing and MIS, made them more aware of the interdisciplinary connections within the business curriculum (mean=3.95). They perceived the project as a venue for learning about E-Commerce vendors of hardware and software (mean=4.28), consulting services (mean=4.12), professional associations (mean=3.79), and job openings (mean=3.63).

It is very likely that the positive experiences reported, thus, far would not have been possible if the Merchandizer storefront software itself was difficult to use. Most students found learning the software a fairly easy task (mean=4.19) and that they found it was a reachable goal to be skillful in the use of it (mean=4.14). The Merchandizer software templates were easy to understand (mean=4.07) so that students were able to learn them on their own without extensive instruction (mean=4.05).

Two important attributes of students in the sample were measured: frequency of computer use and length of time spent working with the computer. In a simple regression procedure, it was found that frequency of computer use significantly predicts students' perception of the ease of learning the Merchandizer software at the significance level of $p<.10$ ($F=3.24284$; $p=.0791$). In two other simple regression runs, it was found that the students' perception of the project as having enhanced collaborative team work predicts their perception of the storefront as being an important learning experience overall ($F=11.42868$; $p=.0016$) and their ability to create a web site with content that is meaningful to the entire team ($F=3.59981$; $p=.0648$). Then, students' perception of Merchandizer as an application software that was easy to use predicted their organizing skills in arranging web site information so that the site could be presented more effectively ($F=12.27518$; $p=.0011$).

When taken together as two independent variables in a regression equation, both the students' perception of the project as having enhanced collaborative team work and their perception of Merchandizer as an application software that was easy to use predict a number of dependent variables. Significance levels were tightest for their organizing skills in arranging web site information so that the site could be presented more effectively ($F=7.28378$; $p=.0020$) and their perception of the storefront as being an important learning experience overall ($F=7.14604$; $p=.0022$). Both independent variables in a regression equation also significantly predicted student's perception that the storefront project encouraged creative thinking ($F=4.12591$; $p=.0235$), their perception that the project enhanced their integrating skills or their ability to put information or content together ($F=3.40767$; $p=.0430$), and their perception that the project developed useful skills in web site development they could use even after the course was over ($F=2.62482$; $p=.0849$).

The association among selected variables using Pearson's correlation values was also investigated. Only those variables that bonded very strongly at the significance level of $p<.0001$ are shown here.

Learning important lessons in determining web site product information and content issues correlated strongly with the following seven variables: learning positive interdependence in the team (.4999); learning different ways of thinking in the team (.5271); achieving the goals as a team (.5511); considering the storefront project an important learning experience overall (.5193); creating web site content meaningful to the team (.4843); developing skills usable even after the course such as building a web site (.6225); learning overall planning issues in a storefront (.6334); and learning design issues for an electronic catalog (.6854).

Learning how to achieve goals as a team correlated strongly with five other variables: perceiving the project as encouraging collaborative team work (.7380); learning to communicate with team members (.7264); learning positive interdependence (.8872); learning interpersonal social skills (.8041); and learning how to achieve goals as a team (.9168).

Learning design issues for creating an online catalog correlated strongly with the following four variables: perceiving the project as encouraging collaborative team work (.5269); learning to communicate with team members (.5038); learning different ways of thinking in the team (.5784); and learning how to achieve goals as a team (.5380).

Learning different ways of thinking in the team correlated strongly with four other variables: perceiving the project as encouraging collaborative team work (.7333); learning to communicate with team members (.7026); learning positive interdependence in the team (.8792); and learning interpersonal social skills (.8245).

Conclusion

This paper has shown concrete data supporting the promise of the use of the WWW for instructional purposes in the area of E-Commerce in the business curriculum. Not only does the WWW provide an environment that perfectly simulates the subject of the course itself, but the web hosting service arrangement also provides information technology infrastructure support to universities that are resource poor or unable to afford the hardware, software, and manpower requirements of mounting E-Commerce projects. The survey results provide positive indications for the achievement of the goals of collaborative inquiry, team-based and active learning, constructivist pedagogical approach, and learning by doing.

References

Adams, D., & Hamm, M. (1996). *Cooperative Learning: Critical Thinking and Collaboration Across the Curriculum.* Springfield, IL: Charles Thomas Publisher.

Adams, D., & Hamm, M. (1995). *New Designs for Teaching and Learning: Promoting Active Learning in Tomorrow's Schools.* San Francisco, CA: Jossey-Bass, Inc. Publishers.

Carey, P. (1998). *Creating Web Pages with HTML.* Cambridge, MA: Course Technology.

Chizhik, A.W. (1998). Collaborative learning through high-level verbal interaction: From theory to practice. *Clearing House*, 72(1), September, 58-61.

Johnson, D.W., Johnson, R.T., & Smith, K.A. (1991). Cooperative learning: Increasing college faculty instructional productivity. *ASHE-ERIC Higher Education Report No. 4,* Washington, DC: The George Washington University School of Education and Human Development.

Pankratius, W.J., Young, M.W. (1995). Perspectives on education: A constructivist approach to an introductory course. *Education*, 115(3), Spring, 363-370.

Didactical Activities and Strategies in the Use of WWW-based Course-Support Environments: Design Guidelines for Instructors

Elka Remmers and Betty Collis
Faculty of Educational Science and Technology, University of Twcnte, Enschede, The Netherlands
e.remmers@edte.utwente.nl, collis@edte.utwente.nl

Abstract: New developments in educational technology at the University of Twente are providing instructors with a set of tools and templates for WWW-based course-support environments. Those templates can be used by the instructors to fill in learning activities and study material for all students, both local and at a distance. The task for the instructional designer is to create these general templates and make them suitable for different kinds of teaching situations. To guide the instructors in how to use those tools and templates, a series of design guidelines for the use of the WWW have emerged for each of the following didactical activities: face-to-face sessions, self-study activities, assignments, monitoring and feedback. Those guidelines are based on the experience of the Faculty of Educational Science and Technology at the University of Twente with the implementation of approximately 44 courses supported by WWW-based environments in the context of the TeleTOP Project (http://teletop.edte.utwente.nl/) as well as on instructional principles that predate WWW use. The paper concludes by noting the need for a course (re-)design model which combines the guidelines into an overall perspective.

A new role for instructional designers.

New developments in educational technology as well as new insights in the experiences of instructional design and information and communication technologies are stimulating new roles for instructional designers. Their major tasks are not to transmit the educational content, but to design activities; not to design hyperlinked learning materials, but to design and develop templates which can be used in multiple situations in which students are active and using WWW tools and environments to support and manage that activity. Their task is to design these tools and functionalities, so that instructors in turn can design their own activities and study material with those tools.

At the Faculty of Educational Science and Technology a WWW-based course-management system has been developed in which tools and functionalities are collected in a database which serves as a general base of templates (This system is called *TeleTOP*; see Collis & De Boer, 1998; see http://teletop.edte.utwente.nl). The instructor chooses the templates or functions he or she desires to support the course, and only has to type into various types of fill-in forms to organize the notes and other material that is to be put into the WWW environment. If a template is not available that meets the instructor's needs, the TeleTOP team creates it.

As the instructors are confronted with the task of choosing tools and functionalities for their courses, they express a need for educational and didactical guidance (Evaluatiewerkgroep TeleTOP en C@mpus+, 1999). In response to this growing need, the new-generation instructional designers of the TeleTOP team have created a set of design guidelines for instructors (Remmers, 1998). Those guidelines can be sorted around five general types of didactical activities which focus on a direct learning process: face-to-face sessions, self-study activities, assignments, monitoring and feedback (Collis, 1997). Communication is a major aspect within all the acitivities. For each didactical activity a variety of different types of (WWW-based) applications can be used. In Table 1 an overview of a sample of such applications is listed for each activity, as well as the numbers of the guidelines that are related to those activity-application combinations (the numbered guidelines are elaborated later in this paper).

Table 1: Didactical activities, their applications and the related guidelines

Didactical activities	Applications	Guidelines
Face-to-face sessions	1. Preparation of material	2
	2. Powerpoint presentation materials	2
	3. Discussions	2
	4. Small assignments	2
Self-study activities	5. Readings and textbooks	3, 5
	6. Quizzes	3, 5
	7. Simulations	3, 5
	8. Uses of asynchronous video	5, 6
Assignments	9. Small assignments	7
	10. Follow-up assignments	4, 7
	11. Asynchronous discussions	7
	12. Quizzes	7
	13. Students contribute to the study material	7, 8
	14. Case studies	7, 8
Monitoring and feedback	15. Individual feedback	12
	16. Group feedback	12
	17. Administration of submitted work of students	9, 11
	18. Peer evaluation	12
	19. Student digital portfolio	9
	20. Quizzes	9, 10

In the next sections the didactical activities are discussed in more detail. Every section discusses the following: (a) backgound information; (b) the manner by which TeleTOP supports the activity and what tools are available for the TeleTOP instructors; and (c) guidelines derived from practice and theory.

Face-to-face sessions and the WWW environment

Face-to-face contact between the instructor and the student as well as between students are still not-to-be neglected instructional activities even when the WWW is extensively used. "It is to the learner's advantage to occasionally come to a face-to-face setting interacting directly with the instructor and peers. Some learning experiences, plus the more-intangible aspects of developing as an intellectual (called in Dutch, *academisch vorming*), are more than the sum of reading books and completing assignments from the convenience of one's home" (Carleer & Collis, 1998). Moreover certain skills as, for example, applying statistical formulas are sometimes only learned by the active discourse between instructor and student, at least for some students.

During the contact session: For students who live at a long distance from the educational institution, the amount of face-to-face sessions must be kept to a minimum because of time and money issues. Therefore, the face-to-face sessions should be used to address only the most important subject matter or activities (see Guideline 1 and Figure 1). The evaluation study of TeleTOP concluded that part-time students, students who carry out a profession elsewhere and study part-time, and students with a part-time job particularly wish to have *elaborations* of the study material in the face-to-face sessions, not to have the time filled up with listening to *organisational aspects* of the course, which they can read in the WWW-based course environment (Evaluatiewerkgroep TeleTOP en C@mpus+, 1999). Thus, Guideline 1:

1. Use face-to-face sessions:
   - to provide the context of the course and the subject matter
   - to show relations between topics in the learning material
   - to explain difficult and essential issues
   - to show (good) examples of applications or assignments
   - to make the students enthusiastic and inspire them
   - to let the students interact and have discussions with one another
   - to reflect upon submitted work
   - to invite expert guest speakers on the subject matter

   Do not use the face-to-face sessions:
   - to provide organisational aspects of the course
   - to repeat what students can read

Figure 1 reflects Guideline 1, showing how a face-to-face session was used in the course "Tele-Learning", not as a lecture, but for a variety of activities, capitalising on the presence of a guest visitor from another institution whose work relates to the study material for the week.

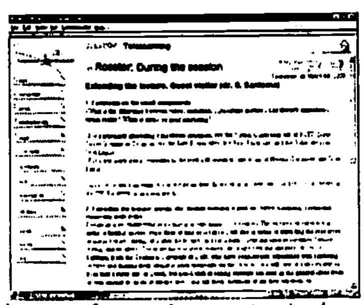


Figure 1: Example of the topics discussed during a face-to-face session in the context of a course which is given partly at a distance, Telelearning course, 1999.

Also, it is necessary to prepare a contact session so that students who were not able to be physically present (especially part-time working students) can also participate, either at the same time but at a distance or at a later time. This typically has three aspects: (a) any content material to be elaborated in the contact session by the instructor is prepared in note form in advance and made available on the WWW environment for students who will not be present; (b) an interactive activity (a discussion, a short analysis task, a problem to work out, etc.) is devised that can involve the students attending the contact session at the same time (and perhaps some of them in different locations) so that the students are actively engaged in some sort of articulation and collaborative learning; (c) support materials to guide this interactive work, plus to be used by the students to report on their work, are created and put in the WWW course environment (see Guideline 2).

2. Prepare the face-to-face session so that students not physically present can also participate (synchronously or asynchronously), by providing the content material to be elaborated, an interactive activity, and support materials to guide this interactivity.

Students' preparation before the session: For the students to carry out an assignment during a face-to-face session, to have discussions, and to reflect on assignments it is necessary for them to have a basic understandnig of the subject matter before they come to the session. For this reason the TeleTOP team has designed a specific kind of matrix-like structure called a *roster*, containing self-study activities to be carried out before the session (see Guideline 3 and Figure 2) that are integrated (via being in the same row) with notes and activities for the face-to-face sessions.

3. To provide students with the necessary basic understanding of the subject matter, give them self-study activities before the session, integrated in the WWW environment.

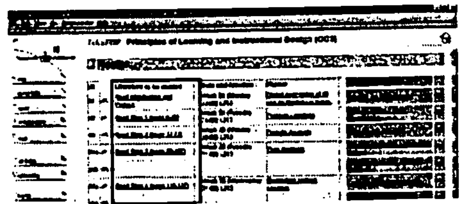


Figure 2: Example of the roster of a WWW-based course-support environment in which the students have to study certain literature before the class session: Principles of Learning and Instructional Design CC3, 1999

Follow-up after the session: After the session a follow-up activity to structure students' reflections on the contact session and how it integrates with their self-study materials and their other course activities can be planned. The instructions for this activity and the reporting form for the students to use are entered into the WWW environment before the contact session. A cut-off time should be indicated for the submission of the follow-up activities from the students, and after this time, the instructor should look at their submitted comments and post a feedback response in the WWW environment or by email (for example, a different comment may be appropriate to the part-time students than to the local students). See Guideline 4.

4. To structure students' reflection on the contact session and to relate it to the study-materials, provide students with a follow-up activity and a WWW-based template through which they submit their work relating to this activity, and indicate a cut-off time for this submission.

Self-study activities

The profile of the ideal professional practitioner requires that students should possess a solid knowledge base with regard to the profession (Verhagen et al. 1999). In general, self-study could be used for rehearsal of knowledge and for reflection on this knowledge. Reflection is oriented towards realising learning tasks: to process and to refine insight and understanding (De Jong, 1995).

Self-study activities are mostly used in TeleTOP as a preparation for face-to-face sessions and assignments and for the replacement of face-to-face sessions if necessary. For self-study activities, as well as for assignments, it is very important that they are not a stand-alone and independent activity. They should be implemented in the course WWW environment with for example an explanation of the relevant issues of the self-study activity, the active involvement of the learner, feedback from the instructor and repetition (Westera, 1999, see Guideline 5); otherwise students will not feel much value in the activity.

5. For self-study activities to be more effective, provide students with the relevant issues to interpret in terms of the study materials, provide WWW-based templates for the students that structure their active involvement, feedback and repetition.

The following applications could be used in TeleTOP for self-study activities: study guides, quizzes, simulations, and asynchronous audio and video. Quizzes will be discussed later in this paper.

Asynchronous audio and video: For students who were not participating in the contact session as it occured, the instructor has the possibility to capture via digitised audio and/or video anything needed to make the notes more effective for those students who will study the materials later. In this way the communication event is captured and can be re-used (Peters & Collis, 1999). Other reasons for using asynchronous video are described in more detail in Peters and Collis (1999) and are summarized in Guideline 6.

6. Use asynchronous audio and video: • to capture presentations or lectures • to give access and depth to real events • to support the learning process in situations involving procedures or social situations • to develop a library of cases or units of learning material • to capture and share one's own video materials

Self-study activities are primarily oriented around the acquiring, rehearsal, and reflective consideration of knowledge, whereas assignments are more focussed on the application of the students' knowledge base and insights into practice (see the next sextion).

Assignments

It is generally accepted that if you "put students to work" they learn more (De Jong, 1995; Collis, 1998). For this, the term action learning is used. Meyers and Jones (1993) identify four major elements associated with action learning which students use to create new mental structures: speaking, listening, reading, and writing and reflecting. Those elements refer to cognitive activities which enable students to clearly investigate, consolidate, and acquire new knowledge. For example, when conducting a discussion, the process of telling clears the thoughts of students, whereas listeners have the possbility to reflect on alternatives to one's own perspectives (Peters, 1998)

Within TeleTOP there are several ways to put the students to action: small assignments (before, during, after or in-between contact sessions), working on case studies, making contributions to the course study material, developing their own research questions and discussions, and contributing materials that can be used as model answers or help resources. For assignments to be effective some of the issues mentioned in Guideline 5 are also important for the implementation of assignments. These are summarized in Guideline 7.

7. To help make assignments be more effective, provide students with relevant issues relating to the topics to be studied, use WWW-based templates that help structure and manage the active involvement of the students and that integrate feedback with the assignments; when possible, use student submissions as a basis for study and reflection in the course itself.

Small assignments: One of the major orientations of the TeleTOP method is to reduce the number of lectures and increase the number of "in-between assignments", relatively small assignments to which feedback is quickly given. The process for handling this is supported within the Roster of the course-support environment (see Figure 2). The trick is to make the management of this process as automatic as possible, while still maintaining instructor contact when useful. This becomes the major task of the instructor: to think of these assignments, and of how they can be carried out efficiently and effectively (i.e., both instructor and student getting regular insights into how the learning process is going on).
In TeleTOP the instructors have the possibility to let the students submit their work on (small) assignments in the WWW environment during a face-to-face session, but also before or after a session. Before the session, to help the students become familiar with the subject matter. After the session, to let the students reflect on the presentation of the instructor, on the answers to the assignments, or on ideas that emerged during the face-to-face session, etc. However, assignments need to be assessed or else students tend not to do them and the learning potential is not realized. "Although students appreciated the follow-up assignments, they often did not have time to carry them out if they were not given points but only offered on a voluntary basis" (Dijkstra, Collis & Eseryel, 1999).

Students' contributions to study material:Another major orientation of TeleTOP is that students can contribute study resources to the course-support environment. This can occur in many ways: for example, through adding to a FAQ (frequently asked questions) collection, adding to a database of examples, supplying model answers, adding links to external resources, adding definitions to a course glossary, and constructing and sharing one's own video & WWW resources (Collis, 1998). The most important function of the students contributing to the course study material is to stimulate a more-active learning process among the students, by providing valuable exercises and letting them participate in building the course environment by finding or creating resources and sharing them with others (Dijkstra, Collis & Eseryel, 1999). For example, "Students appreciated being able to read the contributions of other students in the shared workspace" Dijkstra, Collis & Eseryel (1999).

Working together on case studies: If correctly applied, case studies are suitable for developing skills for problem-solving, for critical thinking, and for creativity (Romiszowski, 1995). For part-time students who carry out a profession as well follow a study, exercises with case studies can be done by placing the case study in the contexts of their work. The TeleTOP system allows different assignments to be described for different groups of students: the students only see the descriptions for the groups to which they belong.
For both the students' contributions to study material and for the case studies, TeleTOP offers the tools *workspace* and *presentation*. At the workspace students can work together on certain assignments and only the group members can enter the group workspace. They can work for example in an on-going way on their case-study exercises or their self-developed study material (see Figure 3). To make the workspace not too complicated, overly fulled with files and comments, the students can present their final work in the section *presentation*. This function could present in a well-organised overview the final products of the groups for all students to access (see Guideline 8).

8. To let the students actively learn or develop skills for problem-solving, critical thinking and creativity, use students' contributions to study material and case study exercises as resources in the course WWW environment: • Let the students work together in a shared workspace and present their final products in a separate part of the course environment. • For part-time students use the context of their work experiences for their case studies.

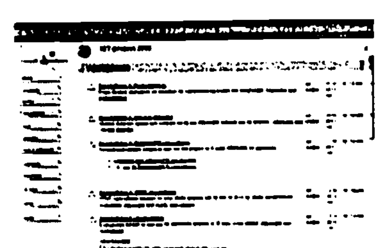


Figure 3: Students working together in the Workspace (in Dutch: Werkplaats). ICT-project 2000 course. 1999.

Monitoring and feedback

One of the reasons for monitoring which Dodman and Coxhead (1994) have put forward is: monitoring students and groups of students to see which parts the students do not master and which they do not master very well. In classical situations monitoring takes place on the basis of the experience and knowledge of the expert, the instructor (Winnips, 1998). In telelearning situations the instructor may not always be present physically, which could result in limited feedback on the progress of the individual students or on a group of students. By applying monitoring strategies, this progress can be made clear and actions can be undertaken if problems should occur.

TeleTOP offers the instructors a number of tools which could make the monitoring of students and group of students easier (see Guideline 9). *Quizzes* (with multiple-choice questions, short answers, true-false, etc.) and *clear overviews of the submitted work* of students are all being used by the instructors of the faculty of Educational Science and Technology. In the beginning of August 1999 the faculty initiated a *digital portfolio* project (see Guideline 9):

9. To monitor the work and progress of the students, use WWW-based *quizzes*, *overviews* via the WWW-site *of the submitted work of students*, and *digital portfolios* accesible via the WWW-site.

Quizzes: When using quizzes in his or her course, the instructor can get a glance at the understanding of the students relating to the topics which are covered in the quizzes (see Guideline 10 and Figure 4). The answers to the questions in the quiz are sent to the instructor and if a student answered (several) incorrect answers, the instructor could take action and give appropriate feedback to the student. Students can also submit quiz questions themselves, as small assignments during the course.

10. Use WWW-based quizzes to monitor the understanding of the students of the subject matter. Let the answers be sent to you via the WWW-site. Consider the strategy of having students contribute quiz questions via the WWW-site as an assignment, which are then used by all the students for self-study.

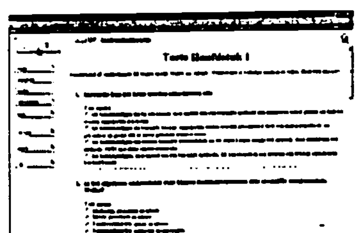


Figure 4: Questions created by the instructor in the course Instructional Theory I, 1999

Overview of submitted work: As the instructor has chosen that the students will submit assignments through the roster, the instructor is able to get an overview of each item of submitted work of each student and can give the student immediate feedback or remedial help and perhaps a mark or some number of points (see Guideline 11 and Figure 5). If the instructor decides to give the students points for the assignments, the overview will also show the total amount of points per student at each moment in time. The instructor should keep track of the student's submissions, and send a message to students who did not submit to find out if they are having particular problems (this message can be pre-structured, so the time and effort needed to send it can be small).

11. To monitor the comprehension of the students as to how to apply their recently acquired knowledge into practice, use an overview of the submitted work of students in which direct links are available to the work of the student, the submitted date, the feedback to the students, the points given; all ordered by student

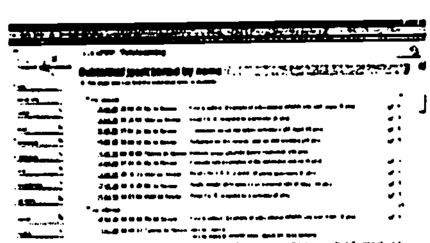


Figure 5: Overview of the submitted work of the students and of the given feedback (checkmarks) and points. Telelearning course, 1999.

Feedback: When feedback is needed, as a consequence of monitoring or as a reflection on the work of students, the instructor has the possibility to (a) provide individual feedback via the course environment (this feedback can only be seen by the instructor and the particular student), (b) provide public feedback (feedback that is meant for one student, but can be read by all students), (c) provide feedback to a group of students, (d) give one key-answer to all students, and/or (e) let students give feedback to themselves and each other (self- and peer evaluation). See Guideline 12.

12. Give the students via the WWW-site:
- personal feedback when they all have to carry out the same assignment.
- public feedback when you want them to learn from each other's answers or maybe use each other's answers for a new assignment.
- group feedback when the numbers of students of the course is large and could not be handled with personal feedback with regard to time constraints
- one answer key to all students when many students make the same mistakes in their answers.
- peer feedback when you want to guide the students in learning how to evaluate and give feedback

Digital portfolios: As a current development for the Faculty of Educational Science and Technology, the students' overall progress within all their courses is being monitored by the use of students' digital portfolios. Individual assessment will still take place by the instructors of the particulair courses, but overall monitoring and support will be done by faculty members serving as mentors. This type of support is designed to stimulate the professional growth of the student by examining his or her added products and documentary evidence relating to his or her work.

How to re-design your course for the use of a WWW-based course support environment?

The above-mentioned guidelines and applications are a handle for the instructors when they are (re-)designing their courses to make them suitable for WWW-based course support or tele-learning purposes. Although the instructional principles underlying the guidelines may not be new in themselves, what is new are increased possibilities for putting these principles into practice through the support of WWW-based tools and environments. Also, WWW tools and environments are being used by many instructors (i.e., in technical faculties) who are not familiar with instructional design theories. The guidelines are written in a pracical way to steer the use of the WWW for good pedagogical practice.

The set of guidelines can be elaborated with new experiences of instructors and students, as well as with new developments in educational concepts. On a regular basis, new guidelines are being designed and added to the set of guidelines that we now have. However, there is also a need to put the guidelines in a broader perspective in such a manner that instructors will know when to choose certain applications in certain didactical situations (especially important for novices). This could result in an instructional (re)design model for WWW-based course-support environments.

References

Carleer, G.J., & Collis, B. (1998, June 15). *Extending good teaching with technology*. Paper presented at the 1988 EDEN Annual Conference, Universities in a Digital Era, Bologna, Italy.

Collis, B. (1998). New didactics for university instruction: Why and how?. *Computers & Education, 31*(4), 373-395.

Collis, B. (1997) Pedagogical reengineering: A pedagogical approach to course enrichment and redesign with the WWW. *Educational Technology Review, 8*(3), 11-15.

Collis, B., & De Boer, W. F. (1998). Rapid prototyping as a faculty-wide activity: An innovative approach to the redesign of courses and instructional methods at the University of Twente, *Educational Media International (EMI), 35*(2), 117-121

De Jong, J.A. (1995). Activerende didactiek: een theoretische orientatie. In J.W.M. Kessels & C.A. Smit (Eds.), *Activerende werkvormen voor groepen. Opleiders in Organisaties*. Deventer : Kluwer Bedrijfswetenschappen.

Dijkstra, S.A., Collis, B. & Eseryel, D. (1999). *Instructional design of WWW-based course-support environments: From case to general principles*. Paper presented at ED-MEDIA '99, Seattle.

Dodman, E. A., & Coxhead, J. F. (1994). *Measuring and monitoring student learning using an educational software engineering environment*. CLCE '94 (pp.87-90). University of Joensuu, Finland. [WWW document] URL: http://cs.joensuu.fi/~mtuki/www_clce.270296/Dodman.html

Evaluatiewerkgroep TeleTOP en C@mpus+. (1999). *Evaluatie TeleTOP en C@mpus+ 1998/1999. End Report*. Internal report. Enschede: Faculty of Educational Science and Technology, University of Twente.

Meyers, C., & Jones, B.T. (1993). *Promoting active learning: Strategies for the college classroom*. San Francisco: Jossey-Bass Publishers.

Peters, O. (1998). *College 'nieuwe stijl': Actief leren in kleine groepen*. [New style lectures: action learning in small groups]. Internal report. Enschede: University of Twente.

Peters, O., & Collis, B. (1999). *A Framework for WWW-based constructivistic learning environments: Combining streaming media and WWW functionalities*. Paper submitted for ED-MEDIA 2000, Montreal.

Remmers, E. (1998, 13 May). The TeleTOP approach summarized in design guidelines. In Collis, B.A., Boer, W.F., Peters, O., Remmers, E., Strijker, A., & Verheij, G.J., *An action research plan for TeleTOP*. Proposals for the ORD '98 (Onderwijs Research Dagen), the yearly Dutch-Belgium conference for Educational Research, Enschede, The Netherlands.

Romiszowski, A.J. (1995). Opleiden op afstand, de toepassingen. In J.W.M. Kessels, & C.A. Smit (Eds.), *Opleiders in Organisaties*. Deventer: Kluwer Bedrijfswetenschappen.

Verhagen, P., Sorgedrager, I., Kornelius, L., & Winnips, K. (1999). *Handleiding mentorgroepen in Toegepaste Onderwijskunde*. [Manual for mentorgroups in the faculty of Educational Science and Technology]. Internal report. Enschede: Faculty of Educational Science and Technology, University of Twente.

Westera, W. (1999). A didactic framework for audiovisual design. *Journal of Educational Media, 24* (2), 87-102.

Winnips, K. (1998, May 25). *Monitoring*. Presentation at the conference 'Effecten van teleleren in het hoger onderwijs. Van illusie naar idylle.' [Effects from telelearning in higher education. From illusion to idyll] Enschede: CTIT, University of Twente.

From the "Invisible Web" to Google: Techniques for Improving Web Searching

Judi Repman
Department of Leadership, Technology and Human Development
Georgia Southern University
Statesboro, GA USA
jrepman@gasou.edu

Randal D. Carlson
Department of Leadership, Technology and Human Development
Georgia Southern University
Statesboro, GA USA
rcarlson@gasou.edu

Elizabeth Downs
Department of Leadership, Technology and Human Development
Georgia Southern University
Statesboro, GA USA
EDOWNS@gsmvms2.cc.gasou.edu

Ken Clark
Department of Leadership, Technology and Human Development
Georgia Southern University
Statesboro, GA USA
kclark@gasou.edu

Abstract: New search tools and techniques that can improve the efficiency and effectiveness of web searches are highlighted, including metasearch tools, improving search relevance with search engines (backward searching and other advanced search features), and searching the "invisible web".

Comprehensive Searching with Metasearch Tools

A recent article in *Nature* (July 8, 1999) by Steve Lawrence and C. Lee Giles received wide attention in the press. Lawrence and Giles examined the World Wide Web in February 1999 and found that publicly indexed web pages had increased to 800 million (up from an estimated 320 million in December 1997). Their article analyzed how well eleven search engines/directories performed in accessing the information contained in those 800 million pages. Lawrence and Giles estimated that the combined coverage of the 11 tools was only 42% of the total web and that the overlap among the search engines was surprisingly low. This research implies that using multiple search engines is a necessity today. Metasearch tools allow us to do just that -- quickly and effectively. Popular metasearch tools include ProFusion (http://www.profusion.com), Metacrawler (http://www.metacrawler.com) and SavvySearch (http://www.savvysearch.com).

Improving Search Relevance with Search Engines

Most of us probably have a favorite search tool, such as Yahoo!, Infoseek, or Excite, and there is certainly something to be said for developing a high degree of familiarity with the search features of a single search engine or directory. However, in the rapidly changing world of the web, it is important to be aware of new search tools and the features that they use to try to improve the relevance of results. New search algorithms are developed regularly, usually in conjunction with a new search service.

Google (http://www.google.com) is one of the most exciting search tools available today. Google's search algorithm is based on an approach called PageRank. The FAQ states that, "PageRank capitalizes on the uniquely democratic characteristic of the web by using its vast link structure as an organizational tool. In essence, Google interprets a link from page A to page B as a vote, by page A, for page B. Google assesses a page's importance by the votes it receives. But Google looks at more than sheer volume of votes, or links; it also analyzes the page that casts the vote. Votes cast by pages that are themselves "important" weigh more heavily and help to make other pages "important"
(available online at http://www.google.com/why_use.html). Google allows users to capitalize on this by choosing an "I'm feeling lucky" button. When this button is chosen the user is directly linked to the page Google identifies as the most relevant. A search limited to United States government sites is also available through Google. A recent addition to Google is a directory, featuring a hierarchical list of sites organized by category. Unlike the more familiar Yahoo directory, the Google directory is based on the same page ranking algorithm used by the search engine.

Oingo (http://www.oingo.com/) suggests that it is the first meaning-based search engine. When a search term or phrase is entered, Oingo returns with one or more dialog boxes that allow the user to specify the exact meaning of the word or phrase in the context of the search. For example, when the search string "travel to Montreal" is entered, Oingo asks the searchers to specify the meaning of two terms, travel and Montreal. For travel, the user is asked to choose between several shades of meaning (from commercial travel to locomotion) and for Montreal, the searcher is asked to specify one of several different locations for towns or cities named Montreal. After the meanings are predefined the search is narrowed and results are presented. Results include categories (from Oingo) and individual web sites (from Alta Vista). Those results that match the predefined meanings are indicated using a lightbulb icon. Another interesting feature of Oingo is that it asks for feedback from the searcher.

While Surf Fast (http://www.surffast.com) isn't based on a new searching algorithm, it does provide "one stop shopping" for web searchers. This well organized page provides keyword searching for all of the major search engines, plus quick access to major news organizations and other useful web resources such as Mapquest and Travelocity. Surf Fast shows how important it is to match the kind of information needed to the search tool. Making this match is crucial in improving search relevance.

Chris Sherman suggests the term "backward searching" for the technique of using the "link" operator to identify pages linked to the URL that you have entered (http://websearch.about.com/library/weekly/aa082499.htm). The basic idea here is that people only add links to sites that they consider highly relevant, although searchers still need to determine whether or not popularity actually equals quality. Backward searching is done using a link operator. Queries are usually structured like this: +link:URL. To assess quality, look over the list of "linking" URLs. Are all of the links from individual pages or are the links from well respected sites like Kathy Schrock's Guide for Educators (http://school.discovery.com/schrockguide/index.html) or the Librarian's Index to the Internet (http://sunsite.berkeley.edu/InternetIndex/)? If you find a promising page and you follow these "backward" links, you get a sense of whether others find the page so useful that they link to it. Backward searching is just one of the many advanced search features included in different search engines. Unfortunately it can be a challenge to locate information about using advanced search features. At Infoseek you have to choose advanced search then choose help before you come to this information (http://infoseek.go.com/find?pg=advanced_www.html&ud9=advanced_www).

Searching the "Invisible Web"

Many useful and relevant resources cannot be retrieved using standard web search tools. ERIC, online library catalogs, and archival resources are examples of resources that are simply not retrieved by the spiders and bots used to build search engine databases. If you have ever spent hours fruitlessly searching for information you're sure is accessible electronically, the information is probably "hidden" on the invisible web. And if students tell you that they couldn't find *even one article* on a common topic, they have probably been doing a web search, not searching in a specialized database. Students often do not understand the difference between information on web pages and information found in databases and indexes. Identifying places to search for these "invisible" resources is one step toward developing this understanding.

Direct Search (http://gwis2.circ.gwu.edu/~gprice/direct.htm) is a comprehensive index maintained by Gary Price at George Washington University. Direct Search provides links to a variety of education specific resources, plus general interest resources including Your Nation (which uses data from the CIA World Fact Book to create customized, comparative statistical profiles for different countries), Termium Plus (billed as the definitive French-English dictionary), and the Writer's Guidelines Database. Lycos provides access to over 300 searchable education databases at http://dir.lycos.com/Reference/Searchable_Databases/Education/. Infomine (http://infomine.ucr.edu/) permits multiple database searching, which is a significant time saver, and it also has two long lists of instructional resources databases (for K-12 and for higher education). The Invisible Web (http://www.invisibleweb.com/) includes both quick and advanced search features. Like Direct Search, The Invisible Web was specifically designed to provide a well organized interface between end-users and information on the invisible web. Categories listed under "education" range from "Alumni and Reunions" to "Distance Learning" but the category structure is simple to follow and provides an excellent approach to each topic. A Hot List of commonly searched topics is clearly presented. Currently the only search enhancements available through advanced search are Boolean and phrase searching.

Research by Hertzberg and Rudner (1999; "The Quality of Researchers' Searches of the ERIC Database", available online at http://epaa.asu.edu/epaa/v7n25.html)) indicates that even experienced web searchers rarely use advanced searching techniques to improve the quality of their searching. Citing results from a study of users of the ERIC database, Hertzberg and Rudner conclude that "Patrons are not using effective search strategies and cannot possibly find the best and most relevant articles in the database being searched. We have reason to believe that most end-users are satisfied with *any* somewhat-relevant hit." (p. 8) If this is the case in a controlled searching environment like ERIC, it is even more of an issue on the web, where search tools and techniques are much less obvious to end-users. Web searching is a complex activity that requires a considerable amount of knowledge, critical thinking, and practice. The good news is that it is a skill that can be perfected, but the bad news is that the strategies and tools available change daily. A recent visit to the Search Engine Guide (http://www.searchengineguide.com/) found a categorized listing of over 3200 search tools, which implies that there is a specialized search tool available to meet virtually any information need. Useful resources for keeping up with the latest trends in searching include the Search Engine Showdown (http://www.notess.com/search/) and Search Engine Watch (http://searchenginewatch.com/). Both sites specialize in providing current news about web searching and both also include critical evaluations and comparisons of search tools.

Moving an Australian Dual Mode University to the Online Environment: A Case Study

Shirley Reushle
Distance Education Centre
The University of Southern Queensland
Toowoomba, Queensland, Australia
reushle@usq.edu.au

Jacquelin McDonald
Distance Education Centre
The University of Southern Queensland
Toowoomba, Queensland, Australia
mcdonalj@usq.edu.au

Abstract: This paper discusses an educational initiative, USQ*Online* which has enabled the University of Southern Queensland (USQ), Australia, to deliver multiple courses via the Internet to students worldwide. The paper briefly outlines the underlying structure and philosophy of distance education at USQ and then describes how the online initiative has evolved from this existing distance education infrastructure. The paper reflects on the conceptualisation and initiation of the USQ*Online* project and the consequences of an apparent shift in the pattern of teaching and learning in a higher education institution following the introduction of online teaching. An interim evaluation conducted by the authors makes the following recommendations: open communication, consultation and collaboration should form the basis of such a major institutional initiative; roles and responsibilities of all stakeholders should be clearly defined; synergies and alliances with strong partners are essential; and there should be sound technological support at all levels.

Background

In recent years, higher education worldwide has been faced with significant change which has been in response to a number of influences (Armstrong et al., 1997, Askew & Carnell, 1998). These influences have been the greater emphasis on lifelong learning and the advent of the Information Age, resulting in globalisation and a move to a knowledge society. Also, economic rationalism has required universities to enter the commercial arena (Coaldrake & Stedman, 1999; Dearing, 1997). Student cohorts have also made further demands on universities for greater flexibility in the ways they are able to access programs and services. The adoption of flexible learning methodology has been a key initiative in many institutions in an attempt to adapt to this changing environment. In addition, information and communication technologies have created new educational opportunities and challenges, which impact upon distance education models and theory and challenge the traditional roles of teachers and learners. The paper will now examine the impact of these changes within the context of an Australian institution of higher education.

USQ is an internationally recognised leader in the provision of flexible learning opportunities and has a well-established Distance Education Centre. In 1999, the Executive Committee of the International Council for Open and Distance Education (ICDE), based in Oslo, Norway, awarded its inaugural Prize of Excellence to USQ in recognition of the University's significant contribution to providing global education. In 1967, USQ was first established as a face-to-face Institute of Advanced Education, moving to full university status in 1992. In 1977, it presented itself as a viable alternative to traditional universities by offering distance education. Distance education has been defined according to several characteristics: separation of teacher and learner; the existence and influence of an educational institution; use of various media; provision of two-way communication; and an absence of group learning with the focus on independent learning (Keegan, 1986; Rumble, 1986). In Australia, a typical distance education learning package consists of print-based materials supported by audio, video and computer-based resources and is designed to enable learners to interact independently with the materials.

USQ delivered distance education while continuing with classroom-based teaching, earning it a 'dual mode' label. This experience in dual mode delivery has strategically positioned USQ to take advantage of possibilities created by the advent of information and communication technologies and the move to online delivery. The university services over 14,000 distance students from every state in Australia, and many overseas countries. It also provides on-campus, face-to-face delivery for 5,000 Australian and international students. USQ is a regional university with an international mission. Almost seventy-five percent of the students studying with USQ are off-campus and more students study offshore through flexible learning modes at USQ than with any other Australian university. Providing learning experiences at a distance using an electronic delivery mechanism presents further challenges but also opens up a whole new world of opportunities and possibilities. For one, the approach questions the traditional definition of distance education as having an independent learning focus and lacking in group interaction.

USQ delivered its first course solely online in 1997. In 1999, a major online initiative called USQ*Online* (http://www.usqonline.com.au) was introduced. This initiative enables the delivery of multiple courses via the Internet to students worldwide. USQ*Online* presently offers 29 award courses and has involved all six Faculties within the university and approximately one quarter of the 400 academic staff. It involves a contractual arrangement with an independent commercial provider, a company in which USQ is a shareholder. Aiming at a mass global market, it provides a complete delivery package - the administrative structures (including enrolment), delivery platform, and mirror sites around Australia, Asia and North America.

Change in Higher Education

The introduction of the online initiative has caused major cultural and administrative change within USQ. The institution has responded to the current influences and demands and has made some substantial changes to the way it offers its programs and services. Many of the institutional systems have had to undergo major reform and the pedagogical framework of "traditional" distance education has been challenged by the unique possibilities of online delivery. There has also been quite significant organisational restructuring to enable the implementation of a more corporate approach to management at the University. Teaching online has had an enormous impact on academic staff roles and workloads, and on the conceptualisation of models of online teaching and learning.

The literature supports the belief that the most critical barriers to change in educational processes are "personal" ones. Kefford (1980) maintain that the most decisive factor in ensuring the success of change in educational organisations is the positive reaction and commitment of the personnel affected by that change. According to Waugh and Punch (1987), there are basic generalisations common to all educational change and these can be incorporated into ideal-type models for implementing change. Waugh and Punch have extracted general variables that should be included in such models, identifying the variables as:

- overall feelings and attitudes towards the previous system, particularly so with regard to teachers who have been in the system for a long period of time. They may not be receptive to change that challenges their traditional values and those of the organisation and previous system;
- the extent of alleviation of fears and uncertainties associated with the change. The lack of knowledge about the proposed change may hinder receptivity to that change and teachers should be encouraged to be actively involved in the decision making process;
- the practicality and importance of the new education system; and
- the personal cost appraisal for the change. Teachers will tend to appraise the value of the proposed change in terms of the amount of incentive and support received to implement change; the amount of energy, time and difficulty involved in having to learn new skills; and the effects on students, on home life, and on personal satisfaction.

Coaldrake and Stedman (1999) observe, "universities more so than most organisations are built on a culture of individualism and academic personal autonomy" (p. 1). The roles of staff and students in the traditional tertiary education framework have been established over hundreds of years. The traditional academic culture has been labelled a "person" culture by Handy (1993, in Laurillard & Margetson 1997), with an emphasis on individualism for both staff and learners. In this culture, academics work autonomously on the preparation of face-to-face teaching materials. It is very much an individual task, with the control of content an individual responsibility. The Distance Education Centre at USQ was established to facilitate design, production and delivery of material for students separated from a tertiary institution by distance, creating what Laurillard & Margetson (1997, p. 3) call a "role culture" or industrial model of education. The introduction of distance education caused considerable tension between the "person" culture and the emerging "role" culture. The role culture of traditional distance delivery means that course material is delivered in print, is therefore available for peer scrutiny and usually prepared in a team environment. The team approach is deemed essential because there is no one person who can design and deliver the teaching/learning programs that are epitomised by distance education, suggesting that perhaps "educators...must...drop the arrogance of academic isolation" (Limerick et al. 1998, p.11) within this culture.

The Study

In order to reflect on the initiation and conceptualisation of the USQ*Online* project within the context of organisational change, the authors conducted an interim evaluation with a representative group of academic staff at the university. This was a preliminary investigation and the authors are not suggesting that the initiative has only affected academic staff. Through an analysis of data collected from interviews, the authors were able to reflect on the staff perceptions of the online initiative. The interviews were conducted over a one week period with staff from a cross-section of Faculties and levels. This was to gain a snapshot view of the perceptions of the initiative, its conceptualisation, initiation and its communication to the university community. The interviewees were sent the questions (see appendix 1, Interview Questions) prior to the interview to allow time for consideration. The structure of the interview was followed closely to give consistency in the data collection, although the opportunity for extended exploration of the themes and more free-ranging discussion was available within the interview context. As a result of analysis of the interview data, the paper identifies key challenges and experiences that have emerged and offers proposals from which others interested in institutional change and transformation might benefit.

Findings and Recommendations

Communication, Consultation and Collaboration

According to the interview data, there was a concerted attempt to inform and consult with staff about the online initiative in a structured way through a variety of channels. Communication occurred via written means and verbal presentations such as university-wide assemblies (including the "launch"), demonstrations, meetings within Faculties, focus groups, and through small committees (see appendix 2 for a diagram of the USQ*Online* management structure). Throughout the interviews, a persistent recommendation was the need for open and ongoing communication involving all stakeholders during the process of conceptualising and communicating of such a major initiative. Interviewees articulated that lack of consultation and free exchange of information can cause feelings of disempowerment and stressed that the implementation process, and the following impact at grassroots level needs to be made very explicit. One recommendation was that an outside consultant could facilitate focus group processes to ensure a professional, unbiased approach with a free and fair exchange of information. It was also articulated that academics have much to offer in the way of educational and management expertise, and that they should contribute to both the conceptualisation and implementation of such an initiative. A consensus of opinion from the interview data indicated a need for shared "vision" and consultation and collaboration at all stages of the developmental process in order to facilitate shared meaning and a sense of ownership of the decision-making process amongst those who have to implement the project.

The literature supports the findings of the interim evaluation. Dolence and Norris (1995) observe: "Campus leadership must find ways to stimulate discussion, debate, and dialogue on the need for a transformation vision. Existing processes and/or initiatives can be reshaped as agents of transformation. Given the ethos of Academe, the development of shared values must be a process of co-creation, consultation and testing of ideas" (pp. 87-8). This supports one of the main variables discussed by Waugh and Punch (1987) – that a lack of knowledge about a proposed change may hinder receptivity to that change. Yukl (1999) emphasises the importance of empowerment and discusses how "resistance can be a source of energy that enables people to collectively make better decisions about what type of change is needed" (p.40. These points were strongly supported by all interviewees in the study.

Roles, Responsibilities and Workload Implications

As previously mentioned, there have been some significant changes at USQ in the way the members of the academic community perform the tasks required to develop and implement flexible learning programs and services. A key pedagogical feature of the online teaching/learning environment is that the technology facilitates interaction through electronic means (discussion groups, email, virtual chats). This capability impacts on the design and delivery of course material and has caused a significant shift from the independent learner mode of traditional distance education courses to interaction between participants in online courses. Distance education also has meant staff have a larger, more varied cohort of students to service and track. Furthermore, teaching online has had a significant impact on student learning and staff workloads, as technology allows opportunity for increased online communication, changes in traditional teaching roles, and changes in the way information is published and resourced. A more commercial emphasis, changes in course design and delivery and a shift to a greater client focus (giving learners what they want, when and where they want it) has meant that courses are now being offered throughout the year, and in multiple modes. Students have been provided with opportunities to extend or shorten the time taken to complete particular units of work. University administrative systems have been put in place to accommodate this added flexibility but staff workload issues remain a major concern. One interviewee observed that "for a long time the university has operated on the goodwill of its staff, but when a job grows from that which is manageable to just another ten percent, things get a bit fractious about the edges". Several of the interviewees observed that USQ staff have already undergone role changes as a result of distance education initiatives so perhaps it is considered by management that staff are ready to undergo a further evolutionary move building on this history of organisational change.

Interview responses provided suggestions for ways to assist the workload situation. These include a reduction in course offerings with a focus on particular disciplines or courses that have already proved popular to learners. Reward/award systems might be established as an incentive for staff having to do the additional work involved which is often on top of existing workloads. However, the conflict still exists in institutions of higher education as to what is considered worthy of reward - research, teaching or a combination of both. The cost-saving benefits of major online initiatives are also still to be proven. An investigation conducted by the University of Illinois (1999) states: "Because high quality online teaching is time and labour intensive, it is not likely to be the income source envisioned by some administrators" (p. 1).

Loosely Coupled Networks/ Synergies and Alliances

One of the key themes emerging in the literature is the need for an organisation to enter into loosely coupled networks or strategic alliances in order to operate within the emerging global environment. Alliances with other knowledge producers, such as a partnership with an independent commercial provider in the case of USQ has been a strategy aimed at capitalising on the strengths of both partners and increasing student access to higher education. Kanter (1989) argues that "a major component of post-entrepreneurial strategy involves developing close working relationships with other organizations, extending the company's reach without increasing its size. Strategic alliances and partnerships are a potent way to do more with less" (p. 347). One interviewee observed that the online initiative at USQ "builds on existing expertise, positions USQ as an initiator and leader in full-scale, online delivery, draws on the capabilities of a commercial partner and also enables opportunities for joint partnerships with other academic institutions". The alliance enables USQ to offer its students global access by using the technology network. According to Higgins and Vincze (1989, in Limerick et al., 1998), "corporations with ambitions must turn to a new strategy of agreements, alliances, and mergers with other companies if they hope to survive" (p. 78). However, as raised in the interview data, the importance of a clear allocation of roles and responsibilities and a clear understanding of the capabilities of each partner is essential and there is also a need to choose strong partners, as synergies do not come out of combined weaknesses.

Technological Difficulties

An important consideration in the use of electronic delivery and communication systems is that of technical support. The interview data revealed that people who are unfamiliar with using technology spend a large amount of time coming to grips with it. Staff skills in using the Internet vary immensely, as do their learning styles. A Staff and Student Support (SSS) Focus Group has emerged out of the new committee structure. This group has been charged with the responsibility of developing interactive, online education and training materials for staff. The group has also established a Staff Development Gateway web site which contains links to other courses available, Help Desk facilities, multiple resources, exemplary materials, teaching and learning advice and peer mentoring support. All interviewees acknowledged that these developments have been well received by staff. However, it was evident from the responses that there is still a need for face-to-face education and training support which is also managed by the SSS Focus Group. It was also acknowledged that this preparation may not be enough to alleviate all the concerns of academic staff and will have to be closely monitored and addressed. The advice through the interviews has been to slow the developmental process down in order to reflect on events and evaluate the initiative and make sure the operational components of the system are working well. It was observed that there is always more to be done but there is still a need for time out and reflection.

Conclusion

The use of an electronic environment such as USQ*Online* to provide learning experiences opens up new challenges in terms of teaching and learning. The interim evaluation conducted by the authors at USQ makes the following recommendations: open communication, consultation and collaboration should form the basis of all stages of such a major institutional initiative; roles and responsibilities of all stakeholders should be clearly defined; synergies and alliances with strong partners are essential; and there should be sound technological support at all levels. The key to organisational change and sustainability is shared vision, shared values and shared decision making. The trends in and impacts of the use of communication and information technologies in the higher education sector mean that change is an ongoing factor of tertiary education. This is not necessarily something to be feared as it also promises to offer some exciting challenges. As Eckel et al. (1999) observe, change is "an ongoing, organic process" and "there is no point in time at which everyone can declare a victory and go back to normal life" (p. 1). The challenge facing all education providers in the 21st century is to meet the needs of lifelong learners in the Information Age and distance education providers are uniquely positioned to service the needs of these learners.

References

Armstrong, S., Thompson, G., & Brown, S. (1997). *Facing up to radical changes in universities and colleges.* London: Kogan Page.

Askew, S., & Carnell, E. (1998). *Transforming learning: Individual and global change.* London: Cassell.

Christ, W.G. (Ed.). (1999). *Leadership in times of change*, New Jersey, USA: Lawrence Erlbaum Associates.

Coaldrake, P., & Stedman, L. (1999). *Academic work in the twenty-first century, Occasional paper series.* September, ACT: Higher Education Division of DETYA, Canberra.

Dearing, R. (1997). *National Committee of Inquiry into Higher Education, British Government Report.* London.

Dolence, M., & Norris, D. (1995). *Transforming higher education: A vision for learning in the 21st century.* Ann Arbor: Society for College and University Planning.

Eckel, P., Hill, B., Green, M., & Mallon, W. (1999). *On change: Reports from the road: Insights on institutional change.* Washington, DC: American Council on Education.

Keegan, D. (1986). *The foundations of distance education.* London: Croom Helm.

Kefford, R.E. (1980). Perceived freedom to change: Teacher resistance to alternatives in school and classroom organisation. *Unicorn*, 6(2), 144-53.

Laurillard, D., & Margetson, D. (1997). *Introducing a flexible learning methodology: Discussion Paper, Occasional Papers, No. 7*, Brisbane, Australia: Griffith Institute for Higher Education, Griffith University.

Limerick, D., Cunnington, B., & Crowther, F. (1999). *Managing the new organisation: Collaboration and sustainability in the post-corporate world.* 2nd Edn. Warriewood, NSW, Australia: Business & Professional Publishing.

Rumble, G. (1986). *The planning and management of distance education.* New York: St Martin's Press.

University of Illinois, (1999). *Teaching at an Internet Distance: The Pedagogy of Online Teaching and Learning The Report of an 1998-1999 University of Illinois Faculty Seminar.* [Online]. URL: http://www.vpaa.uillinois.edu/tid/report/tid_report.html, [Accessed 21/01/00].

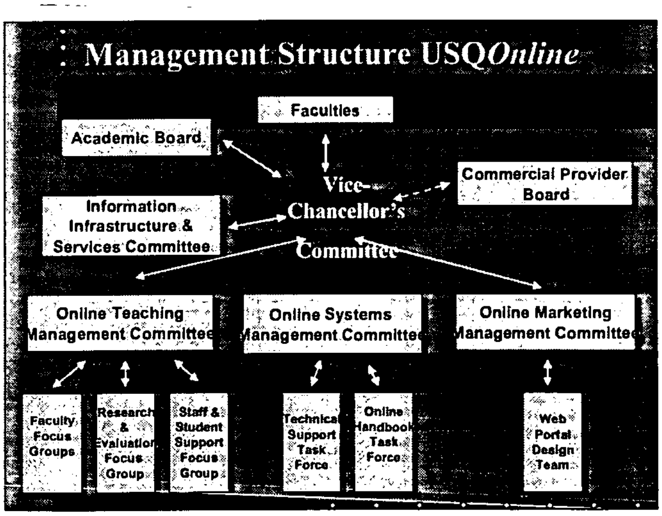
Waugh, R. F., & Punch, K. F. (1987). Teacher receptivity to systemwide change in the implementation stage. *Review of Educational Research*, 57(3), 237-54.

Yukl, G. (1999). An evaluative essay on current conceptions of effective leadership. *European Journal of Work and Organizational Psychology,* East Sussex: Psychology Press Ltd, UK, 33-48.

Appendix 1: Interview Questions

How would you describe the USQ*Online* initiative to other academics unfamiliar with the project?
What do you believe was/is the leaders' vision for USQ when initiating this project?
How was the vision communicated to USQ academic staff?
Reactions/personal reflections to/on the concept?
Reactions/personal reflections to/on the methods of communicating the concept.
Commendations and recommendations.

Appendix 2: Management Committee Structure



BEST COPY AVAILABLE

Using Directed World Wide Web Navigation Guidance: An empirical investigation

David Ribeiro Lamas

Jennifer Jerrams-Smith
(University of Portsmouth, UK, jenny.jerrams-smith@port.ac.uk)

David Heathcote
(Bournemouth University, UK, dheathco@bournemouth.ac.uk)

Feliz Ribeiro Gouveia
Universidade Fernando Pessoa, Multimedia Resource Center
Praça 9 de Abril, 349, Porto, Portugal
+351 22 5071306, +351 22 5508269 (fax)
{dlamas, fribeiro}@ufp.pt

Abstract: The **Computer Aided Information Navigation (CAIN)** project provides a new method of adaptive navigation support that aims to increase the World Wide Web's value as a pedagogical tool. To examine whether the system's approach improves comprehension under specific conditions, an experiment compared **CAIN** with conventional web tools on three measures of performance: comprehension scores, task completion times and user satisfaction. Results revealed that comprehension scores were 30% greater with CAIN than with the conventional tools and indicated that task completion times can also be reduced without compromising user satisfaction.

Introduction

The **Computer Aided Information Navigation** project (**CAIN**) aims to provide adaptive navigation support as a way of increasing the Web's value as a pedagogical tool. **CAIN**'s approach is a reactive one as it seeks to provide a way of dealing with the vast amount of useful information available on the Web as it currently exists rather than trying to improve or alter the Web's infrastructure.

In order to help users reach their goals, **CAIN** provides direct guidance navigation support as a form of non-obtrusive *weak hypertext linearization* enabling the user to follow a context specific ranked sequence of selected Web pages without ever needing to perform any search or follow any link if they do not wish to. This approach does not seek to prevent goal-oriented exploration but rather to provide a sound thread or guideline to help users to retain their focus.

The system's representation of the Web, crucial to the success of its adaptive features, builds on the Dublin Core (Weibel & Lagoze 1997) and on the Resource Description Framework (Lassila & Swick 1998).

The users' representation combines three user modeling techniques resulting in a hybrid solution that uses stereotypes, overlays and attribute-value pairs (Benyon & Murray 1993; Brusilovsky 1996).

Navigation support is accomplished by a basic route-finding heuristic which selects context specific Web model items, sorts them using associated qualitative ratings, and presents them to the user, one at the time, based on the attributes of the user's model (Lamas 1998).

This paper presents and discusses the results of an experiment which examined whether the directed Web navigation guidance provided by **CAIN** can improve the performance of Web users under appropriate conditions. Section 2 describes the methodology used and section 3 presents and discusses the results. Section 4 discusses related empirical work and section 5 evaluates the current study and suggests directions for future research.

Method

It was hypothesised that contextualized direct guidance of the information available on the World Wide Web may improve comprehension under the specific conditions that:

- Users are either inexperienced in Web use or have little expertise in the target subject topic, or both.

- Users use the system pursuing learning or initial research goals.

For this purpose a standard task was devised in which volunteers were required to use the WWW to learn as much as they could about two given subject topics — cryptography and poetry — using either **CAIN** or alternative tools that the users chose to employ.

The experiment compared the use of **CAIN** with conventional tools on three dependent measures of performance:

- **Comprehension** as measured by a multiple-choice comprehension questionnaire;
- **Time taken** to complete the tasks; and
- **System usage appreciation** assessed by a like/dislike rating completed at the end of each task.

Performance was examined as function of the following independent variables:

- **Tool used**, either *CAIN* or *Free*;
- **Web expertise**, the Web experience of the users, either *Low* or *High*; and
- **Subject expertise**, the users' expertise in the target subject areas, either *Low* or *High*.

In order to implement the experiment, volunteers were recruited from the university's population[1], specialist help was required to build the domain model and to provide the subject abstracts and questionnaires and a specially designed environment was prepared to implement the experiment.

Design and procedure

The devised task consisted of carrying out two learning assignments performed in sequence and assessed at each one's completion.

The task could be accomplished using either **CAIN** or any other Web navigation tool.

Forty volunteers were used as test subjects, 20 of whom performed the test using **CAIN** while the remaining 20 performed the task using the tools of their choice. To control for order effects, the **CAIN** and non **CAIN** groups were each divided into two sub-groups of 10 subjects so that the learning assignments were counterbalanced between groups.

Each sub-group was assigned to a task permutation, either *CAIN AB*, *CAIN BA*, *Free AB* or *Free BA*.

- **Before the test began** — Self-assessment of Web expertise along a scale of 1 to 7 was provided by each participant.
- **Before each of the learning tasks began** — Self-assessment of expertise in the subject area of 1 to 7 was provided by each participant.
- **Following completion of each of the learning tasks** — A ten question multiple choice comprehension questionnaire was completed by each participant together with a 7 point rating of system satisfaction.

Participants were required to complete the tasks within time boundaries and each participant's actual completion time was recorded with a resolution of 1 minute[2].

Volunteers undertook the tasks in a specially prepared and isolated environment.

Materials and apparatus

In order to provide valid learning assignments and comprehension questions, two specialists[3] in the domains provided all relevant data from CAIN's domain model to the assignment descriptions and the comprehension assessment multiple choice questionnaires.

The questionnaires

Task scripts, learning assignment descriptions and the various questions were specially prepared to cater for each of the four task variations.

Everything was written in Portuguese as the experiment was conducted in Portugal.

Apart from ensuring the specific multiple choice questionnaires, the subject specialists also provided marking grids so that data could be gathered as soon as the tests were accomplished.

The test site

The test site was designed so that volunteers could enjoy suitable silence and isolation.

A pilot experiment was run before the main with four volunteers to establish the appropriate experimental parameters such as the time boundaries, the learning assignment descriptions, the number of MCQ questions.

Participants

An opportunity sample of 40 volunteers was used in the experiment. All volunteers were members of the university and were the first 40 who responded to the call for volunteers broadcast throughout the university.

The sample consisted of 24 undergraduate students, 12 postgraduate students and 4 staff members. There were 28 males and 12 females in the sample.

---

1 Universidade Fernando Pessoa, Porto, Portugal

2 these are the Time A and Time B variables

3 professors Estela Pinto Ribeiro Lamas and Feliz Ribeiro Gouveia, both from Universidade Fernando Pessoa

All had English reading skills. No financial inducements were offered and written consent was obtained from each of the volunteers.

Results and discussion

The participants were grouped to produce three independent variables as described below.

- Given that the design of the experiment was counterbalanced, the four permutations, *CAIN AB*, *CAIN CA*, *Free AB* and *Free BA,* results in the *Tool* grouping variable with two levels, *CAIN* and *Free*.
- In order to class volunteers as either *High* or *Low* in Web expertise, a mean was taken of overall self-assessed Web expertise. Volunteers who scored above the mean were assigned to the high Web expertise group and volunteers who scored below the mean were assigned to the low Web expertise group resulting in the *Web expertise* grouping variable.
- The same was done with subject (i.e. domain) expertise resulting in the *Subject expertise (*High/Low) grouping variable.

Finally, comprehension assessment scores were collapsed across subject A and subject B multiple choice questionnaires scores resulting in a mean comprehension score dependent measure.

The same technique was applied to the time taken to accomplish the learning assignments and to the system appreciation/satisfaction ratings producing two further dependent measures: *mean completion time* and *mean user satisfaction*.

The new variables meanings and usage conventions are explained in table 1.

Variable	*Meaning*
Tool	The tool used by the volunteer to perform the task classified as either CAIN or Free
Web expertise	The volunteer's self assessed Web expertise classified as either Low or High
Subject expertise	The volunteer's self assessed subject (domain) expertise classified as either Low or High
Mean score	Average comprehension score achieved by a volunteer after completing a learning task ranging from 0 — minimum — to 10 — maximum
Mean time	Average time taken by a volunteer to complete a learning task measured in minutes
Mean system	Average used system appreciation by volunteer rated from 1 — minimum — to 7 — maximum

Table 1: Definition of the independent and dependent variables used in the experiment

Comprehension

The results of the self assessments conducted before each learning task began showed that subject expertise was equivalent for the *CAIN* and *Free* groups ($t(38) = 0.276$, $p = 0.784$), a difference of only 2.5% (approximately). Therefore a meaningful comparison between the comprehension performance of the *CAIN* and *Free* groups following a Web learning session was possible.

Following Web learning, a *t*-test comparing comprehension scores showed that comprehension was significantly greater in the *CAIN* group than in the *Free* group ($t(38) = 2.9$, $p = 0.006$).

The comprehension score group statistics presented in table 2 together with the mean subject expertise ratings presented in table 3, indicate that **CAIN** produces an improvement in comprehension scores of nearly 30% compared with the other methods used by the volunteers.

Tool	*Volunteers*	*Mean*	*Standard deviation*	*Standard error mean*
Free	20	3.8750	1.2126	0.2711
CAIN	20	5.0500	1.3367	0.2989

Table 2: Comprehension score group statistics

	Tool	
Mean	Free	CAIN
Subject expertise	3.03	3.10
Average score	3.88	5.05

Table 3: Mean subject expertise and comprehension score contrast

In order to explore these results further, an analysis of variance of comprehension scores, with *Subject expertise*, *Tool* and *Web expertise* as the three independent factors, was conducted.

The analysis showed a significant main effect of *Tool* such that comprehension scores were higher after completing a learning assignment with *CAIN* than after completing a learning assignment with *Free* ($F(1,32) = 4.85, p = 0.035$).

This repeats the result from the *t*-test and in this case, no other variable or interaction between variables has enough statistical significance (all $p > 0.05$) to be regarded as influential.
Separate analyses of variance were conducted on comprehension scores for subjects *A* and *B* which revealed that the main effect of *Tool* was highly significant on comprehension scores for subject *B* ($F(1,32) = 8.554$, $p = 0.006$) but not for subject *A* ($F(1,32) = 0.709$, $p > 0.05$).
Subject *A* was *cryptography* and subject *B* topic was *poetry*. These results may reflect the fact that cryptography Web sites have better structure or are easier to find and use than poetry Web sites and so benefit little from the use of **CAIN**.
The separate analysis of variance also revealed a significant main effect of Web expertise for subject *A* ($F(1,32) = 5.979$, $p = 0.020$) and subject *B* ($F(1,32) = 5.353$, $p = 0.027$) which did not appear in analysis of variance collapsed across domain.
This situation results from a crossover interaction between Web expertise and domain (subjects *A/B)* (see table 4).

Web expertise	Overall mean	Subject A mean	Subject B mean
Low	4.38	4.29	4.47
High	4.52	5.83	3.22

Table 4: Comprehension scores means by Web expertise *level*

Although unexpected, these results suggest that the subject topics used — cryptography and poetry — are at opposite ends of a qualitative range for Web sites and that by using them both, this experiment neutralised their differences and provided a fair testing environment.
Finally, table 5 provides a straightforward comparison between the mean comprehension scores under every condition combination.

Web expertise	Tool	Subject expertise: Low	Subject expertise: High	Mean
Low	Free	3.80	3.50	3.65
	CAIN	4.25	5.33	4.79
High	Free	2.66	4.25	3.46
	CAIN	5.87	4.75	5.31
Mean		4.15	4.48	

Table 5: Web expertise *X* Tool *X* Subject expertise *comprehension scores.*

Time taken

Next, an analysis of variance of completion time performance was conducted with the same *Subject expertise*, *Tool* and *Web expertise* independent variables.
Although overall learning assignment completion times are quicker with *CAIN* than with *Free*, this difference is *not* statistically significant ($F(1,32) = 2.05$, $p > 0.05$).
Nevertheless, several interesting remarks can be made:

- There is a significant main effect of Web expertise such that highly experienced Web users performed faster than the low experienced Web users ($F(1,32)=9.02$, $p=0.05$). As all of the experiment was conducted over the Web, it is not surprising that highly experienced Web users performed faster.
- There is an interesting 3 Way interaction between *Subject expertise*, *Tool* and *Web expertise* ($F(1,32) = 4.61$, $p = 0.039$).

Table 6 illustrate this last result highlighting the fact that *CAIN* produces faster performance than *Free* under all combinations of levels of the independent variables except when the volunteer has *High* Web expertise and *High* subject expertise, *i.e.* it suggests that:

- Time taken may be slower with **CAIN** when the user is a highly experienced Web user and a an expert in the learning assignment field, but;
- **CAIN** is faster when users are inexperienced Web users and inexperienced in the study subject or inexperienced in the Web and experienced in the subject or experienced in the Web and inexperienced in the subject.

Web expertise	Tool	Subject expertise: Low	Subject expertise: High	Mean
Low	Free	91.70	86.50	89.10
	CAIN	86.17	68.50	77.34
High	Free	74.67	61.50	68.09
	CAIN	50.50	75.44	62.97
Mean		75.76	72.99	

Table 6: Web expertise *X* Tool *X* Subject expertise *performance times contrast*

Note that Web expertise alone does not slow performance when using **CAIN**. In fact, highly experienced Web users performances are slightly faster under *CAIN* than *Free*.

It is the particular combination of *High* Web expertise and *High* subject expertise that slows performance using **CAIN** compared to using other tools on the World Wide Web.

Further analyses of variance, conducted separately on time performances for subjects *A* and *B*, revealed that the main effect of *Tool* was specially significant for subject *B* ($F(1,32) = 5.783$, $p = 0.022$) but not significant for subject *A* ($F(1,32) = 0.017$, $p > 0.05$).

These results provide further evidence that cryptography Web sites may differ in quality or quantity from poetry Web sites and that **CAIN** may be more effective when addressing topics whose Web sites have characteristics similar to those of poetry Web sites (i.e. less well organised).

The same analysis of variance confirmed the significance of the main effect of Web expertise on both subject *A* ($F(1,32) = 4.819$, $p = 0.036$) and subject *B* ($F(1,32) = 5.362$, $p = 0.027$) performance times.

This only indicates that although **CAIN** improves time performance in general, Web expertise still plays an important rôle as novice Web users spent more time than experienced Web users. This does not comes as a surprise since **CAIN** is itself Web based and it does not replace existing navigation tools, it merely provides non-obtrusive navigation support.

System usage appreciation/user satisfaction

The t-test for system usage appreciation does not show any significant difference between the *CAIN* and the *Free* groups ($t(38) = 0.698, p = 0.489$).

In fact, table 7 shows that *CAIN* rated 5.7 out of 7 while *Free* rated 5.475 out of 7. This is only a 4% increase.

Average system	*Volunteers*	*Mean*	*Standard deviation*	*Standard error mean*
Free	20	5.475	1.0696	0.2392
CAIN	20	5.700	0.9652	0.2158

Table 7: System usage appreciation group statistics

Table 8 provides a straightforward comparison between the mean like/dislike scores under every condition combination.

		Subject expertise		
Web expertise	*Tool*	*Low*	*High*	*Mean*
Low	Free	6.00	5.50	5.75
	CAIN	5.75	6.00	5.88
High	Free	4.75	5.75	5.25
	CAIN	4.86	5.92	5.39
Mean		5.34	5.79	

Table 8: Web expertise *X* Tool *X* Subject expertise *system usage appreciation contrast*

As shown, satisfaction was higher for **CAIN** under almost every condition combination except for users ranking low in both Web and subject expertise. This was probably due to the extra effort required to cope with new systems, the Web and **CAIN**, and a new subject at the same time.

Finally, in this case there was no significant difference between the independent analysis of system usage appreciation for subjects *A* and *B*.

Related empirical evidence

Although to date empirical studies on the value of adaptivity in hypertext based learning environments are limited, they are critically important to validate the different approaches in this research area.

Although most of the existing empirical evidence reviewed by Eklund and Brusilovsky (1998) fails to show if adaptive hypertext navigation contributes at all to improve the student's or researcher's performance, it hints that adaptive navigation could be valuable under appropriate conditions.

Nevertheless, in experiments measuring the number of hypertext nodes used to accomplish some predefined goal, existing empirical evidence favours *adaptive curriculum sequencing*[4] versus adaptive link annotation over a closed information corpus. Although not directly related to **CAIN**, these results do not contradict this project's approach.

Further, on the InterBook[5] experiment reported in the same review, apart from other results, it is also stressed that the direct guidance mechanism was chosen by test subjects in over 90% of the transactions. Again, this system relies on a closed information corpus but nonetheless, the experiment's results provide added support to **CAIN**'s approach.

This is however an under-investigated area and there is clearly a need for continued studies on the value of adaptivity in hypertext based learning environments.

4 a direct guidance approach

5 an adaptive hypertext system supporting adaptive link annotation and direct guidance in the form of a continue link

Final Remarks

The experiment herein examined the nature of the interaction between the users' Web expertise, Subject expertise and the used tool and its results show that **CAIN**, as specified and implemented, does indeed improve user's comprehension by 30% when supporting learning or initial research tasks performed over the World Wide Web.

This is probably due to the way **CAIN** guides the user through a sequence of previously selected and relevant Web resources.

Though not in a very significant way, the experiment's results also suggest that the time taken to accomplish such tasks can also be reduced when using **CAIN** except in circumstances in which it is redundant, *i.e.* when the user is already an expert using the World Wide Web and an expert in the subject domain.

As far as enjoying the system, the results do not show any significant difference between using **CAIN** or any other approach to navigate the World Wide Web. In fact, the results show that users in general enjoy using the Web with whatever tools they use.

Although encouraging, this experiment's results are not sufficient to understand all the implications of a system like **CAIN** and further studies need to be undertaken. In fact, the current investigation only measures the adaptive guidance support leaving untouched issues related to all the other relevant areas brought together in this work such as:

- The adequacy of the metadata records and associated rating strategy;
- The soundness of the implicit co-operation model;
- The reliability of the relevance feedback mechanism; and
- The validity of adaptivity itself.

Specifically, it fails to understand other success factors such as:

- How relevant is the order in which Web resources are presented to the user?
- How do users cope with the domain building process?
- Are the rating criteria adequate and easy to apply?
- Is such Web representation successful for all its users?
- How does the system cope with long term users?
- How does physical distance affect the system's collaborative nature?

This is an under-researched area and there is clearly a need for continued studies on the value of adaptivity in hypertext based learning environments.

In conclusion, the **Computer Aided Information Navigation** system appears to be moving in the right direction and research will continue in order to achieve this collaborative environment's long term goals: To *guide* the user while *learning*, *understanding*, *memorising* and *forgetting* material in order to increase *motivation*, *concentration* and *comprehension*, reducing the environment's noise and improving the knowledge acquisition process.

Bibliography

Benyon, D. & Murray, D. "Adaptive systems: from intelligent tutoring to autonomous agents", *Knowledge-Based Systems*, 6.4, (1993): pp. 197-219.

Eklund, J. & Brusilovsky, P. "The value of adaptivity in hypermedia learning environments: a short review of empirical evidence", *On-line proceedings of the Second Workshop on Adaptive Hypertext and Hypermedia*, http://wwwis.win.tue.nl/ah98/Eklund.html, Agosto 29, 1998.

Lamas, D. "Adaptivity on the Internet", *University of Portsmouth research seminars*, University of Portsmouth, UK, 1998.

Lassila, O. & Swick, R. "Resource description framework RDF model and syntax", http://www.w3.org/Tr/WD-rdf-syntax/, Janeiro 9, 1998.

Weibel, S. & Lagoze, C. "An element set to support resource discovery: the state of the Dublin Core: January 1997", *International Journal on Digital Libraries*, 1.2, (1997): pp 176-186.

A Java-Based Hypermedia Framework for Delivering Fluid Power Training via the Internet

Thomas G. Richards
Engineering Design Centre in Fluid Power Systems
University of Bath
Bath, UK
T.G.Richards@bath.ac.uk

Edmund J. Hughes
Engineering Design Centre in Fluid Power Systems
University of Bath
Bath, UK
E.J.Hughes@bath.ac.uk

Derek G. Tilley
Engineering Design Centre in Fluid Power Systems
University of Bath
Bath, UK
D.G.Tilley@bath.ac.uk

Abstract: Many industries, including aerospace, automotive, agricultural and marine, use Fluid Power systems for power transmission. The design of these systems is a skilful and complex task requiring significant practical experience and heuristic knowledge gained over many years. With few formal Fluid Power design courses being taught in further and higher education, both academia and industry are seeking new methods of delivering this specialist knowledge. The Internet opens up low-cost, low-risk training opportunities for Small-to-Medium Enterprises that may not be able to afford the cost of residential courses, and also for employees seeking career development within the context of lifelong learning. This paper describes the early stages of a project to develop an open, domain-independent, Java-based framework for the delivery of multimedia training. This framework forms part of a Performance Support System for trainees and professionals involved in Fluid Power systems design. Also described is a formative evaluation of the framework.

Introduction

The need for lifelong learning is driven by the swiftly changing nature of global commerce which requires unprecedented levels of flexibility from a highly competitive employment market. The term itself refers to the continuous renewing, upgrading and updating of existing personal skills and expertise required - in addition to the acquisition of new capabilities - if individuals are to remain in gainful employment [Davies 1998]. Holt and Radcliffe [1991] state that the quality of engineering design is largely determined by the quality of the learning processes that are central to the design experience. From this, it is apparent that, in order to remain competitive, enterprises within engineering must become pro-active partners with education providers in the lifelong training of their employees [Berkeley 1991]. Despite this, many Small-to-Medium Enterprises (SMEs) often find themselves unable to afford traditional training courses either in terms of the financial outlay or the time lost through personnel being absent for extended periods.

The term "Fluid Power" is used to denote systems where mechanical power is transmitted from one point to another by means of a fluid such as hydraulic oil. Examples are to be found on aircraft, ships, industrial plant and mobile equipment. The teaching of Fluid Power Systems Design poses particular problems, principally due to the complex nature of the task which often requires extensive heuristic knowledge and many years of practical experience for a professional to become proficient. In the context of lifelong learning, an overhead such as this may become prohibitive for many individuals. It is argued that by using hypermedia to facilitate the learning process within the context of an overall Web-based Performance Support System for Fluid Power Systems Design, the cost of Fluid Power training to industry in general and SMEs in particular can be reduced to acceptable levels, and the problem of learning overhead for individuals can also be overcome. It is also argued that the developed methods and techniques would bring potential benefits to other domains.

One drawback with delivering training material over the WWW is the very loose integration of the Web itself. In order to co-ordinate lessons and gather feedback from trainees a somewhat tighter integration is required which is nevertheless flexible enough to accommodate changing content, changing users and changing styles of learning. One approach is to use server-side scripting to generate HTML pages and forms on the fly. Three systems currently seeking to improve integration of WWW learning frameworks are Interbook [Brusilovsky et al. 1996], IDEALS-MTS [Graf & Schnaider 1996] and KBS-HYPERBOOK [Frölich et al. 1998]. One disadvantage of a server-centric approach is that the resulting content can be rather static or slow in its interaction due to being bound to the server, while making little use of the ever-increasing client-side power and multimedia capabilities of modern computers. The framework under development aims to provide an optimum balance between integration, flexibility and interactivity by linking generic client-side Java navigational tools and multimedia renderers with server-side tracking, feedback and dynamic content-generation capabilities. Schank and Cleary [1994] describe eight principles for designing educational software, which, they argue, also pertain to teaching in general. These provide a checklist of desired tasks and outcomes for computerised teaching tools. The need to relate any given information to real-life examples and problems is crucial, with preferably simulation offered to enable trial and error analysis. Software should be adaptable to the students' needs and a good design will enable self-assessment and monitoring of progress. The framework under development seeks to satisfy these principles by providing real-life examples via multimedia elements such as 2-D and 3-D interactive graphics, sound and video, and supporting user experimentation via simulation. Each framework element is discussed below with reference to a prototype being developed at the University of Bath.

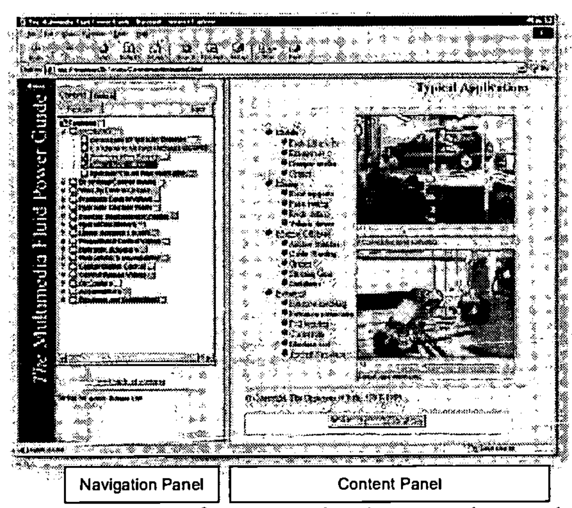


Figure 1: Screen shot of prototype showing general screen layout

Feasibility Study

Richards et al. [1999] describe a feasibility study into the applicability of Java technologies for delivery of multimedia over the Internet. Multimedia examples from the domain of Fluid Power were developed as animations, 2D and 3D interactive simulations, and digital video. Navigational tools were also created to provide a "clickable" table of contents (TOC) and the facility to search a remote database. Java technologies were used, including "Swing", Java Media Framework, Java 3D, Java Database Connectivity (JDBC) and Remote Method Invocation (RMI). [Fig. 1] shows the general screen layout of the framework. The prototype multimedia modules were tested on a mixture of PCs and SUN Workstations. The conclusion was that the Java technologies tested had reached a sufficient level of maturity and breadth of functionality to satisfy the requirements for the system. Java was therefore selected as the authoring language, with version 1.2 taken as the project baseline.

Client / Server Architecture

At the beginning of each session, user data is read from a client-side "cookie" by the TOC applet and passed to the server. The server creates a new session, retrieves the corresponding user object from the previous session (or creates a new one), and returns the URL of the last page visited, enabling the TOC to load the corresponding page in the Content Panel and update the TOC node elements accordingly. The appearance of the nodes indicates which sections have been consulted and (where applicable) successfully completed. The tree structure of the TOC itself provides one suggested path through the course material, but additional guidance will be provided by modifying the structure and appearance of the nodes according to user actions through integration of the JESS [Friedman-Hill 1999] inference engine on the server side. Java RMI is used for client/server interaction because it offers the possibility of passing true Java objects between client and server. The architecture also lends itself to the provision of expert design guidance as part of the overall Performance Support System.

Re-Usability of Software Components

In order to allow users to construct circuits and observe their behaviour via simulation, Fluid Power Components have been modelled as JavaBeans, which can be loaded dynamically and discover each other at run-time. The JavaBeans Event Model enables components to be aware of flow, pressure and demand signal changes within the circuit and react accordingly. Circuits built up in this way can be saved and re-used as courseware using the generic multimedia renderer applet (see below). The user can choose to view each component in the form of a realistic (and, where appropriate, animated) diagram or as an internationally-recognised symbol. Component pop-up menus contain embedded search hyperlinks that trigger searches in a remote multimedia database. The results of a search can be browsed by the user in a separate window using a generic multimedia viewer. This viewer provides a single container into which the system can plug different renderers on the fly, depending on the type of multimedia content to be displayed. The same generic viewer can also be embedded as an applet in an HTML page, maximising software re-use and simplifying the work of the courseware author.

User Testing of Prototype

Selection of Test Users, Equipment and Courseware

The test users were attendees of a Fluid Power course run by the Centre for Power Transmission and Motion Control at the University of Bath. The course was entry-level in terms of its Fluid Power content and was administered using traditional teaching methods. The delegates were divided into four groups with 6 trainees per group. The allocation of groups was carried out by the course organisers on a random basis. The experiment was conducted on four PCs, each running either Windows95 or NT4.0, ranging from a 200MHz Pentium MMX laptop to a 400MHz Pentium II. Installed RAM was between 64 and 160 MB, but available RAM dropped to between -9 and 44 MB with both the operating system and web browser running. The web browser used was Netscape Navigator, though the framework has also been used successfully with Microsoft Internet Explorer. In addition, each test PC was set up with the Java Plug-In (version 1.2.2, using Java Runtime Environment version 1.2), Java Media Framework 1.1 for video rendering and Java3D 1.1.1 (DirectX for Win95, OpenGL for NT) in conjunction with the Java3D VRML 97 loader for rendering of 3D content. The existing course notes were converted into individual HTML pages, each page corresponding to a section within a chapter. The formatting was adapted to on-line viewing using Cascading Style Sheets and by the inclusion of multimedia elements where it was thought that this would enhance comprehension.

Test Procedure and Method of Evaluation

Each test session lasted 35 minutes. A short introduction to the system was given in which the objectives and procedure of the experiment were explained. It was left to the users to organise themselves between the available workstations. In general, the less experienced computer users tended to work together. The users were allowed to proceed at their own pace through the chapters of the test courseware. A questionnaire was used to evaluate the users' reactions, which was divided into four sections. The first section, consisting of 14 questions, concentrated on the generic features of the system, such as navigational means, screen layout, and feedback given to the user by the system. The second section (three questions) focussed on the users' estimation of the suitability of the system and multimedia in general to future training needs. The third section (10 questions) asked users to assess the effectiveness of the multimedia elements used and also give personal preferences for relative levels of differing types of multimedia in future. The fourth and final section collected data on the users' individual levels of experience. All questions used sets of bipolar semantically anchored items, on a scale from 1 to 5, except for the questions on personal experience where a scale of 1 to 10 was used in order to provide users with greater freedom. Due to the practical constraints of having to operate within the framework of the external course, it was not possible to administer pre- and post-tests or to divide the users into control and test groups.

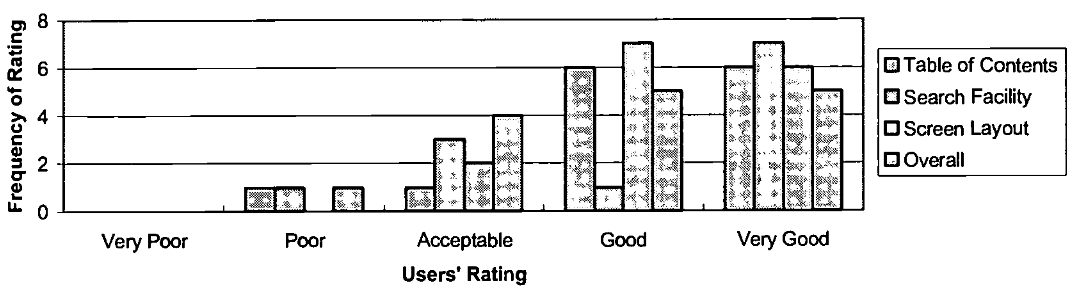


Figure 2: Evaluation of generic features of system

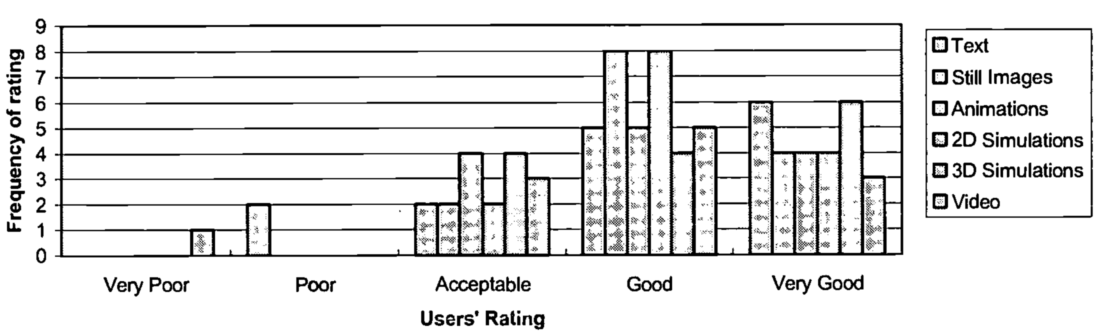


Figure 3: Evaluation of effectiveness of multimedia content

Test Results

There was a broad range in the users' experience with both Fluid Power and the Internet, but in general the users could be said to have "average" experience of these domains. In contrast, they considered themselves above average in terms of their computer skills. As can be seen from [Fig. 2] the generic features of the system such as TOC, search facility, navigation, screen layout and overall impression were felt to be mostly "Good" or "Very

Good". Comments made indicated that users liked the ability to simultaneously view the content and browse to another topic via the navigational tools. The screen layout was thought to be clear and uncluttered. The ability to increase the size of the content panel by selectively hiding and revealing the navigational panel was welcomed.

[Fig. 3] shows a high appreciation by the users of the effectiveness of the multimedia elements used in the tutorial, particularly the 2D and 3D simulations. Comments made indicated that the 3D axial piston pump simulation in particular [Fig. 4] was a good example of interactive multimedia techniques enabling users to visualise a Fluid Power concept which is extremely difficult to teach and visualise with traditional methods. In the context of what form of training users would generally prefer, however, [Fig. 5] reveals a relatively low preference for multimedia-based instruction over traditional methods. This particular question generated the most comments by far. Many users emphasised the value of human interaction - both with tutors and other trainees - which is absent in self-paced individual multimedia learning, and proposed the adoption of some kind of hybrid approach. Notwithstanding this, the users were very enthusiastic about the possibility of future multimedia courses being offered and the suitability of the system when fully developed for meeting future Fluid Power training needs.

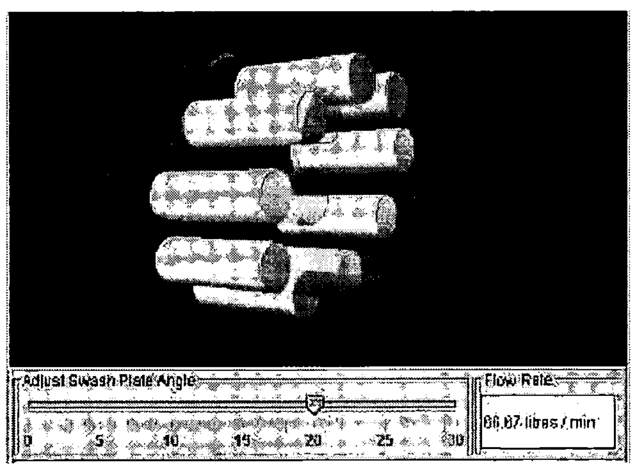


Figure 4: Interactive 3D simulation of axial piston pump

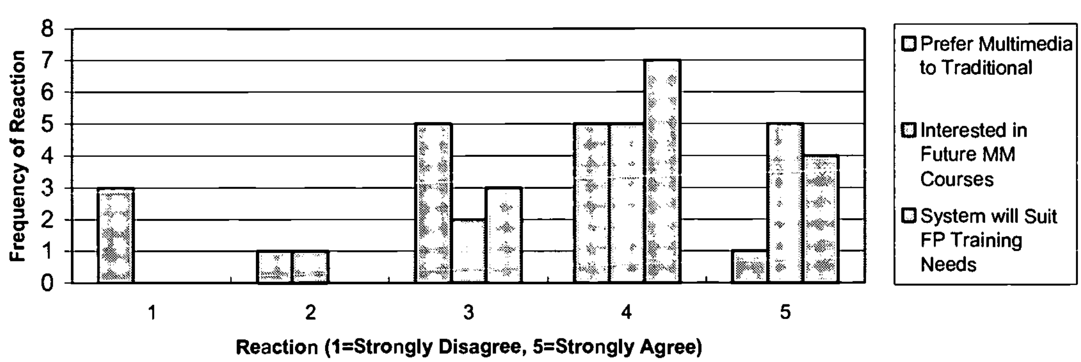


Figure 5: Suitability of system for meeting future Fluid Power training needs

Conclusions

The Java-based hypermedia framework described in this paper has been implemented in prototype form within the context of an overall Performance Support System for Fluid Power Systems Design. The content used was drawn from the domain of Fluid Power Systems, and formative testing of the framework as an educational tool was carried out with Fluid Power Systems trainees. The results showed a high level of appreciation of the navigation and search facilities, the multimedia elements used and the overall functionality. The application of 3D techniques to provide visualisation of complex concepts was particularly valued. The possibility of future multimedia-based courses was welcomed, and it was felt that the system would ultimately be well suited for the future training needs of the Fluid Power industry. In future, summative testing will be carried out to evaluate the framework's educational effectiveness. Its use as a design support tool, complementing the educational role, will also be investigated. Although the content itself, together with a number of the prototype's interactive elements, was specific to Fluid Power Systems Design, the overall framework is by no means limited to this one domain, but lends itself to application in many other fields. In the next stage of development, the adoption of XML for content storage and encoding will further enhance its cross-domain applicability.

References

[Davies 1998] Davies, D. (1998). The virtual university: a learning university. *Journal of Workplace Learning*, Vol. 10, No. 4, pp. 175-213

[Holt & Radcliffe 1991] Holt, J.E. and Radcliffe, D.F. (1991). Learning in the organizational and personal design domains. *Design Studies*, 12(3), pp. 142-150

[Berkeley 1991] Berkeley J. (1991). Promoting lifelong learning through education partnership: part 1. *Education + Training*. Vol. 33 No. 6, pp. 4-8

[Brusilovsky et al 1996] Brusilovsky P., Schwarz E., Weber G. (1996). A Tool for Developing Adaptive Electronic Textbooks on WWW. *Proceedings of WebNet'96, World Conference of the Web Society, San Francisco, CA, 1996.* Association for the Advancement of Computing in Education, Charlottesville, VA. pp. 64-69

[Graf & Schnaider 1998] Graf F., Schnaider M. (1998). IDEALS-MTS - A Modular Training System for the Future. *Proceedings of ED-MEDIA '98, World Conference on Educational Multimedia and Hypermedia, Freiburg, Germany, 1998.* Association for the Advancement of Computing in Education, Charlottesville, VA. pp. 486-492

[Fr□lich et al. 1998] Fr□lich P., Nejdl W., Wolpers M. (1998) KBS-HYPERBOOK - An Open Hyperbook System for Education. *Proceedings of ED-MEDIA '98, World Conference on Educational Multimedia and Hypermedia, Freiburg, Germany, 1998.* Association for the Advancement of Computing in Education, Charlottesville, VA. pp. 430-435

[Schank & Cleary 1994] Schank R.C., and Cleary C. (1994). Engines for Educators - Principles of Quality Software. http://www.ils.nwu.edu/~e_for_e/nodes/NODE-209-pg.html

[Richards et al. 1999] Richards, T.G., Hughes E.J., Tilley D.G.. (1999). A Multimedia Approach to Fluid Power System Design. *Proceedings of IEEE Multimedia Systems '99, International Conference on Multimedia Computing and Systems, Florence, Italy, 1999.* Institute of Electrical and Electronic Engineers, Piscataway, NJ. Vol. 1, pp. 792-796

[Friedman-Hill 1999] Friedman-Hill E.J. (1999). JESS, the Java Expert System Shell. http://herzberg.ca.sandia.gov/jess/, 19 October 1999

Acknowledgements

The authors acknowledge the financial support of the United Kingdom's Engineering and Physical Sciences Research Council (EPSRC) through grant GR/L26858.

Meaningful Learning in a Virtual University by Using High-Speed Internet Connections

Riitta Rinta-Filppula
CERN
Geneva, Switzerland
riitta.rinta-filppula@cern.ch

Anne-Maria Korhonen
CERN
Geneva, Switzerland
anne-maria.korhonen@cern.ch

Abstract: This is a report on a case study, which was carried out by applying the qualities of meaningful learning based on constructivist theory to the evaluation of the distance learning environment. As a part of the Web University -pilot, the evaluation was directed to the lecture series: "Web Publishing Today and Tomorrow" by Håkon Lie, organized at CERN (European Organization for Nuclear Research), in Geneva, Switzerland. Web University distributed the lectures to distance audiences in Finland over a high-speed network and recorded them on a server. Originally, the lectures have been planned for face to face learning but modified suitable for distance learning by using learning tasks of the distance students. The distance learning environment, delivery technology complemented by distance tasks, has been evaluated by analyzing how the qualities of meaningful learning appear. The results of the case study lend support to assumptions that delivery technology could be complemented by the student project work and obtain the qualities of meaningful learning.

Introduction

Web University (Rinta-Filppula 1999) is the international pilot of the Finnish distance learning project "Open Learning Environment" (1999-2002). Web University is based on the concept of virtual university where distance participants communicate over the network by using applications such as multicast interactive videoconferencing, video-on-demand, World Wide Web (Web), email and mailing lists. The project uses national research networks and European wide high speed Internet connections.

Distance learners can update their knowledge by participating in CERN seminars from their personal workstations or conference rooms over the real-time broadband network based on ATM (Asynchronous Transfer Mode) and Internet technology. Teaching is interactive and it is in principle targeting researchers and postgraduate students, but some courses in physics and information technology have been additionally offered to undergraduate students and special groups, such as journalists and general public.

The latest scientific knowledge of the researchers can be applied straight and immediately even to undergraduate student studies. The technology enables to attend the lectures and update knowledge, no matter the physical location of the learner.

The aim of this case study is to evaluate a realization of the vision how CERN lectures could be integrated in local studies of distance students by using the qualities of meaningful learning based on constructivist theory (Rinta-Filppula 1999). The evaluation has been carried out analyzing the learning tasks and the recorded transmissions. The selected case is the lecture series "Web Publishing Today and Tomorrow" given by Håkon Lie from the World Wide Web Consortium in March 1999 at CERN and a local implementation of distance student tasks in Tampere University of Technology in Finland.

The Qualities of Meaningful Learning

The evaluation was realized by reflecting the qualities of meaningful learning over distance learning environment. The content of the lectures was not included in the analysis. The aim of the study was to analyze how the qualities appear in real-time sessions, recorded transmissions and learning tasks. Two alternative learning tasks – learning diary and project work with student evaluation reports – were connected to the lectures in Tampere University of Technology, where the distance students participated in real-time lectures.

Theoretical background of this evaluation lies on the theory of constructivism. Based on the assumptions of constructivist perspective Jonassen has proposed a list of qualities of meaningful learning (Jonassen 1995). Ruokamo & Pohjolainen (1998, 293-294; 1999, 7; 1999, 924) have merged conversational and collaborative qualities in Jonassen's list into one and added the quality of transfer into the list. On the basis of Jonassen and Ruokamo & Pohjolainen, seven qualities will be presented as follows:

Active – Learners have an active role during the mindful processing of information and they are responsible for the result.

Constructive – Learners construct new knowledge by accommodating new ideas into prior knowledge.

Collaborative – Learners cooperate in building new knowledge together exploiting each other's skills and providing social support. .

Intentional – Learners attempt actively and willingly to achieve a cognitive object.

Contextual – Learning tasks are situated in a meaningful real world tasks or they are introduced through case-based or problem-based real life examples.

Transfer – Learners are able to transfer learning from situations and contexts, where learning has taken place and use their knowledge in other situations.

Reflective – Learners articulate what they have learned and reflect on the processes and decisions entailed by the process.

Distance Learning Environment

Interactive and Real-time Videoconferencing

The CERN lectures were transmitted real-time and interactive over the high-speed network and recorded digitally on CERN server at the same time. The recordings were transferred to FUNET (Finnish University and Research Network) server daily after the real-time session. This gives an opportunity for distance participants to study distributed lectures in case a temporary network problem in a real-time learning session.

The lecturer and the distance audiences in Finland were introduced at the beginning of CERN's face to face lecture series. The lecturer Håkon Lie welcomed all the participants at CERN and in Finland (Espoo, Pori and Tampere) and the distance learners were taken notice and accepted to attend the lectures as local audience.

The lecturer gave the distance audiences an opportunity to ask questions during the lecture, not only at the end of each lecture. Some questions were asked during the lectures. When a distance learner wanted to ask a question, he/she showed the question sign whereafter the lecturer gave him/her the floor. The learner then took a microphone and asked. The lecturer and all the participants at CERN and in Finland heard the question and saw the speaker.

Real-time interaction between the lecturer and the distance learners functioned well. The learners and the lecturer were active, the situation was authentic and the audio was clear and comprehensible. Only movements of video images were a little bit slow because of 256 kbit/s limitation of the software used for transmissions. In spring 2000, the limitation has been risen up to 1 Mbit/s.

Video-on-demand Service

The whole transmission including the distance audiences has been recorded on a server. Successful studying of the recordings requires PC, Linux or Unix workstation with network connection, soundcard and loud speakers.

Studying the recorded transmission presupposes an active role from the learner. The control of the recorded lecture is on the learner's hands. From the control panel of the recorder, the learner is able to see how long the lecture is still going on. It is also possible to return to a chosen point of the lecture again, e.g. to check some information. The learner can study the recordings from his/her own workstation at his/her convenience. He/she can study the recorded lectures together with other local learners and/or a tutor or professor whenever necessary.

The interaction between the lecturer and the learner who studies the recordings is possible by using applications such as e-mail or mailing list. The benefit of the recorded transmissions is that thcy are available when the students have time to study.

The quality of the real-time session is as good as the quality of digital recording taken that the real-time network functions without any problems. This has been usually the case: the sound has been excellent, the video colored, clear and bright and the images of the lecturer and the distance audiences in Finland all visible and recorded. Actually, the whole transmission has been recorded. It is also possible just to listen to the recordings without observing the video.

Learning Tasks

The students in Tampere University of Technology included the CERN lectures to their studies and accumulated credits. In addition to attending the interactive and real-time videoconference, their professor Seppo Pohjolainen integrated alternative learning tasks to the lectures. The students should write individual learning diaries or prepare project works in small groups and write down student evaluation reports about their work and learning experiences. Moreover, the professor asked all students to add own opinions and criticism with arguments.

The professor requested the students to describe in their dairies the content of the lectures as well as the topics they had found interesting. Furthermore, the students were asked to analyze the way the lectures were accomplished and suggest how the lectures should be improved.

The students who chose to write the diaries got one study credit, whereas the students participating in the lectures and the project work in a small group could get three. The project work was realized, as follows: a team was asked to name the project work after an interesting topic presented by the lecturer. In addition, the students should deepen the chosen topic by examining their notes and looking for material from the library and Web. The team was required to publish their project work on the Web and study other team project works. The teamwork also consisted of an individual contribution of each student. Finally, the team was asked to present their work in a virtual seminar and prepare questions about other team project works. The professor also wanted the team to analyze the project working itself and both the personal and team learning process. Nearly twenty students with their professor participated in the real-time lectures in Tampere University of Technology. Ten of them made distance tasks and passed the course, six students wrote diaries and four students formed a group.

Evaluation of the Learning Tasks

Both learning tasks supported the student learning as a process, where the knowledge is constructed through a personal and active participation. It presupposes not only an active participation in the lectures but also successful activation of the students to follow the lectures intensively. The abstract of the lectures published on the Web beforehand facilitated the student orientation to the content – it activated the prior knowledge of the learners. This might also encourage the learner to search information on the topics independently.

Learning Diaries

Each learner writing a diary had to react to the information with a critical attitude and present his/her personal opinions about the topics. This presupposes that the student understands the content and facilitates calling in question in the knowledge. In addition, it activates the student to modify prior knowledge with new one and requires him/her to give arguments for own understanding and ideas. The conversation with another learners is seen to improve the student social skills, collaboration and argumentation.

Writing a diary strengthens the student as an active, responsible and self-directed learner. The fact that the students were additionally asked to write about the topics that interested them personally supports the student as an intentional learner.

The students were asked to comment on not only the content of the lectures but also the way the lectures were realized in practice. The feedback showed that they were satisfied with the lecturer and technology, which functioned even surprisingly well. The audio was very clear but the images of the video could have had a higher speed. The content of the lectures was considered interesting and useful. Some students requested to have more this kind of expert lectures.

When writing a learning diary the student reflection is internal if he/she has neither experience nor practice in process writing. The student could naturally reflect his/her own ideas with the professor who gave the credits. The interaction with the other students would probably have deepened the learning process because the learning and knowledge construction are also collaborative and socially interactive.

Project Work

Technical help was available for the student throughout the learning period. This is important when using new technology. The project work organized and created in a small group required both active individual and collaborative learning. The team had to select a jointly interesting topic and divide the work itself into individual tasks. The group should select work tools and make a timetable and a plan to ensure that all-essential information would be included. Furthermore, the request for additional material to the project work encouraged each student to take an active role in his/her own and group learning process. It also deepened the understanding and knowledge of the learner.

The learning process engages the students in analyzing information through the project work. Each individual student is responsible for the whole team success by contributing his/her own activity, knowledge and skills for the good of the project. The team was also asked to report on the division of labor of the group. This makes possible to evaluate the activity of an individual member and ensures that the student is willing to take responsibility for his/her own objectives of the teamwork. The fact that the group made their project work about the topic that interested personally and published it on the Web gave some additional support to intentional learning.

The content of the lectures was implemented by asking the team to publish their project work on the Web. This means that the learners are able to transfer their knowledge to a new situation and use it. The technology and the content of the lectures offered a fine learning environment not only by providing the lectures but also by operating as a context of knowledge performing. The title of the project work carried out is Style Sheets. Some students who wrote the dairies had asked additional information on and examples of the style sheets. Now they and others who will later study Web publishing have all necessary available on the Web.

The project work enabled the student collaboration. The team members had a common goal and they constructed new knowledge together. The seminar at the end of the project work supported collaboration as well as the development of social skills and reflection. As only one group was formed, the team reflected their own project work with their professor in the face-to-face seminar. The learners used e-mail and organized four face-to-face meetings during the project because they all worked in the same office.

In addition to the project work, the team was asked to report their learning experiences by writing down what they had learned individually and jointly. The student work and learning evaluation report enable to analyze the learning process as a whole. The students articulated the matters they had learned about the topics. It was probably too difficult to describe the learning process itself if they had no previous experience in it. More detailed questions about the student learning process could support the process.

The students also gave statements about execution of the course and proposed e.g. how to improve it. This means that the students were accepted to participate in the development work. The students gave affirmative feedback about the lecturer, the lectures and very well functioned technology. In addition, they expressed a wish that the slides would be published in advance on the Web. In order to help the students to concentrate on making their own notes and comments to the copies instead of wasting time for copying the slides. The distance learners evaluated very carefully the technology used for transmissions. They even noticed that the audience at CERN heard distance questions better than the lecturer.

Conclusions

In this case of distance education, the qualities of meaningful learning were realized at least partially throughout the process. The real-time interactive videoconferencing enabled interaction between the distance students and the experts. The digital recordings and the material on the Web supported the student flexible learning process and encouraged the individual and group activity. In addition, the means and methods mentioned above offered the students an opportunity to reflect their prior knowledge and notes taken when constructing and deepening the knowledge by doing the tasks. This kind of distance education gave the students even a possibility to include the latest research results to their studies and reflect their own ideas with the well-known experts. This all took place thanks to well-functioned technology.

The learning tasks, learning diaries and project work together with the student evaluation report indicated the qualities of meaningful learning but on a different level of student learning process. Both tasks were based on the student activity and self-learning. The intentional learning was realized through writing the topics and selecting the project work topic that interested the students. The learning context, knowledge construction, transfer and reflection were achieved by creating and publishing the project work about Web publishing on the Web and by writing the student learning evaluation report. The student knowledge construction and reflection seemed to happen by writing the learning diary. These were internal processes for the student and more superficial in comparison with the other learning task.

Jonassen underlines (1995) that the most productive and meaningful uses of technology engage learners in knowledge construction, conversation, articulation, collaboration and reflection. Technology used in this case was delivery technology complemented by learning tasks. The results of the case study lend support to assumptions that delivery technology could be complemented by the student project work and could thus obtain the qualities of meaningful learning.

References

- Book references:

Ruokamo, H. & Pohjolainen, S. (1999). Etäopetus multimediaverkoissa – ETÄKAMU. Etäopetus multimediaverkoissa. Digitaalisen median raportti I/1999. (Distance learning in Multimedia Networks. Report of Digital Media) (ed. Ruokamo, Heli & Pohjolainen, Seppo). Sipoo, Tekes.

- Proceedings references:

Pohjolainen, S. & Ruokamo, H. (1999). Distance Learning in Multimedia Project – Experiences and Results. Proceedings of Ed-media 99. World conference on educational multimedia, hypermedia & telecommunications. Charlottesville, AACE. 922-927.

Rinta-Filppula, R. (1999). Distance Learning and Working over High Speed Internet. Proceedings of Ed-media 99. World conference on educational multimedia, hypermedia & telecommunications. Seattle, Charlottesville, AACE. 727-730.

- Journal references:

Jonassen, D. H. (1995). Supporting Communities of Learners with Technology in Schools. Educational Technology, 35 (4), 60-63.

Ruokamo, H. & Pohjolainen, S. (1998). Pedagogical principles for evaluation of hypermedia-based learning environments in mathematics. Journal of Universal Computer Science, 4 (3), 292-307.

Teaching Image Ethics in Multimedia Programs

Paula Roberts
School of Communication and Information Studies
University of South Australia, Magill, Australia
email: paula.roberts@unisa.edu.au

Jenny Webber
School of Communication and Information Studies
University of South Australia, Magill, Australia
email: jennifer.webber@unisa.edu.au

Abstract: Graphics-dependent industries such as advertising and the print and electronic media, as well as institutions which undertake in-house and on-line publishing, require computer professionals skilled in electronic image manipulation, however, employers often overlook the need for staff to apply high ethical standards in the practice of their technical skills. Computer technology allows 'seamless' alteration of photographs and other images, but these technical advances have made possible visual misrepresentation with intent to deceive, as well as difficulty in establishing copyright for original images. The challenge for educators in teaching techniques of image manipulation is to instil in students an ethical basis for their practice as computer professionals. This paper describes the image/ethics interface in a higher education multimedia program.

Introduction

A 1999 television advertisement on behalf of an Australian Cancer Research Foundation is 'spoken' by the late actor Steve McQueen, who died of lung cancer some twenty years ago. He begins his message by saying, 'I died in 1980. There wasn't a cure for cancer then and there isn't now, but ...' and he goes on to solicit donations to assist cancer research. This advertisement demonstrates state-of-the-art computerised imaging, but also brings into sharp relief ethical questions related to image manipulation.

On investigation, no ethical problem is created by this particular advertisement, as was explained in a television interview (Kirwan 1999) when a spokesman for the Sydney advertising agency which produced the video clip described its technical dimensions, and, more significantly, how its graphic effects were accomplished ethically. Kirwan told how his advertising agency gained prior approval from the executors of Steve McQueen's estate for the use of a clip from McQueen's film *The Cincinnati Kid*, in which the actor spoke directly to the camera. To create the impression that McQueen was 'speaking' twenty years after his death in support of cancer research required the use of an actor with a McQueen look-alike mouth, and another with a McQueen sound-alike voice, and these physical features were 'seamlessly ' dubbed into the old film clip, using similar imaging techniques to those which created the 'talking' pig and other animals in the Australian film, *Babe*.

From its beginning, the McQueen project was ethically beyond reproach, from the worthiness of its intent, the seeking permission to use the actor's image, the involvement of the McQueen executors during the advertisement's production, and their approval of its final outcome. However, the print and electronic media do not always display such ethical behaviour in respect of the computer manipulation of photographic images. For example, in Australia, on the day following the tourist shootings at Port Arthur, in Tasmania, a photograph of the alleged gunman's face appeared on the front page of some Australian newspapers with his eyes 're-touched' to create a sinister facial expression. This unacknowledged 're-touching' was evident when the same (but untouched) photograph of the suspect appeared in other newspapers.

Similarly, in the United States, at the time of the O.J. Simpson trial, a cover of *Time* magazine featured a computer-retouched police 'mug shot' of the former football star and then alleged murderer. When challenged that the photographic manipulation was misleading, racist, and potentially prejudicial, the editor argued that the photographic image had been 'subtly smoothed and shaped into an icon of tragedy' (Wheeler & Gleason 1995: 8), however, under further pressure, the editor did in fact apologise to his readers for this photographic manipulation. During this same period, Kobre (1995: 14) describes a *National Enquirer* photograph under the banner headline 'Battered Nicole: Photos taken by her sister show how O.J. beat her up', which gave, at first impression, a photograph of Nicole Simpson's bloodied and swollen face, until a statement in small type under the photograph was noticed, '*Sister describes photos seized by cops - computer re-creation*'.

In the face of such blatant, misleading manipulation, Kobre makes a case for greater photographic access to all situations and a wider distribution of photographs, so that fakes may be countered with the truth. He argues that had the media had access to the pictures tendered at the trial of the beaten Nicole Simpson, which were even more horrendous than the *Enquirer's* fictional image, then the fake would not have been necessary, or it would, at least, have been countered by the authentic images. Unfortunately for Kobre's argument, the control of visual news information increasingly rests with a powerful few (Reaves 1995), and photographic manipulation has a long history. Thus there appears little chance that greater photographic access will control this misrepresentation by skilfully altered photographs unless the ethics of its practice are challenged.

Photographic manipulation's long history of deception

The manipulation of photographs dates back to the early nineteenth century, when photography, while basing its validity on its technical capability for making representations of reality, was always a 'combination of artistic, technical, theatrical and entrepreneurial achievement' (Slater 1995: 218-219). Thus, from its inception the concept of photography as truth has been set alongside artforms such as photomontage, where photographic manipulation was used for caricature (Evans & Gohl 1986), but in these early days, this practice most often stopped short at retouching to remove unflattering facial characteristics such as wrinkles and pock marks in middle class portraiture, which was popular at the time (Lester 1991; Kobre 1995).

Later there was more serious manipulation with obvious intent to deceive, and this may be seen in historial war and political photography, where the deceptions were not detected until much later. For example, some photographic manipulations from the American Civil War were discovered only when similar photographs were set alongside each other and comparisons revealed, for example, the rearrangement of 'corpses' in different photographs of the same scene. Even the famous portrait of Abraham Lincoln was a composite of the body of a Southern statesman, with Lincoln's head sandwiched atop. (The same technique has been used recently to set Oprah Winfrey's head on the body of actress Ann-Margret on a *TV Guide* magazine cover.)

In *Making People Disappear*, Jaubert (1986) (cited by Lester 1991: 101) chronicled numerous photographic abuses by totalitarian regimes which involved using retouching and effacement techniques to doctor the historical record to reflect a political leader's version of the truth. And, in more recent times, charges of manipulation cloud famous historic photographs. Lester (ibid.: 117) recounts the 'unrelenting ethical controversy' surrounding Rosenthal's Pulitzer Prize photograph involving the US marines' flag-raising at Iwo Jima in World War II. Subsequently it was revealed there were at least four photographs taken at the time, three by Rosenthal and another by a Naval photographer, which suggests the occasion of the famous photograph was staged, and it was not the eye-witness representation of the historical event as was first believed.

What is significant about this historical record of photographic manipulation is not that it happened, but that it was so easily discovered. Detection was easy then because the clumsy techniques of the time allowed the discovery of alterations. As well, these earlier techniques took painstaking work which was expensive and time consuming, and this deterred the practice from becoming more common. On both counts, this is no longer the case, for the application of computer technology now allows photographs to be modified seamlessly, that is, with little or no evidence of alteration, and with an ease and speed which encourages the practice.

Modern computerized photographic techniques also allow the quick synthesis of artificial images which are not based on reality. When a photograph is taken with a digital camera, or scanned and converted to digital information, the entire image can be modified in many ways, that is, its colour, brightness and focus can be changed, and elements of the image (such as a background, or persons) can be replicated or removed in a process which takes only minutes and is almost impossible to detect. In some cases, these techniques are revealed intentionally to warn readers of the potential for deception, as in a *Science 84* cover (cited in Ritchin, 1991: 32) which used three major imaging techniques to create a 'realistic' image from scratch, that is, a simulated reality. The editor did not set out to deceive his readers, in fact the cover carried a caption 'This Picture is a Fake'.

In addition to issues of misrepresentation, photographic manipulation raises questions of both copyright and ownership with respect to the original photograph. Should the original photographer and the photographic manipulator share the reward for the new image? How might a manipulated photograph be traced back to its source? Whereas a book or painting may be seen as a whole, and the copying of all or part may be reasonably detectable, the easy, and most often undetectable, manipulation of photographs and other images (including clip art) renders the ownership of this artwork difficult, if not impossible, to protect (Mitchell 1994: 51).

Ethical problems related to photographic manipulation arise not only in respect of photojournalism, but also in using photographs as evidence in legal cases and for other documentary purposes such as the compilation of social and cultural histories. And wider still are the ethical considerations which relate to the rights of subjects in photographs, and the visual persuasion and deception which is evident in the advertising industry.

Moral rights of subjects in photographs

Abuse of the moral rights of subjects in print media photographs, television and film has been identified by Gross et al. (1988) and Lester (1991, 1995 & 1996). One case was the use by the large corporation, Benetton, of the harrowing picture of a dying AIDS patient in an advertisement of its products (Lester 1995: 78-79, 98-99). Other examples of the intrusiveness and inappropriateness of photographic reporting of tragic and often grisly events are reported in Lester (1991 & 1995) and in his 1996 text, in which he has examined the use of photographs in perpetuating the stereotyping of minority groups.

The struggles for protection of the privacy of personalities from the intrusion of media photographers have been reported comprehensively, but Powell (1998: 93) suggests the privacy of ordinary individuals is also now under threat with developments in satellite technology which fast outstrip the development of ethical protocols which might guide its use. He reminds us that in earlier days of U-2 spy planes and Sputnik, ethical issues centred on military secrecy and national boundaries, while at the end of the nineties it is satellite use, high-powered lenses, infra-red sensory devices, instant high-resolution image transmission, and the capacity for global observation which magnify communication ethics issues.

As satellite images reveal military forces, conventional warfare becomes obsolete, but civilian privacy has changed dramatically as well, as 'backyard sunbathers, naturalists, couples, speeding vehicles, and naked paramours seen through bedroom windows can all be identified, photographed, and publicized without their awareness or permission', (Powell ibid.: 94).

Powell suggests that as the capacities of space photography increases in parallel with its potential commercialism (already vendors in many countries routinely sell space imagery to media outlets), then communication ethicists must consider, firstly in journalism, the decisions of editors and producers regarding the publishing of invasive photographs, and secondly, in new media ethics, who it is who 'employs, duplicates, regulates, as well as who sells and buys satellite imagery', (Powell ibid.: 95).

Visual Persuasion in Advertising

Ethical issues regarding visual persuasion in advertising have been raised by Mitchell (1994) and Messaris (1997). Advertisements which use images to make false claims or to sell harmful products can be readily judged as unethical, but a different form of advertising uses images in a more subtly unethical manner. For example, Messaris (1997: 267-8) points to images which focus on the discrepancy between an idealized vision of life and the needs and abilities of real people, for advertisements which use sex or status for their appeal may create a source of dissatisfaction in people's lives, such as with their body shape, thereby creating an anxiety which may be linked to eating disorders.

But, Messaris (ibid.: 271) suggests ethical judgements on specific advertisements may not always be clearcut, and cites a 1990 Volvo TV commercial in which a monster truck flattens other cars, but fails to squash a Volvo 240, in a scene staged with a car which had been strengthened. As the advertisement was based on a real-life incident in 1988 in which a Volvo had withstood a monster truck's weight, why was it necessary to reinforce a similar car for filming the commercial? An industry spokesman's defence was that the car was reinforced because of the need for repeated 'takes', but Messaris questions whether this explanation justified the advertisement's staging, or whether the addition of a 'dramatization' tag would be sufficient to excuse the commericial's creators.

And graphics-based advertising may allow sellers to express ideas they might be unwilling to put into words, lest the advertiser's claims be challenged legally. Messaris (ibid.: 273-4) cites an example of the promotion of nutritional supplements for bodybuilders. Scientific evidence had shown that these were no better at inducing muscle growth than an ordinary balanced diet, and, in fact the commercial did not claim that they did, verbally. Instead its message relied on a visual 'cause-effect juxtaposition: that is, on one hand, an image of the product; on the other, an image of a champion body-builder'. When challenged, a spokesman argued the company could not be held responsible for what individual viewers concluded from these images, however, the intent here was obvious, that is, persuasion by inference.

Towards a Protocol for Graphics Ethics

Wheeler & Gleason (1995) suggest that, in respect of the digital manipulation of photographs, an ethical protocol should be established which would identify (by the use of a system of icons) altered and unaltered photographs, thus enabling a reader or consumer to ascertain whether or not the graphic had been modified. However, whilst a system of labelling of photographs and other artwork is commendable, there is need for a more encompassing protocol for image ethics in view of the myriad of new communications technologies developed in the late 1990s, and others which are anticipated.

These technologies (which include satellites, the Internet and virtual reality), each bring with them social effects and ethical issues which arise before society has begun to assimilate these rapid developments in technology. Documents and photographs can now be altered from a distance without detection, and realistic, yet artificial, images can be quickly synthesized. Theoretically, as Cooper (1998: 74) suggests, 'a presidential candidate may now be computer-generated, credentialled online, and elected without ever being publicly seen (other than via a human stand-in)'. In similar vein, Powell (1994) predicts totally synthetic news events.

When invasion of privacy occurs with old technologies such as a camera with telephoto lens, such invasion has very different qualities than 'cyvacy', (computer privacy invasion) (Powell 1998: 93). This new invasion of privacy is remote, undetectable and impersonal and amplifies existing problems such as obscenity and indecency 'by making controversial and criminal (in many cultures) images available to much larger, different, and younger audiences' (Powell ibid.: 94).

A protocol for image ethics thus must encompass the issues outlined above and be proactive rather than reactive to the ethical problems created by the unique features of the new technologies, which are exacerbated by their rapid rate of invention and implementation.

Image Ethics in a Higher Education Multimedia Program

In higher education the teaching of ethics is most often left to philosophers or to specially designated courses. This is a missed opportunity, for research shows that integrating ethics in discipline-appropriate ways embellishes the study of ethics (Roberts 1994 & 1995; Lisman 1996). This view supports the integration of image ethics in the multimedia program of a Bachelor of Arts award in an Australian university.

The image ethics program relies on the model of ethical decision-making developed by Rest & Narvaez (1994: 23-24) which involves a continuum of four distinctive stages, that is, moral sensitivity, moral judgement, moral motivation, and moral character. This model is particularly useful in the context of the university's 'Graduate Qualities' which are a set of personal and professional qualities which the university anticipates as outcomes for its graduates, and which underpin its educational programs. One Graduate Quality involves the development of the graduate as an ethical citizen and professional.

The Image Ethics program commences in a foundation (mandatory) introductory computing subject in the first semester of the Bachelor award. Its pedagogy (described in Roberts 1994 & 1995) aims to establish a moral sensitivity to a range of issues in Computer Ethics, which includes, amongst others, an examination of computer crime, 'hacking', privacy, computers in critical systems, and the use of imaging techniques, with the intent to deceive. Some 650 students undertake this subject. For some of these, this will represent their only exposure to considerations of the social and ethical implications of computing, but as users and citizens, this first encounter with Computer Ethics may provide them with the opportunity to make better informed choices, and as consumers, they are more likcly to influence the design and direction of new technologies (Pool 1998).

For other students who will extend their studies to the computing major in Multimedia Studies, in subjects which have as their main focus visual arts and communication, these will engage in the construction and manipulation of graphics. Each subject in the major includes an image ethics component, appropriatc to the particular level of study and its technical content, and the students are encouraged to develop moral judgement in their creation and use of images in the artwork which they design, in a manner similar to their judgement in the use of text, with respect to copyright and the intellectual property of others.

As students spend hours of painstaking work in creating their own artwork, their natural concern for their own rights to claim intellectual property for their products is a timely and practical reminder of their responsibility also to protect the rights of other artisans, and to encourage their peers to do likewise. It is gratifying to see examples of this growth in moral motivation which is a cornerstone of the moral character required of the computing professional.

In these laboratory sessions, the integration of discussions of ethical issues in image creation and manipulation is combined with practical work to produce a natural interface between ethics and computing, which avoids creating a dichotomy of an abstract philosophical theorizing of ethical principles in computing, and the 'hands-on' work of the computing practitioner.

The overall aim of this ethics program then is that students establish a personal protocol for image ethics which they will apply in their academic, personal and professional lives. This protocol may be briefly summarised as follows:

- An image should be identified as 'original' or 'altered' and labelled accordingly;
- An image should not infringe copyright or another's intellectual property;
- An image should not be used to deceive or persuade;
- An image should not infringe the moral rights of its subject(s) in relation to privacy and stereotyping;
- An image should not breach ethical and legal standards in relation to obscenity and decency;
- A computing professional should anticipate that new communication technologies may carry with them unpredictable and unwanted effects for society, be prepared to research and debate these effects, and work towards society's control of technology;
- A computing professional has an individual responsibility for vigilance and action to defend the visual truth of information.

Conclusion

Too often ethical issues in computing are studied only after serious problems have arisen. With the benefit of hindsight it can now be anticipated that each new technology will bring both benefit and disturbance to society, and that in order for society to gain control over technology and to be able to influence its effects, evaluations of technologies must include not only the performance of their technical properties, but their potential effects on organizations, societies and individuals.

Such is the case in the teaching of imaging techniques to users and future industry practitioners who will work in a variety of contexts which use graphics to enhance communication. There is a vital task here for all educators to prompt awareness of the scope of ethical issues which arise from the use of this technology, and the need for moral responsibility in its use.

How do we get these budding professionals to look beyond the seductive power of computer technology and the aesthetic appeal of working with graphics? The skills/ethics interface is all important in this task, an interface which requires that at the same time that students learn the skills of image manipulation, they are also made aware of the ethical dimensions of these skills.

Students are now fully aware of the issues of plagiarism of text in their academic work, and universities have policies in place which require students to acknowledge the intellectual property rights of authors, by procedures for referencing quotations and ideas from original work. The same respect for the artwork and photographs of visual artisans has been ignored, and a similar system of referencing which applies to a scholarly essay should be applied to the production of graphics in a student's multimedia projects.

But the wider issue of an ethical approach to the presentation of visual information has great importance for a society which turns increasingly to a reliance on pictorial communication. For as Ritchin (1991: 37) warns:

> As readers we must remain vigilant. Otherwise, what as a society, and among societies, are we going to be left with as a form of communication that can be trusted? What information will people be able to rely upon to make decisions? Or most precisely, what will the role of the press in a democracy be worth? ... Undoubtedly, we will all be told that what has happened is the computer's fault, and we will then be even more isolated in our own media bubbles than ever before.

References

Cooper, T. (1998). New Technology Effects Inventory: Forty Leading Ethical Issues. *Journal of Mass Media Ethics*, **13:** 71-92.

Evans, D. & Gohl, S. (1986). *Photomontage: a political weapon*, London, Bedford: Gordon Fraser Gallery.

Gross, L., Katz, J.S. & Ruby, J. (eds.) (1988). *Image Ethics: The Moral Rights of Subjects in Photographs, Film and Television.*, Oxford: Oxford University Press.

Kirwan, P. (1999.) Interview, *Today Show*, Channel 9 Television, Australia, July.

Kobre, K. (1995). The long tradition of doctoring photos. *Visual Communication Quarterly*, **2:** 14-15.

Lester, P. (1991). *Photojournalism: An Ethical Approach*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Lester, P. (1995). *Visual Communication: Images with messages*. Belmont, CA: Wadsworth.

Lester, P. (1996). *Images that injure: Pictorial stereotypes in the media.* Westport, CT: Praeger Publishers.

Lisman, C. D. (1996). *The curricular integration of ethics: Theory and practice*. Westport, CT: Praeger.

Messaris, P. (1997). *Visual persuasion: The role of images in advertising*. Thousand Oaks CA: Sage.

Mitchell, W.J. (1994). *The Reconfigured Eye: Visual Truth in the Post-Photographic Era,* Cambridge, MA.: MIT Press.

Pool, R. (1998) *Beyond Engineering: How Society Shapes Technology*, New York, Sloan Technology Series.

Powell, A. (1994). On ramps to the information superhighway. *Media Studies Journal*, **3:** 113-121.

Powell, A. (1998). Satellite Imagery: Ethics of a new technology. *Journal of Mass Media Ethics*. **13:** 93-98.

Reaves, S. (1995). Magazines vs. newspapers: Editors have different ethical standards on the digital manipulation of photographs. *Visual Communication Quarterly*, **2:** 4-7.

Rest, J. & Narvaez, D. (1994). *Moral development in the professions: Psychology and applied ethics*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Ritchin, F. (1991). Photojournalism in the age of computers. In C. Squiers, (ed.) *The Critical Image: Essays on contemporary photography*, London: Bay Press.

Roberts, P.M. (1994, April). The place and pedagogy of teaching ethics in the computing curriculum. *Australian Educational Computing.*

Roberts, P.M. (1995). Ethics: the neglected factor in computing education. In J.D. Tinsley & T.J. van Weert (eds.) *Liberating the Learner*, London: Chapman & Hall.

Slater, D. (1995). Photography and modern vision: The spectacle of 'natural magic'. In C. Jenks, (ed.) *Visual Culture*, London and New York: Routledge.

Wheeler, T. & Gleason, T. (1995). Photography or photofiction: an ethical protocol for the digital age. *Visual Communication Quarterly*. **2:** 8-12.

Report on Learning Technology Standards

Robby Robson
Department of Mathematics
Oregon State University
United States
robby@orst.edu

Abstract. Metadata and interoperability standards are essential to support the educational and commercial effectiveness of learning technology. A number of related and cooperating organizations are working to develop such standards. This paper briefly explains why such standards are important, who is involved in their development, and what standards are being developed. The penultimate section discusses the standards process in general and points out that learning technology standards are attempting to create new infrastructure rather than codify or standardize existing practice.

Introduction

This paper reports on activities in two areas: *metadata* and *interoperability standards.* Its purpose is to give a snapshot of the players and recent developments in these areas and to make some general comments on the standardization process. Its focus is work being done by the IEEE Learning Technology Standards Committee (LTSC, 2000) and related efforts.

Metadata and Interoperability Standards

Metadata is data about data. In this paper metadata refers specifically to relatively small amounts of descriptive data that capture essential aspects of a learning resource. An example from the print world is the information in a library card catalogue. The title, author, publisher, publication data, copyright, subject classification, and call number are metadata that cover important aspects of a book or document, although pedagogical information is largely missing. The most prominent examples of metadata standards in the educational arena are Dublin Core metadata and the *Learning Object Metadata* (LOM) that is being developed by the IEEE learning technology standards committee. Dublin Core metadata consists of fifteen core elements that as yet do not address educational issues. This paper will concentrate on developments in LOM and standards related to it.

Interoperability standards are standards that permit different systems or different parts of the same system to work together. Protocols such as Internet Protocol (IP) and standards such as Postscript may be thought of as interoperability standards. IP allows diverse systems to exchange information by standardizing its encoding for transmission. Postscript provides an abstract and device-independent language for describing two-dimensional print and graphics; documents described in Postscript can be rendered on any device that can interpret the language. An analogous effort in learning technology is a standardized scheme for describing the quizzes and tests commonly used by learning management systems and other online testing software. A quiz described in this fashion could be exported and imported by any compliant systems.

Metadata can in many instances play the role of interoperability standards. The MIME type (Hood, 1998) is a piece of metadata associated with data delivered over the Internet that tells the recipient the general nature of the data and what software is needed to process it. As such, the MIME type enables interoperability. Descriptions of the subject matter, intended grade level, student learning outcomes, and other educationally relevant data associated with a learning resource also serve as interoperability standards since they can potentially assist in assembling a collection of resources into a single cohesive unit such as a lesson or course.

Organizations Involved in Learning Technology Standards

A number of organizations are involved in producing metadata and interoperability standards specifically for instructional technology. A list of the major ones includes:

- ADL: The *Advanced Distributed Learning Network* was formed in 1997 by the United States Department of Defense and the White House Office of Science and Technology Policy to enable anywhere/anytime access to quality learning.

- AICC. The *Airline Industry CBT Consortium* was formed in 1988 to standardize hardware used for training in the airline industry. Since that time it moved into the standardization of Learning Management Systems as well. (AICC, 2000)

- ARIADNE. The *Alliance for Remote Instructional and Authoring and Distribution Networks for Europe* started in January of 1996 and focuses on the development of tools and protocols that support the production, storage, delivery, and reuse of curricular components used in educational training (ARIADNE, 2000).

- CEN/ISSS WS-LT. The CEN (European commission for standardization) *Information Society Standardization System* started a *Learning Technologies Workshop* in March, 1999, with the goal of supporting the learning technology market and ultimately the European information society with standards-oriented services and products (CEN/ISSS, 2000).

- DUBLIN CORE: The Dublin Core metadata initiative began in May, 1995, as a metadata workshop sponsored by the Online Computer Library Center (OCLC) and the National Center for Supercomputing Applications (NCSA) in Dublin, Ohio (Weibel et. al., 1995). The Dublin core has produced a stable set of 15 elements that support the storage and retrieval of general online resources. An education working group was started in August, 1999, to investigate extensions for pedagogic resources (Dublin Core, 2000).

- GESTALT: *Getting Educational Systems Talking Across Leading Edge Technologies* is a European Community project involving eight academic and corporate partners. Projects include metadata and architectures for learning technologies.

- IEEE LTSC: The *Learning Technology Standards Committee* of the IEEE was formed in 1996 and is in the process of developing standards for a variety of aspects of learning technology divided into five groups: General, Learner-related, Content-related, Data and Metadata, and Management Systems and Applications. Participation is open to any individual or organization.

- IMS: The IMS project is a coalition of corporate, academic, and government partners that grew out of the EduCom *National Learning Infrastructure Initiative* in 1997. Originally entitled the "Instructional Management System project," IMS has the vision of creating a comprehensive open architecture and infrastructure for learning technologies (IMS, 2000).

- ISO/IEC JTC1/SC36: The *International Standards Organization and International Engineering Consortium Joint Technology Committee* (ISO/IEC JTC1) has started a Standards Committee (SC36) on Information Technology for Learning, Education, and Training. The first plenary session was held in March 2000 (JTC1/SC36, 2000).

- PROMETEUS: The PROMETEUS (*PROmoting Multimedia Access to Education and Training in EUropean Society*) initiative was started in late 1998 to assert Europe's role in learning technologies and also to protect educational and multicultural values central to the European culture. PROMETEUS members sign a Memorandum of Understanding committing to the goals of PROMETEUS, among which is interoperability. PROMETEUS supports several study groups on metadata an interoperability standards. Members of PROMETEUS include a range of corporate and academic institutions.

Learning Object Metadata

Learning object metadata is important for the discovery and re-use of educational objects. One of the exciting developments of the last year and a half is the agreement among many groups developing learning object metadata (IMS, ARIADNE, GESTALT, AICC) that they would use the IEEE LTSC as the vehicle for standardization. All four of these organizations have actively participated in the development of LOM, as the IEEE LTSC metadata standard is called. Conversely, IMS meta-data Version 1.0 is based on LOM 3.5, which was the IEEE metadata working group document prior to September 1999, and similar statements apply to metadata implementations by ARIADNE and GESTALT.

The LOM Data Model

The approach being taken to LOM is based on an extensible structured data model. Mathematically, this model is a tree. The object being described is the root. The leaves contain data. Every other node is labeled as an *element*. At any node in the tree, the path from the root to that node determines *what is being described* and the entire sub-tree descending from that node *is the description*.

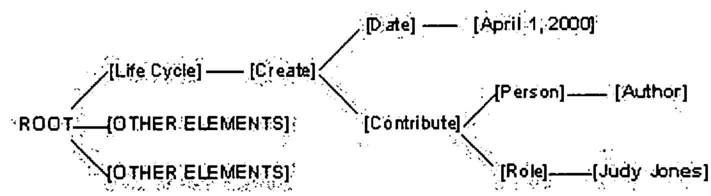


FIGURE I. Part of a LOM Tree

For example, in Figure I the path to the node [Contribute] proceeds from the root object through the path *LifeCycle - Create - Contribute.* This means that the node is describing a contribution to the creation of the object being described. The sub-tree emanating from *Contribute* has two elements, *Person* and *Role* and terminates in leaves containing the data Judy Jones and Author. Together (but not separately!) these specify that the contribution being described is that of an author named Judy Jones.

LOM Bindings

As it stands, LOM specifies three things:

- A set of metadata elements and their meanings (semantics)
- Relationships among the elements (structure)
- The type and size of data permissible in each leaf (data types)

This is abstract and does not dictate how LOM should be implemented in a real learning environment or digital library. To do this, one needs a *binding* of LOM, meaning a concrete data structure that meets the LOM specifications. When existing projects, such as ARIADNE, GESTALT, or CMU Online (CMU, 2000) use learning object metadata, they must store, transmit, and receive the metadata. In doing so, they create bindings of LOM in the form of XML DTD's or database designs. These bindings are not unique, which makes the bindings themselves candidates for standardization. A recent move on the part of the IEEE LTSC was to separate LOM as defined by the three bullet points above from any of its bindings and to view bindings as separate projects.

Interoperability Standards

From an interoperability perspective, it is important to have a standardized definition of the components and architecture of learning systems, as well as standardized interfaces among them. Having this would address at least three major frustrations:

- Content developed for one Learning Management System is not usable in another except to the extent that raw text, HTML, graphics, or applets can be extracted and uploaded.
- Large consumers of training and educational materials (e.g., the Department of Defense) are limited in their ability to specify compliance for procurement purposes.
- If content can be developed once and used many times, its value is greatly enhanced. This increases the incentive to develop educationally effective and professional quality learning materials and is a pre-condition for a thriving market – a precondition that has been lacking and that has contributed to the reluctance of content producers to commit large development budgets to online educational materials.

Work on interoperability standards is being done by the IEEE LTSC, the IMS project, ADL, the AICC, and various European groups. Many of the people and organizations involved are active in two or more organizations,. Each group is really part of a larger community effort but has its own emphasis. The AICC is focused on a single industry. The ADL is focused on broad applications and early on designated the IMS project as the means through which at least metadata specifications would be developed. The ADL has also set up a "CO-lab" program and is working closely with corporate and academic institutions. The IEEE LTSC is working towards official standardization, which is a difficult and often political process about which more will be said later. The ISO/IEC SC36 that has just started will also work towards standardization, while the various ARIADNE is focused on creating and maintaining a knowledge pool of learner resources, PROMETEUS is concerned with European social and political issues, GESTALT has developed a working implementation, and CEN/ISSS is concerned with standardization and dissemination in Europe.

Specific Interoperability Projects

Among the many pieces that comprise interoperability, the potentially easiest to handle is that for questions and tests. The IMS project has released a first version of a *Question and Test Interoperability* structure, together with and XML binding. The AICC has done a LTSC work on Computer Managed Instruction as well as SCORM – *Shareable Courseware Object Reference Model* – released on January 31, 2000, by the ADL. The people responsible for SCORM are from the DOD, the AICC, the IMS, and the IEEE LTSC Computer Managed Instruction working group. The press release (SCORM, 2000) indicates that the University of Wisconsin System, Wisconsin Technical College System and Carnegie Mellon University are academic partners.

Another area in which progress is being made is that of *learner profiling*. This includes not only personal information about the user of a learning technology but might also reference *competencies* that a learner has demonstrated or that accrue to the learner as the result of a particular experience. Learner profiling is educationally important in that it is necessary to implement any sort of situated learning. In other words, the background, context, and goals of the learner can and should influence the choice and method of learning experience. Learner profilcs also include electronic transcripts (Roberts & Robson, 1997). But learner profiling touches on numerous institutions external to technology and education – such as privacy protection and legal access to information. Identifying the learner in a typical academic or corporate training setting also begs for interoperability with information systems that handle student/employee data and records.

Schools Interoperability Framework

The combination of these external influences makes the standardization of learner profiling a high stakes and non-trivial matter. To underscore this, Microsoft Corporation started an initiative called the *Schools*

Interoperability Framework (SIF) that has been taken over by the Software and Information Industry Association (SIIA, 2000) and is being developed there as an open standard. The SIF Web Page (SIF, 2000) explains SIF as

> The Schools Interoperability Framework (SIF) is an industry initiative to develop an open specification for ensuring that K-12 instructional and administrative software applications work together more effectively. SIF is not a product, but rather an industry-supported technical blueprint for K-12 software that will enable diverse applications to interact and share data seamlessly; now and in the future.

The version 1.0 specification was released at the end of March 2000. Although SIF is intended for K-12 use only, it should be observed that it is in some sense in competition with the work being done by IMS, of which Microsoft is a member. SIF is an XML application but is educationally very conservative and primarily codifies an American K-12 system based on letter grades and seat time, not content standards or outcomes. SIF also goes beyond the work of being discussed in this paper since it includes specifications for the food service, HR/financials, and transportation.

Comments on Standardization

Until now an emphasis has been placed on what is to be gained by standardization. However, there are some negative sides as well.

The industrial standardization process has traditionally been one of fossilization whereby established (and possibly competing) industry practices were made uniform. As the pace of change in technology has picked up, the time lag between the establishment and the institutionalization of practice through the standards process has perhaps lessened, but the standardization process has remained driven by that which exists as opposed to that which is envisioned. The process can be highly charged since choices made by standards bodies can pick winners and losers and affect billions of dollars worth of commerce, but having standards is also a condition for accelerated growth of an industry sector (Shapiro & Varian, 1998).

In the educational arena, content standards have traditional been instruments of social change. This was true of Carnegie units and standardized tests and remains true of the current educational reform movement. Educational standards are typically developed in response to failures of existing institutions and in the hopes that the new institutions introduced by the standards will be meet with more success. Thus it may be said that educational and technology standards live on opposite sides of the line between fossilization and innovation.

Learning technology standards have purposefully crossed over the line from fossilization to innovation. The goal of the IMS project, and indeed its parent, the National Learning Infrastructure Initiative, was to develop non-existent infrastructure that its architects envisioned as being needed in the near future. The same applies to ADL. Although the IEEE LTSC is more constrained, its standards also have an anticipatory quality. This choice of *modus operandi* was made quite intentionally at the beginning of the work

Learning technology standards are consequently a bold experiment in creating standards. The World Wide Web Consortium (W3C, 2000) has done much the same thing with the development of its recommendations (the equivalent of standards), but W3C recommendations operate for the most part on the level of communication protocols as opposed to applications. A clear danger with developing anticipatory standards for learning technology is that premature standardization can cut off desirable future development paths. If, for example, the model of learning systems being promoted by SCORM dictates industry practice, then new models will be harder to develop. Since pedagogic innovation is slower paced and much less of a science than technological innovation, premature standardization could lead to the tragic result that truly better ways to teach and learn are nipped in the bud because they were not anticipated.

Another difficulty with the approach being taken by the standards community in learning technology is one illustrated by the emergence of SIF and the exaggerated claims made by academically oriented Learning Management System companies. In practice, formal standards do not carry as much weight as de facto standards, and the information industry is not in the habit of waiting for formal standards. However, for sales and marketing purposes it is often convenient, if not necessary, to claim conformance to formal standards. The learning management system vendors have been claiming IMS compliance for well over a year, despite the fact that there is no clear definition of what this compliance means. If this situation persists, it could devalue all formal learning technology standards and leave the industry with a set of competing de facto standards. The result would be a lack of interoperability and a lot of finger pointing.

Conclusion

Only time will adjudicate the success of learning technology standards. It seems clear that they are badly needed and that there is a hard-working community making good progress on their development. Anyone interested in developing learning technologies, especially online and networked learning technologies, should pay close attention and, if possible, participate in this process. This paper lists a number of references to relevant organizations and is meant to be a starting point for this type of involvement.

It remains to be seen whether the attempt to use the standardization process as a means to anticipate and jump-start the learning technology industry will be successful. It could spur growth yet not find acceptance for the standards currently being produced and thus succeed by failing. But given the participation of the major technology companies, government agencies, and academic institutions, there is a good chance that the combination of the partners listed earlier will succeed in creating accepted standards and that the ultimate question will be how to adjust and revise these in response to innovative products and pedagogy.

References

AICC. (2000). *Aviation industry CBT committee.* <WWW Document> http://www.aicc.org/. Accessed April 1, 2000.

ARIADNE. (2000). *Alliance of Remote Instructional and Distribution Networks for Europe.* <WWW Document> http://ariadne.unil.ch/. Accessed April 1, 2000.

CEN/ISSS. (2000). *CEN/ISSS Learning Technologies Workshop.* <WWW Document>. http://www.cenorm.be/isss/Workshop/lt/meetings.htm. Retrieved April 1, 2000.

CMU (2000). *CMU Online.* <WWW Document>. http://online.web.cmu.edu/. Retrieved April 2, 2000.

Dublin Core (2000). *The Dublin Core Metadata Initiative.* <WWW Document> http://purl.org/dc/. Accessed April 1, 2000

GESTALT. (2000). *Getting Educational Systems Talking Across Leading Edge Technologies.* <WWW Document>. http://www.fdgroup.co.uk/gestalt/about.html. Accessed April 1, 2000.

Graves, W. (1994). *Towards a National Learning Infrastructure.* Educom Review, 29 (2), 1994. <WWW Document> http://www.educause.edu/pub/er/review/reviewArticles/29232.html. Accessed April 1, 2000.

Hood, E. (1998, July 11). *Multipurpose Internet Mail Extensions.* <WWW Document> http://www.oac.uci.edu/indiv/ehood/MIME/MIME.html. Accessed April 1, 2000.

IMS (2000). *The IMS Project.* <WWW Document> http://www.imsproject.org/. Accessed April 1, 2000.

JTC1/SC36 (2000). *Joint Technology Committee Standards Committee 36.* <WWW Document>. http://jtc1sc36.org/. Accessed April 1, 2000.

PROMOTEUS (2000). *Promoting Multimedia access to Education and Training in European Society.* <WWW Document>. http://prometeus.org/. Retrieved April 1, 2000.

Roberts R. and Robson, R. (1997). *Electronic Transcripts in the Age of Standards.* Pages 729-731 in S. Lobadzinski and I. Tomek, eds., WebNct97: World Conference of the World Wide Web Internet and Intranct, Association for the Advancement of Computing in Education, Charlottesville, VA.

SCORM (2000, Feb 2). The Department of Defense Advanced Distributed Learning -- ADL -- Initiative Releases Version 1.0 of the Sharable Courseware Object Reference Model -- SCORM 1.0 -- <WWW Document>. http://biz.yahoo.com/bw/000202/dc_dept_of_1.html. Retrieved April 2, 2000.

Shapiro, C. & Varian, H. (1998). *Information Rules: A Strategic Guide to the Network Economy,* Harvard Business School Press.

Weibel, S., Godby, J., Miller, E., Daniel, R. (1995). *OCLC/NCSA Metadata Workshop Report,* <WWW Document> http://purl.org/dc/workshops/dc1conference/report.htm, Accessed April 1, 2000.

Instructional Design Agents – An Integration of Artificial Intelligence and Educational Technology

Erika Rogers
California Polytechnic State University
Dept. of Computer Science
San Luis Obispo, CA
erogers@csc.calpoly.edu

Carol Scheftic
California Polytechnic State University
University Center for Teacher Education
San Luis Obispo, CA
scheftic@calpoly.edu

Emilio Passi and Sharon Lanaghan
California Polytechnic State University
Dept. of Computer Science
San Luis Obispo, CA
{epassi,slanagha}@falcon.csc.calpoly.edu

Abstract: The purpose of this paper is to introduce a project whose goal is to design and develop a productivity tool which helps academic instructors in their course preparation. This tool will be composed of a number of "instructional design agents", which combine techniques in human-computer interaction, artificial intelligence and educational theory. The first of these agents is based on Bloom's Taxonomy, and a brief overview of this work in progress is presented.

Introduction

In today's rapidly changing academic environment, the role of university professors is also increasing in complexity. While the three core areas of faculty evaluation are still typically teaching, service and professional development/research, in reality, there are many additional responsibilities that are embedded in these core areas. For example, faculty are not only responsible for the more traditional tasks of preparation and delivery of course materials, but they are also expected to devise and choreograph appropriate "active learning" activities, to incorporate new technologies such as multimedia and the Internet, and to participate in seemingly endless cycles of self- and program assessment and evaluation, to name just a few. In addition to the conduct of their own professional lives, it appears that faculty are also to be held accountable for students' learning, even though increasing class sizes and shrinking resources make it harder and harder to monitor and adjust in such an individualized manner.
It is becoming more and more difficult to lead a "scholarly" life, particularly at institutions where teaching is the primary activity. In fact, even there, it is almost impossible to find the time to devote to thorough *a priori* course design, development and improvement. Traditionally, university faculty are trained to be highly skilled content experts in the process of obtaining a Ph.D. Training for job duties in the classroom, however, has been typically left to chance (e.g., receiving training as a teaching assistant), and/or the instructor's own initiative. Even with some amount of training or experience, most university faculty are not necessarily fluent with either a process for instructional design or the many education-related theories of learning that describe the impact of the instruction or teaching style on the students' learning experiences.

Furthermore, in this age of technology, there is a surprising paucity of effective tools available to the instructor to help bridge this gap in knowledge. Today's educational "productivity" tools in the academic environment center around web and slide authoring tools, generation of automated tests and communication-enabling technologies (e.g., email, electronic forums, video-conferencing, etc.) (The equivalent of this ten years ago might have been to say that the typewriter or a word-processor and a thermal transparency machine were "productivity" tools.) If faculty are to keep abreast of the changing face of education, it is our contention that they should also then be provided with a suite of tools, preferably on their desktop, which will assist them in critical tasks such as: formulation and organization of course content, design of classroom activities, and delivery of course artifacts.

Our research group is therefore currently working on the design and development of a set of such tools called "Instructional Design Agents" (IDA), and this paper describes the work in progress on this project. It is an interdisciplinary effort that aims to produce intelligent interactive support agents for instructional design in an academic environment. Our approach is to apply practical and theoretical aspects of human-computer interaction, artificial intelligence, cognitive science, educational psychology and educational technology to the problem of helping faculty become more effective and efficient in their roles as course designers, developers and managers. We have adopted a user-centered approach to this project, and have identified four initial categories of activity: 1) the conduct of detailed interviews with course instructors, and observations of them in the processes of both designing and delivering courses, 2) in-depth cognitive, task and content analyses of a specific set of courses, 3) rapid prototype development of a number of small, dedicated stand-alone agents, each of which focuses on some aspect of instructional design theory (e.g., Bloom's Taxonomy, Learning Styles and Multiple Intelligences, to name a few), and 4) deployment of these agents in the academic community for feedback and iterative improvement.
Our next goal is then to combine these individual agents into an integrated intelligent desktop agent which will interact with an instructor to assist in development of a course from the initial outline, through the analysis and organization of the content, to the production of educational artifacts for each class session (i.e., lecture notes, interactive class activities, multimedia presentations, web-based documents and animations, etc.). With such an agent to provide basic support, particularly in the early time-consuming content development and structuring phases, the instructor would then be free to address the more creative aspects of course delivery, and to devote more time to individual student interaction. Our emphasis at this time is to provide collaborative assistance for the instructor, rather than the automatic generation of "ideal" course outlines.

A longer-term goal is to incorporate a learning component in which the agent obtains feedback on the outcomes of its recommendations, and then provides improved suggestions the next time. If multiple instructors are using them, the agents could even learn from each other, comparing notes, and sharing successes and failures with their human counterparts.

Related Work

If we turn to the field of Instructional Systems Design (ISD), we find a domain in which many of these activities have already been formalized into models. They typically consist of five basic processes: analysis, design, development, implementation and evaluation, which are then configured in a variety of ways. (see Gagne et al. 1992 or Seels & Glasgow 1998) . In addition to the large sector of professionals who have made a career out of implementing instructional design, a number of high-powered computer-based products are also available in the marketplace. However, the current lack of such facilities (either human or computer-based) in the daily professional lives of most academic faculty suggests at least two major obstacles: 1) access to formal instructional design software packages and/or ISD professionals is very expensive -- certainly beyond the reach of most academic faculty; (ironically, this problem is exacerbated at institutions whose primary mission is teaching, where funds are usually limited and there is little opportunity to invest in such high cost "facilities" for faculty); 2) it appears that the most successful work in the ISD field has focused on development of industry-style training courses, rather than academic-style teaching/learning courses. Although many researchers in the field of ISD also mention academic content in their descriptions of ISD models, it is often as an aside, and it's not clear that these systems-oriented process models really fit the goals, objectives and desired outcomes of academic course delivery. Seels and Glasgow discuss this in relation to public school implementation:

> "Although ISD has been adopted by many corporations, the military, and many government agencies, the impact of ISD in public schools has been low. Some of the reasons for this low impact are that (a) the responsibility and authority over instruction are vested in the teacher's direct contact with students, rather than in the development of systematically designed materials; (b) the rigidity of the daily schedules are defined in terms of hours spent in a classroom with a teacher, rather than the learning outcomes achieved,

and (c) the amount of discretionary funding available to support systematically designed technology-based instruction is low (Seels & Glasgow 1998)."

Although the above quotation only mentions public schools, it seems that ISD impact is also poorly represented in the higher education environment, possibly for similar reasons. This suggests that perhaps these techniques and models do not fit the realities of the academic world, although there are some who would say that the academic world should be changed to be more in line with the ISD kinds of approaches.

In industrial training settings, where learning objectives frequently correspond to concrete, well-defined job-related skills, computerized systems, which implement the linear configurations of the majority of instructional design models, may be extremely effective. However, it is our hypothesis that in the more traditional academic setting of higher education, activities such as course design may be modeled more appropriately as opportunistic problem solving, similar to other complex domains such as architectural design or medical diagnosis. That is, the problem is too complex, uncertain and unspecified to be easily tackled in a procedural or algorithmic fashion. Furthermore, there is no one necessarily "right" answer (i.e., a perfect complete course specification) -- a partial or less than optimal solution may be the best we can do, given the various constraints which impact not only the design process, but the final delivery as well. Rather, the instructor thinks about different aspects of the problem almost in parallel, and "islands of partial solutions" develop and compete with each other for the person's cognitive attention until eventually there is a sufficient amount of structure from which to go forward. The instructional design model most closely related to this approach is that of (Kemp et al. 1998), which has nine design elements that can be approached by different paths, and which are surrounded by two outer ovals, which indicate revisions occurring throughout the process (similar to that of user-centered design in the human-computer interaction community).

Bloom's Taxonomy Agent

The first Instructional Design Agent under development in our project is based primarily on Bloom's Taxonomy, and we are using this as a basis to explore a number of design issues:

- how can theories related to instructional design be used proactively by instructors to articulate, structure, design and implement academic courses?
- what kind of knowledge is needed by the agent not only to capture the concepts of the theory but also to understand and respond to the problem-solving behaviors of the instructor in the process of design?
- what kinds of data/knowledge representations are needed to structure the relationships between course content, theoretical constructs and classroom artifacts?
- what kinds of information visualization techniques can be employed most effectively to allow instructors to: a) navigate their design problem space, b) to detect patterns in the relationships of concepts, and c) engage in "what if" scenarios, where the effects of changes in certain parameters (e.g., order of course material) on other course components are immediately visible?
- can we effect a noticeable shift of cognitive load so that the instructor can operate primarily as a content expert, and have the agent provide the infrastructure and expertise which a human instructional design assistant might otherwise afford?

The Taxonomy of Educational Objectives was developed in the 1950s by a team of educational psychologists, headed by Benjamin Bloom, as a tool for classifying educational goals and outcomes (Bloom et al. 1956). Of the three domains of behavior described in the original work , the cognitive domain is the one most associated with educational outcomes, and it is described as a hierarchy of six major components, each increasing in complexity: knowledge, comprehension, application, analysis, synthesis and evaluation. From the literature it appears that use of this particular taxonomy as a context for designing instruction has focused primarily on classifying goals, objectives and/or test items once they have been devised (see Jonassen et al. 1989). This suggests that the instructor has somehow been able to break down the components of the course into atomic pieces, which then can be labeled. However, it is our contention that such detailed *a priori* analysis of course content and delivery strategies is rarely accomplished, at least in the first few years of teaching a course. This suggests that devising the course outcomes, goals and objectives themselves (i.e., developing the mental model of the course) is a challenging task, and that perhaps the intelligent assistance agent should first aim to help the instructor articulate these preliminary building blocks. In order to accomplish this, our agent embodies Bloom's Taxonomy as an interactive design tool, which should help the instructor formulate an effective mental model of the course concepts, rather than just as a diagnostic tool for a pre-existing model.

Initial System Design

In order to further constrain the problem, we have selected the freshman computer science course, CSC 101, as the focus for our first prototype system. A preliminary set of interviews conducted with two groups of experts (educational theory experts and instructors of CSC 101), provided the foundation for our initial design decisions:

- course objectives, content and outcomes are the three main components to be addressed, and appropriate mappings among these three kinds of elements must be defined;
- Bloom's taxonomy provides one kind of hierarchical approach to the expression of the course objectives and/or the outcomes – therefore the tool should provide assistance in articulating the objectives/outcomes as well as in authoring the content in the context of those objectives/outcomes;
- the course design process should not be overly constrained by the taxonomy itself – this suggests that the agent should be functional in at least two modes: 1) explicit taxonomy, where the instructor wishes to do the course development in the context of the formal objectives and outcomes, or 2) transparent design, where the focus is on the content development, and the agent keeps track of objectives and outcomes "behind the scenes".

With these ideas in mind, a metaphor of a "course design space" has been developed, which we define as the environment that contains all the resources an instructor needs to design a course. This environment includes electronic resources such as our software agent, content authoring tools, and the World Wide Web, as well as physical artifacts such as textbooks, videos, demonstration equipment, etc. The user interface of our agent reflects this notion of course design space by supporting asynchronous problem solving. Unlike the physical artifacts of the course design space, the agent is dynamic, in that it demonstrates how a change in one aspect of the design is reflected in other relevant components.

The presentation of this work in progress will include an overview of the design of the Bloom's Taxonomy agent, a demonstration from our first prototype, and preliminary results from our first round of functionality and usability testing.

References

Bloom, B.S., Englehart, M.D., Furst, E.J., Hill, W.H., & Krathwohl, D.R. (1956). *Taxonomy of educational objectives: The classification of educational goals: Handbook I. The cognitive domain.* New York, NY: Longman.

Gagne, R.M., Briggs, L.J., & Wager, W.W. (1992). *Principles of Instructional Design.* Orlando, FL: Harcourt Brace Jovanovich.

Jonassen, D.H., Hannum, W.H. & Tessmer, M. (1989). *Handbook of Task Analysis Procedures.* New York, NY: Praeger.

Kemp, J.E., Morrison, G.R. & Ross, S.M. (1998). *Designing Effective Instruction.* Upper Saddle River, NJ: Prentice Hall, Inc.

Seels, B. & Glasgow, Z. (1998). *Making Instructional Design Decisions.* Upper Saddle River, NJ: Prentice Hall, Inc.

Acknowledgements

The authors would like to acknowledge the support of the Cal Poly State Faculty Support Grant Program and the Department of Computer Science at Cal Poly.

Mathematical Abilities and Development of Mathematical Word Problem-Solving Skills in a Technology-Based Learning Environment: Methods and Main Results

Heli Ruokamo
TAMPERE UNIVERSITY OF TECHNOLOGY
Digital Media Institute/Department of Mathematics
Hypermedia Laboratory
P.O. Box 692, FIN-33101 TAMPERE
Finland
Tel. + 358 3 365 2111, Fax + 358 3 365 3549
E-mail: heli.ruokamo@tut.fi

Abstract: This article examines Solver Learning Environment, methods and main results of the study dealing with mathematical abilities and development of mathematical word problem-solving skills in a technology-based learning environment. To collect data a teaching experiment was arranged at Kaukajärvi School in the city of Tampere, Finland. The participants of the study were fifteen years old. In the study empirical group comparison methods were used. During the teaching experiment the group A studied mathematical word problem-solving in the technology-based Solver Learning Environment. The group B studied the same material with conventional teaching methods, using paper and pencil only. A control group did not take part in the problem-solving lessons, they just participated in the tests. Several tests were arranged to measure pupils' mathematical word problem-solving skills and to evaluate their mathematical abilities. In this paper we present the study design and main results of the study, too.

1 Introduction

The aim of this study was to examine the connection between different learning environments with the development of problem-solving skills of pupils on different levels of mathematical abilities. In this study we compare the development of problem-solving skills achieved in a technology-based Solver Learning Environment with learning environment of conventional paper and pencil tasks. During the teaching experiment we collected data on Solver's suitability to develop pupils' problem-solving skills on different levels of mathematical abilities. (See Ruokamo-Saari 1996a, 1996b, 1997.)

This study was an independent part of the Schools to Information Superhighway (SISU) Project (see Koskelainen et al. 1996a, 1996b). A group of mathematics teachers at Kaukajärvi School prepared mathematical word problems and their model solutions for Solver Learning Environment in co-operation with the author. Solver was produced as a part of the Nääsnetti Project of Multimedia Services of Alexpress Ltd. of Aamulehti Group Ltd. The Nääsnetti Network Multimedia Project was part of The Finnish Multimedia Programme (FMP). Later on this study became a part of Distance Learning in Multimedia-Networks Project (*<URL: http://matwww.ee.tut.fi/kamu/>*) of the Finnish Multimedia Programme (FMP) (see Pohjolainen & Ruokamo-Saari 1997; Pohjolainen & Ruokamo 1998, 1999; Ruokamo & Pohjolainen 1999).

This article describes the Solver Learning Environment, design and main results of the study, too. Participants of this study were ninth grade pupils (N=66). The contents of Solver Learning Environment were designed taking into account contextual approach and transfer: word problems were connected to real life situations and thus to the real world. Problem-solving was done collaboratively and the view of learning was "moderate" constructivistic (Reusser 1991a). Solver was designed to support pupil's own activity and reflection. (cf. Ruokamo-Saari 1996a, 1996b, 1997.) In this paper we present the main results achieved via the teaching experiment using quantitative research methods.

2 Solver Learning Environment for Solving Mathematical Word-Problems

Solver is a technology-based learning environment that includes different presentation forms of hypermedia (e.g. hypertext, graphics, animation, sound, video) and network properties, social interaction, physical learning activities and mental thinking processes in learning situation. (See Ruokamo-Saari 1996a, b; Ruokamo & Pohjolainen 1998.)

Solver was used to study the connection between the level of pupils' mathematical abilities and development of their problem-solving skills when working in a technology-based learning environment (Ruokamo-Saari 1997). Solver was designed on the basis of an existing computer-based program developed for word problem-solving by Reusser et. al. HERON (see Reusser 1988, 1991a, 1991b; Staub et. al. 1994; Reusser 1993, 1995). In the Solver Learning Environment pupils solved word problems by constructing solution trees with cognitive tools. This process ends up with final result that solves the problem posed in the text. (See Ruokamo & Pohjolainen 1998.)

In Solver Learning Environment the properties of on- and off-line hypermedia were connected together. The on-line part was designed to be used via the WWW and the off-line, local part was programmed with Multimedia ToolBook 3.0. Figure 1 presents the user interface of Solver Learning Environment (in Finnish): the tools, solution tree, and equation in off-line ToolBook application are on the right and the tools and problem text of an on-line HTML document are on the left. (See Ruokamo & Pohjolainen 1998.)

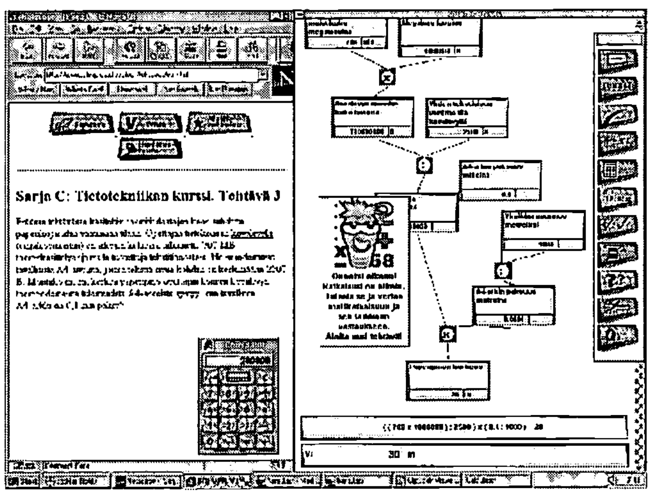


Figure 1: The user interface of Solver with on-line and off-line tools

Problem tasks, hints, the model solutions, and a bulletin board were programmed using HTML, so that these can easily be distributed via network, and they can be updated later on. In creating the problem situations a contextual approach was adapted: the topics chosen for the word problems were based on pupil inquiry: the pupils were asked about real life problems they would like to solve. Video material was produced to introduce the problem situations for pupils. (See Ruokamo & Pohjolainen 1998.)

In the problem text there were links, by activating them pupils could get definitions, rules, formulas, and other information about the subject. If a problem was too complex to solve, the user may select the hint tool to obtain tips for constructing the solution. Pupils may ask hints from each other in problematic situations when constructing the solutions. Using the bulletin board, pupils were able discuss with other pupils or with their teacher methods for solving the problems. On the basis of these conversations they could further develop their own constructions. (See Ruokamo & Pohjolainen 1998.)

In the Solver Learning Environment the model solution for a given mathematical problem was presented step by step, and the pupils were assumed to discover the solution procedure. The pupils' solutions were saved to be analysed later on. (See Ruokamo & Pohjolainen 1998.)

Solver does not tutor pupils in the problem-solving process, unless asked for help or hints. This property was thought to be suitable for especially better problem-solvers who do not necessarily need any tutoring but are able to conduct autonomous and original problem-solving. Tutoring was designed with those pupils' needs in mind who had difficulties in problem-solving. It was also important that pupils had a chance to notice by themselves possible mistakes they made during problem solving. When a user asked for a hint during the solution-process, Solver tried to find a so called context sensitive hint related to the user's situation in his/her solution. If the user's way of constructing the solution was very original and Solver could not help him/her, it asked the pupil to try to find support from other pupils via bulletin board or to go on and check the final result at the end with the checking tool. (See Ruokamo & Pohjolainen 1998.)

The user could start modelling in any situation and move on to an open solution space. In principle, he/she was able to construct the whole solution without tutoring until the final stage, where Solver asked the pupil to evaluate the final equation. If the user made mistakes in constructing the solution, the checking tool informs him or her about wrong results. After checking the results, the user could see a representation of the model solution and could compare it with his/her own solution. Even if the solutions were not similar, they could be correct. All the pupils' solutions were saved to files, so that the problem-solving processes could be examined and compared later on. The new solutions proposed by the pupil can be used as examples of alternative ways to construct solutions. (See Ruokamo & Pohjolainen 1998.)

3 The Methodological Solutions

In addition to measuring mathematical abilities, the study examined pupils' word problem-solving skills and their development using the Solver Learning Environment as opposed to a traditional pencil-and-paper method. A second goal was to determine whether there is any connection between the development of word problem-solving skills and pupils' gender, attitudes and experiences and mathematical abilities.

In this study we compared differences in the problem-solving skills of pupils on different levels of mathematical abilities. Pupils studied in different learning environments: in the technology-based Solver Learning Environment and in a learning environment of conventional pencil-and-paper tasks. The study was an experimental comparative study. Experiment group A studied in the technology-based Solver Learning Environment and experiment group B studied in the conventional way. The control group did not study problem-solving, they only took part in tests. (Ruokamo-Saari 1997.)

3.1 Experimental Design and the Participants of the Study

The research was an empirical and experimental comparative study of randomly chosen pupil groups. The experimental groups were made by lottery. The experimental design of this study is presented in Figure 2. below:

Experiment group A	MR ------ M1/A1 ------ TBLE/S1 ----- M2 /A2 ----- MM ----- M3
Experiment group B	MR ----- M1/A1 ---------- PP ---------- M2/A2 ----- MM ----- M3
Control group	MR ------ M1/A1 -------------------------M2 --------- MM ----- M3

Figure 2: Experimental design of the study

In the experimental design MR (for all the groups) refers to the matrices test of Raven, M1 refers to the pre-test of problem-solving skills and M2 to the post-test. A1 and A2 are tests of attitude towards mathematics, word problem-solving, information technology (IT) (A1) and towards the environment used in the teaching experiment (A2). MM is a test that measures essential mathematical knowledge (Kupari 1983). TBLE and PP are environments - TBLE is technology-based Solver Learning Environment and PP is conventional environment of pencil-and-paper tasks. (cf. Cohen and Manion 1987.) S1 denotes an inquiry associated to Solver. M3 (for all the groups) refers to delayed test of lasting quality of problem-solving skills. The control group took part into the pre-, post- and delayed tests and measurements of mathematical abilities. The purpose of these tests was to find out the differences between the pupils who have practised and who have not practised problem-solving. (Ruokamo-Saari 1997.)

It was decided to change the ordinary grouping. The groups were divided so that they were as homogenous as possible. Pupils were selected randomly. The division into groups was made randomly so that each group consisted of 11 girls and 11 boys. Pupils in the technology-based learning environment group were grouped into working pairs on the basis of gender and of success in the pre-test. (Ruokamo-Saari 1997.)

3.2 Measurements and Data Collection

Data was collected on mathematical abilities with two different kinds of tests: The Standard Progressive Matrices (SPM) of J.C. Raven (1958) to evaluate reasoning ability, and a test made of tasks of mastery of core mathematics by P. Kupari (1983). With this test we tried to evaluate the pupils' mathematical knowledge. We also evaluated the pupils' mathematical abilities on the basis of their average grades in mathematics. We made pre-, post- and delayed tests of mathematical word problem-solving to collect data of pupils problem-solving skills. We also made attitude tests in regard to mathematics, word problem-solving, information technology (IT) and learning environments.

3.3 Teaching Experiment

The teaching experiment and data collection lasted 11 hours. In the first lesson we measured the reasoning ability of the pupils (N=66) with the SPM by Raven. The Raven Test was the first part of the evaluation of pupils' mathematical abilities. In the second lesson we arranged a pre-test of pupils' problem-solving skills. After that we also arranged an attitude test. With that test we evaluated the pupils' motivation and their attitudes towards mathematics, towards mathematical word problems, and towards IT. We collected data during the six consecutive math lessons, simultaneously with different groups. The pupils were grouped randomly into an experiment group A (N=22) and an experiment group B (N=22) and a control group (N=22). Group A and group B (N=44) were studying mathematical word problem-solving. Experiment group A worked in pairs during lessons collaborating with other pupil pairs, and group B studied in a conventional way. The post-test of pupils' problem-solving skills was arranged after the teaching lessons, when we also measured pupils' attitudes towards learning environments and also to the experiment. After the post-test we arranged second test of mathematical abilities: a test of mastery of core mathematics. One and a half months after the lessons we arranged the last test of the experiment, the delayed test. (see Ruokamo-Saari 1997.)

3.4 Methods of Analysis

In this study we analysed data using various quantitative methods, and the research data was handled by SPSS 8.0 for Windows (SPSS Advanced Statistics 7.5. for Windows). The data comprises the scores of the tests of mathematical abilities and the scores of the pre-, post- and delayed test and the scores of the motivation and attitude tests. The usability of the statistical methods was affected by the number of pupils actually participating in the experiment (N=66). The quantitative analysis methods used include frequencies, correlation, variance analysis, regression analysis, factor analysis and covariance analysis.

4 Main results

The Solver group did best in the delayed test. Problem-solving skills also developed best in this group among those pupils who scored highest in mathematical abilities. Results are not statistically significant, possibly due to the smallness of the sample. No connection was found between gender and mathematical abilities, problem-solving skills or their development. A positive attitude to math correlated with success in math, likewise with problem-solving skills. Boys had a more positive attitude toward IT than girls and were more likely to view math as a hobby. Math enthusiasts had better problem-solving skills, and IT enthusiasts showed the greatest improvement. Gifted pupils opted for harder courses. Attitudes to word problem-solving correlated with mathematical abilities and problem-solving skills, except for success in the Raven Test. Girls reacted more positively towards the situation model as a tool and to the contextuality of the Solver Learning Environment.

Gender affected interest in all six series of tasks. It may be concluded that the Solver Learning Environment helped to improve problem-solving among mathematically gifted pupils. Further research should undertake a qualitative analysis of pupils' problem-solving processes.

5 Conclusions

This article described the Solver Learning Environment, the methodological solutions and main results of the study dealing with mathematical abilities and development of mathematical word problem-solving skills in a technology-based Solver Learning Environment. In this paper we described experimental design, measurements, and data collection of the study. We gathered data from the teaching experiment that was organised in spring 1996, in this paper we also presented quantitative analysis methods of the data and main results of the study.

References

Cohen, L. & Manion, L. (1987). Research methods in education. London: Croom Helm.

Koskelainen, P, Rakkolainen, I., Soininen, R., Suvanto, J. (1996a). ATM-based Multimedia. Trial in Comprehensive Schools. Telematics for Future Education and Training: Proceedings of the EAEEIE '96 Seventh Annual Conference June 12-14, 1996, Oulu, Finland, 23-25.

Koskelainen, P., Rakkolainen, I., Soininen, R., Suvanto, J. (1996b). SISU - Schools to Information Superhighway. In: S. Rao et al. (Eds.) Global Information Infrastructure (GII) Evolution, Interworking Issues. IOS Press, 651-654.

Kupari, P. (1983). Millaista matematiikkaa peruskoulun päättyessä osataan? Yhdeksäsluokkalaisten oppimistulokset keskeisessä matematiikassa. Institute for Educational Research. Publications 342/1983. University of Jyväskylä.

Pohjolainen, S. & Ruokamo-Saari, H. (1997). Distance learning in multimedia-networks: A Finnish national multimedia project. T. Muldner & T.C. Reeves (Eds.) ED-MEDIA/ED-TELECOM 97. World Conference on Educational Multimedia/Hypermedia, World Conference on Educational Telecommunications. Volume II. Proceedings, University of Calgary; CANADA; June 14-19, 1997, 853-863.

Pohjolainen, S. & Ruokamo, H. (1998). Distance Learning in Multimedia Networks Project: Current State of the Art and Perspectives for Future. J. Gil-Mendieta & M.H. Hamza (eds.) Computers and Advanced Technology in education (CATE '98). Proceedings of the IASTED International Conference. A Publication of the International Association of Science and Technology for Development – IASTED. IASTED/ACTA Press. Anaheim, Calgary, Zurich. CATE'98 Conference, May 27-30, 1998 Cancun, MEXICO, 91-95.

Pohjolainen, S. & Ruokamo, H. (1999). Distance Learning in Multimedia Networks: Experiences and Results. In B. Collis & R. Oliver (Eds.) ED-MEDIA 1999. World Conference on Educational Multimedia, Hypermedia & Telecommunications. Proceedings of ED-MEDIA 99 – Volume 2. Seattle, Washington USA; June 19-24, 1999, 922-927.

Raven, J.C. (1958). Standard Progressive Matrices. Sets A, B, C, D, and E. Printed in University Printing House, Cambridge, Great Britain. London: H.K. Lewis & Co. Ltd.

Reusser, K. (1988). Problem Solving beyond the Logic of Things: Contextual Effects on Understanding and Solving Word Problems. Instructional Science, 17 (14), 309-338.

Reusser, K. (1991a August). Intelligent technologies and pedagogical theory: Computers as tools for thoughtful teaching and learning. Paper presented at the Fourth European Conference for Research on Learning and Instruction EARLI, held at Turku, Finland, 24-28 August, 1991.

Reusser, K. (1991b October). Tutoring systems and pedagogical theory: Representational tools for understanding, planning and reflection in problem-solving. Universität Bern. Abteilung Pädagogische Psychologie. Forschungsbericht/Research report No.9.

Reusser, K. (1993). Tutoring systems and pedagogical theory: Representational tools for understanding, planning, and reflection in problem solving. In S.P. Lajoie & S.J. Derry (Eds.), Computers as cognitive tools. Hillsdale, N.J.: Lawrence Erlbaum Associates, 143-177.

Reusser, K. (1995). From Cognitive Modeling to the Design of Pedagogical Tools. In S. Vosniadou, E. De Corte, R. Glaser & H. Madl (Eds.). International Perspectives on the Design of Technology-Supported Learning Environments. Hillsdale, NJ: Lawrence Erlbaum Associates, 81-103.

Ruokamo-Saari, H. (1996a). Hypermedia Learning Environment for Especially Mathematically Gifted Pupils for Mathematical Word Problem-Solving. In: P. Carlson & F. Makedon (eds.) Educational Multimedia and Hypermedia, 1996. Proceedings of ED-MEDIA 96-World Conference on Educational Multimedia and Hypermedia. Boston, Mass., USA; June 17-22, 1996, 804.

Ruokamo-Saari, H. (1996b). Designing Hypermedia Learning Environment for Solving Complex Mathematical Word Problems. In L. Aho (Ed.) Learning in Multiple Contexts. Papers and posters presented at the First Joensuu Symposium on Learning and Instruction. 10.-11. November, 1995. Bulletins of the Faculty of Education, University of Joensuu, N:o 62, 141-158.

Ruokamo-Saari, H. (1997). Mathematical Giftedness and Development of Mathematical Word Problem-Solving Skills in A Technology-Based Learning Environment: A Teaching Experiment. T. Muldner & T.C. Reeves (Eds.) ED-MEDIA/ED-TELECOM 97. World Conference on Educational Multimedia/Hypermedia, World Conference on Educational Telecommunications. Volume II. Proceedings, University of Calgary; CANADA; June 14-19, 1997, 923-927.

Ruokamo, H. & Pohjolainen, S. (1998). Pedagogical Principles for Evaluation of Hypermedia-Based Learning Environments in Mathematics. In JUCS – Journal of Universal Computer Science, 4 (3), 292-307. (online <URL: http://www.iicm.edu/jucs_4_3/>)

Ruokamo, H. & Pohjolainen, S. (1999). Distance Learning in Multimedia Networks Project: Main Results. In L. Baggott & J. Nichol (Eds.) Proceedings of the Ninth International PEG Conference. Intelligent Computer and Communications Technology, Teaching and Learning for the 21st Century. Exeter, UK, July 10-12, 1999, 153-162.

Staub, F.C., Stebler, R., Reusser, K. & Pauli, C. (1994 March). Improving understanding and solving of math story problems through collaborative use of a computer tool (HERON). Paper to be presented in a structured poster session on "Children's understanding of mathematical knowledge" at the Annual Meeting of the American Educational Research Association, New Orleans, 4-8 April, 1994.

Acknowledgements

Special thanks are due to the Alexpress Ltd. of Aamulehti Group Ltd. for technical implementation and programming of the Solver Learning Environment and to the Digital Media Institute of Tampere University of Technology for technical support. Part of this work was financed by the Academy of Finland within the Information Research Programme. I gratefully acknowledge the teachers and the pupils of the Kaukajärvi School, who were so willing to collaborate and so positive towards the experiment.

Is Computer-Mediated Communication (CMC) Really Open and Flexible?

Malcolm Ryan, School of Post Compulsory Education and Training, University of Greenwich, UK.
m.ryan@greenwich.ac.uk

Abstract: This paper considers the concepts of openness and flexibility and the extent to which computer mediated communication supports these approaches to learning. Following an examination of aspects of open and flexible learning, the nature and role of Computer Mediated Communication (CMC) is considered within a context of continuing professional development. Models of curriculum delivery employing CMC and experiences of using these with adult learners are examined. Student feedback is used to illustrate positive and negative aspects of our approach. Barriers to learning flexibly when employing CMC are identified and conclusions drawn about the extent to which such strategies are open and flexible.

The concepts of open and flexible learning

Open and flexible learning (OFL) are characterised in the literature by the extent to which they enable students to *access* learning opportunities. The literature reveals such learning to be 'resource-based', exploiting a range of media from printed texts to intelligent tutoring systems using the latest information and communication technology (ICT). The use of a wide range of resources normally results in such learning being 'self directed' including a number of 'self assessment' activities.

A major advantage for students of this approach to learning has been its 'time-location independence', removing the need to travel to a particular physical location in order to study. This aspect of OFL has led to the development of global education opportunities, enabling students, irrespective of their geographical location, to undertake a programme anywhere in the world.

The availability of quality materials on a wide range of subjects has enabled 'learning on demand' to occur, independent of a tutor or educational institution. Being the recipient of a range of learning resources has required students to become 'self managed' and led to greater 'autonomy'. 'Guided discovery' and interaction with these materials replacing the large amounts of information that were often delivered in a didactic and sometimes authoritarian manner in large lecture theatres.

This move towards OFL methods of delivery has resulted in a changed role for the teacher. No longer is the tutor the fount of all knowledge, the 'sage on the stage', or a deliverer of content; instead s/he has become the 'guide on the side', a facilitator of learning. Another significant element of OFL, has been the extent to which peer networking and collaboration are being encouraged in both physical and virtual classrooms.

Rowntree (1992) maintains that open learning is both a philosophy and a method concerned with, *"reducing the barriers to access and giving learners more control."* He claims that open learning provides opportunities for:

- *Access* - enabling more people to learn
- *Time-Place Independent study* - when and where
- *Individual pace* - to suit own style/circumstance
- *Learner Autonomy* - greater individual responsibility and negotiation

Increased access to higher education has been a government target within the UK in recent years and student numbers have increased dramatically. This has led to a shortage of accommodation and a concomitant growth in open learning in an attempt to address overcrowding in classrooms. Many institutions have converted classrooms into open learning centres or invested large sums of money in building new centres, often combining traditional libraries, computing facilities and individual and small group learning spaces.

Whilst being freed from the constraints of timetables and physical spaces can have a liberating effect on students, there is evidence to suggest that not all learners either appreciate nor benefit from this apparent freedom. Anecdotally, having to attend a physical class often provides students with the necessary discipline and focus to engage with learning. Evidence from our own post-graduate students suggests they appreciate the flexibility of open and especially, distance learning because they are better able to self-manage studying, work and personal (including family) commitments. However, when questioned, many say they would have preferred to attend a traditional class with a tutor and peer group on a regular weekly basis but their personal circumstances make this a non-viable option.

Linked to this self-managed learning are issues of learning style (or preference) and pace. Given the circumstances of many of our adult learners, studying for a professional qualification, working full-time and participating in family life, organising learning around these diverse demands is seen as advantageous. Having the freedom to engage with materials and undertake activities at a time of the day or week that suits individual circumstances is, for them, the most attractive aspect of flexible learning. However, unless a student is highly self-disciplined, this freedom can be abused and lead to irregular and unproductive periods of study, resulting in loss of motivation and high rates of dropout from courses.

Greater autonomy may enable an adult student to manage their time but there are assessment targets to meet and courses often start and end at times which are more convenient to the host institution than the individual student. This can generate stress, frustration with the system and result in loss of motivation, failure and dropout.

So, OFL provides students with the opportunity to, *"take greater responsibility for their learning and to be engaged in activities that meet their own individual needs,"* (Wade, 1994). It is free of time and place constraints and allows access to a wide range of resources as and when required but does not suit all learners, especially adults.

The nature and role of CMC

These philosophies of openness and flexibility can be realised through a variety of approaches and those that employ Information and Communication Technology (ICT) are regarded as 'new forms of learning' (Laurillard, 1994). According to the UK's Further Education Funding Council (1996), *"exploiting emerging (new) technologies will lead to more open systems allowing students to study away from institutions, at a time, place and pace to suit individual circumstances."*

The University of Greenwich has been using CMC with adult students on a range of courses for several years. The main reason for using it is that it facilitates, *"interaction between students and tutors irrespective of geographical location or time zone."* (Ryan, 1997) Exploiting the unique features of technology enhances the student experience (Anderson, 1996) and leads to new forms of learning and teaching.

Our use of the groupware product, Lotus Notes with customised desktops being distributed to students, led to the creation of a Virtual Integrated Learning Environment (Ryan and Culwick, 1997) and the discovery of a number of unique features (Fig.1).

Features	CMC	Dist
Access to community	Y	N
Archived discussion	Y	N
Collaboration	Y	N
Team teaching	Y	N
Reflection	Y	Y
Time-Place Ind.	Y	Y

Figure 1: Features of CMC and traditional distance modes compared

Firstly, students have access to a learning community that helps address the feelings of isolation so often experienced by distance learners. Within a traditional distance learning context, students normally only have access to their peer group if they attend a study day or weekend. The second novel feature associated with the use of CMC is that all discussion is archived and becomes a much-valued resource by students and tutors. (Ryan, 1997)

Our experience of using CMC indicates that it has considerable potential for facilitating collaboration between students although they are studying at a distance. Within a conventional distance learning context, such collaboration is only possible if students come together for a study day in a physical location. Though regarded as invaluable by students themselves, if one is working with a global cohort then, it is unlikely that students will be able fo attend such events. The quality of collaboration we have experienced, particularly with health professionals engaged in paper writing activities, has been excellent

Team teaching, now considered too expensive in physical classrooms, is both possible and cost-effective within a CMC programme. There is a steep learning curve when tutoring in a virtual classroom for the first time (Ryan and Woodward, 1998). Once tutors are accustomed to operating differently, it is possible for several colleagues to provide multiple perspectives on a topic, at no additional cost. Within a traditional distance learning context, team-teaching is usually only apparent in the writing of materials or at study days. However, the costs of employing several tutors are considerable and something of a luxury in today's financially constrained environment. Print-based materials are commonplace in distance programmes but are expensive to produce, store and revise. They quickly lose their currency and as ICT systems provide us with up-to-the minute data and become more widespread, they are likely to replace print-based materials in all learning and teaching contexts.

Traditional and CMC delivered distance modes share the facility for students to reflect on content and their responses to activities. Another shared feature is that both modes are independent of time and place, though traditional distance learning is more independent because one does not need access to ICT.

Models of Computer Mediated Curriculum Design

Mason (1998) suggests the emergence of distinct approaches or models to CMC delivered or supported OFL programmes.

Content and Support

The content and support model is often applied to existing programmes of study where students receive content through a variety of media and ICT is used as just one of several support mechanisms. This may take the form of; simple e-mail, a bulletin board, bespoke conferencing software or a web-based system such as WebCT. Because CMC is only one of many means of communicating between students and tutors, it is often under utilised and its unique features go unexploited. Many institutions begin to explore the use of ICT in an OFL context by adopting this approach. It has the advantages of being relatively cheap to set up and does not necessarily require any major changes to either the content of a course or its delivery.

Wrap Around

The second approach is known as the 'wrap around' or 50/50 model. The content of the programme is provided through a single medium, such as a published book or multiple media, and some form of conferencing mediates all interactions and communications. This has become a very popular way of employing ICT in support of students operating at a distance because it often uses existing materials. However, as all of the interactions employ new technology, it is vital that students and tutors have regular and frequent access to appropriate ICT tools and support. For many participants, interacting via a computer is a new and strange phenomenon requiring a different set of skills to those normally employed when learning and teaching at a distance.

Integrated

The third emerging model is the integrated approach where both the content and the interactions are delivered and managed by an ICT system. This is perhaps the most difficult to establish because it often requires a revision of all materials and a complete review of learning and teaching strategies. Its major advantage is that one platform can be used for both delivery and support, but this can also be a major shortcoming. If access to the technology is restricted for any reason, for example, a technical breakdown, then the programme ceases to function until connectivity to the system is restored. As with the wrap around model, familiarisation with the system and an opportunity to explore this new way of learning and teaching is vital to the success of any programme using the integrated approach.

As a long-term strategy, the adoption of the integrated approach has the potential to provide global education opportunities using the most up-to-date materials and research. Before an institution can embark upon programmes using this model, a satisfactory system for the delivery of materials incorporating sophisticated conferencing tools and facilitating the full range of interactions between participants must be established. Once established, the benefits in terms of cost and learning effectiveness can far outweigh the associated risks.

These last two models exploit the unique features of a CMC delivered OFL curriculum. They allow students to have asynchronous access to the learning community, at any time, irrespective of their geographical location. Secondly, most conferencing systems keep an archive of interactions so any participant can review and reflect upon entries at their leisure. Many systems provide message threading and can graphically display such activities as brain storming and complex discursive interactions. Opportunities for collaboration are present although participants are geographically dispersed. Tutoring in a virtual environment is very different to either face-to-face class teaching or supporting students on a traditional OFL programme (Ryan and Woodward, 1998). It is vital that appropriate staff development be undertaken to ensure that tutors have the necessary ICT skills and are aware of and can manage those factors which influence the quality of interactions in a computer mediated classroom. (Salmon, 1998)

Drawing upon experience

Schools at the University of Greenwich employing CMC have found that where it is integrated into the curriculum process it provides valuable, additional learning and teaching experiences (Lewis, et al, 1997; Jordan and Ryan, 1997; Hodges and Ryan, 1999). Over a five year period each of these emerging models has been applied to different programmes of continuing professional development (CPD).

As an illustration of the support model, Lotus Notes was used to support adult distance learners engaged in a teacher education programme. The students received materials in the form of printed texts that included a range of activities. Contact with the peer group was minimal except at induction and optional study days. Telephone, fax, and occasionally e-mail provided tutor support. The use of this groupware allowed students to interact with each other and their tutors more regularly. However, the materials had been designed for a traditional distance programme, which resulted in some confusion over the purpose and status of activities delivered on-line, versus those in the printed materials. Because the use of CMC was optional, only those students who engaged regularly with the system and recognised its potential, actually benefited. The experience of using CMC was new to both students and tutors. A Notes desktop was provided for all participants but there was little evidence of improved learning and it would have been an expensive system to operate with large numbers. However, many students welcomed the opportunities for interaction and increased access to their tutors even if they didn't always fully exploit this additional support.

The wrap around model is currently being used by the Natural Resources Institute (NRI) who are delivering a grain storage management programme at masters level to a world-wide audience. The original programme involved students being resident in Britain for periods of time, combined with study in the host country and tutors from the NRI visited and assessed students abroad. Building upon their expertise in delivering face-to-face workshops and providing high quality materials, a team of subject specialists worked in conjunction with curriculum and ICT developers to produce a new distance version of this existing programme. Essential elements that needed to be retained included; diversity of subject specialist inputs, opportunities for students to apply new knowledge to their working environment in their own country and sharing of peer expertise and experiences. The rationale for developing such a programme focused on the need to reach new markets and to be more cost-effective. Employing the wrap around model allowed the essential features to be retained but the costs of international travel and accommodation and separation from families on the part of students were removed. As the programme is only in its first year of operation, it is not yet possible to say whether it has been successful. Anecdotal evidence suggests that the tutors, who undertook considerable staff development, are committed to this new programme and believe that it fulfils all of the outcomes of the earlier traditional model. Student feedback has been limited but the indications are that the experience of working within a virtual environment has been positive.

Two schools currently employ the integrated model; one to deliver an experiential course in computer mediated tutoring (CMT), the other is a Masters in CPD for health professionals. These programmes fully exploit those innovative features of CMC outlined earlier in the paper and include electronic submission of assignments and on-line anonymous evaluation. In both cases, a face-to-face event precedes the virtual delivery, which is provided by customised Lotus Notes desktops. These desktops include the virtual classrooms, electronic resource and information centres and a student common room. Apart from a programme handbook, course outlines and instructional materials to aid students with the installation and operation of Lotus Notes, all other materials, activities and interactions are delivered within this Virtual Integrated Learning Environment (VILE). An in-depth evaluation of the Masters programme, which has just had its first graduates, has revealed many benefits to learners and overall satisfaction. Within the University of Greenwich, this programme is considered highly innovative and many other schools are seeking to adopt the model.

Issues Raised by Evaluation

Whilst there have been some negative criticisms of the use of CMC in support of OFL programmes the majority have been positive. *"With CMC there are a lot more advantages than with other distance learning because you have the support of your peers and their instant availability."* Another student said, *"the asynchronous medium has been wonderful for me because I don't think easily on my feet. I do like to ... be able to sit back and reflect before I put my thoughts forward."*

These comments serve to illustrate a number of important issues. Firstly, those students who are prepared to make a commitment to the learning community, which includes connecting to the system regularly and frequently, are more likely to have a positive experience which can result in learning gains. The claims made about the use of CMC and its ability to address issues of isolation, facilitate collaboration and reflection are supported by student evaluation. However, critical comments suggest that there are potential barriers to employing CMC.

A questionnaire given to adult students said, *"I have no access to e-mail & the Internet and if I did I would be reluctant to use it.* A second student indicated that they, *"personally prefer 'old-fashioned' methods of communication."* A third said, *"If I had the time, I would have used the On-Line Campus,"* Finally, another said it is a, *"very good idea if it is not going to be a substitute for (face-to-face) tutorial support."*

Whilst this feedback was in connection with the use of CMC as a support tool, some of the comments echo remarks made by students both on-line and in end of course evaluations with regard to the integrated model. I stated earlier that access to reliable equipment and systems is a prerequisite for using CMC within an OFL context. Students and tutors who have access to a computer both at home and work are in a better position to exploit the advantages of virtual learning systems. Despite the media hype that implies every home in the UK has a computer connected to the Internet, this is far from the truth. Where there is a computer, often the children within a household have the skills and spend the most time interacting with the technology. For some adult students, even if they have access to a computer, they claim to lack the necessary range and level of skills required to make the most effective use of the software.

It is not just the apparent lack of time or ICT skills that prevents some adults from engaging with a CMC programme. We need to undertake more research into the relationship between learning styles and ICT, but experience suggests that adult students often encounter significant difficulties in adapting to new ways of learning and teaching. Both the wrap around and integrated models require students to engage with the materials and then interact with their peers, even if their preferred style of learning is to work as an individual at their own pace. Many of our adult learners find it difficult to commit regular amounts of time to studying each week. Their comments suggest that on occasions, several weeks may elapse before they undertake activities contained in a printed text. Within a virtual environment where tutors are extolling the virtues of interaction with the peer group and expecting students to participate in collaborative activities, it is essential that everyone attend regularly. This concept of 'virtual attendance' can be a real barrier for many students.

Another feature of this new way of learning is the facility to read the entries of other students before composing their own. Many consider this to be cheating; though, several have commented favourably, suggesting that they sometimes learn a lot from the inputs of other students and have little of significance to add. Furthermore, traditional distance material can be didactic in its approach partly because it assumes little or no opportunity for interaction between the learner and tutor. Many adult learners, even when pursuing an open or flexible programme, have an expectation that they will be 'taught' by an expert. The approach to learning embodied within most of our CMC supported programmes is much more-student centred, partly because we seek to exploit the novel features afforded by the technology. This clash of cultures, students wanting to be taught, whilst tutors see themselves as facilitators of learning, is an additional barrier.

Some conclusions

When employing CMC models within an OFL context, there is a general shift towards activities that require collaboration and peer exchange. In a CMC environment students are encouraged to become more dependent on the learning community and there may be peer and tutor pressure for *virtual attendance* on a regular and frequent basis. Traditional OFL programmes do not require students to be so dependent upon the peer group or tutor and there is usually no requirement to study within such prescribed time frames. This allows students to be more autonomous, independent, self-managed and some might say, more flexible and open. Additionally, where access to and use of a computer is not a pre-requisite, one might claim students have access that is more open. Certainly some barriers to access are reduced, if not entirely removed, if students do not need to be ICT literate or need to acquire the skills and attitudes needed to learn in this new way.

Within our CMC programmes, we have witnessed some tensions between the autonomy of the individual and the needs of the learning community. Whilst we continue to advocate the benefits and novel features of using CMC our experience suggests the approach may be less open and flexible than more traditional systems of delivery and support.

References

Anderson, T.D. (1996) The Virtual Conference: Extending Professional Education in *Cyberspace. International Journal of Educational Telecommunications*, Vol. 2 No. 2/3, 122.

FEFC (1996) Background paper: emergent technologies and their impact on further education in *The Higginson Report: Report of the Learning Technology Committee*. London: FEFC

Hodges R.J. and Ryan, M., (1999) Technological and professional development for SE Asia: computer-mediated distance learning in post-harvest technology in *Proceedings of the Education Superhighway 1999 Conference*. Penang, Malaysia.

Laurillard, D. (1994) *Rethinking University Teaching: a framework for the effective use of educational technology*. London: Routledge

Jordan, G.G., Ryan, M. (1997) Computer Mediated Communication (CMC) - a collaborative tool for continuing professional development (CPD) in Baggott, L. (Ed.) *Super Highways, Super CAL, Super Learning - CAL97* International Conference Proceedings. Exeter, March 1997. COTE, University of Exeter.

Lewis, T., Gould, M., and Ryan, M. (1997) Computer Conferencing and the Continuing Professional Development of Teachers in the post-16 sector, in Field, J. (Ed), *Electronic Pathways: Adult Learning and the New Communication Technologies*. NIACE.

Mason, R. (1998) Models of On-Line Courses in Banks, et al (Eds.) *Networked Lifelong Learning: Innovative Approaches to Education and training through the Internet*. University of Sheffield, UK

Rowntree, D. (1992) *Exploring Open and Distance Learning*. London: Kogan Page.

Ryan, M. (1997) Exploiting groupware reveals an enhanced distance paradigm, in Muldner, T. and Reeves, T. (Eds.) in *ED-MEDIA and ED-TELECOM 97 Proceedings*. Calgary, Canada, June 1997. AACE, Virginia.

Ryan, M. and Culwick, G. (1997) Creating a Virtual Integrated Learning Environment (VILE), in Muldner, T. and Reeves, T. (Eds.) in *ED-MEDIA and ED-TELECOM 97 Proceedings*. Calgary, Canada, June 1997. AACE, Virginia.

Ryan, M. and Woodward, L. (1998) Impact of Computer Mediated Communication (CMC) on Distance Tutoring, in Ottmann, T. and Tomek, I. (Eds.) in *ED-MEDIA and ED-TELECOM 98 Proceedings*. Freiburg, Germany; June 1998. AACE, Virginia.

Salmon, G. (1998) Developing learning through effective online moderation, in Beetham et al (Eds.) *Active Learning: Technologies for lifelong learning*. Number 9 December 1998. CTI: Oxford.

Wade, W. et al (Eds.) (1994) *Flexible Learning in Higher Education*. London: Kogan Page

A distributed notebook system for vocabulary learning

Tomoko Sagisaka
The Graduate School of Information Systems
University of Electro-Communications, Japan
Dept. of Foreign Languages, Tanagawa University,Japan
sagi@hako.is.uec.ac.jp, sagi@lab.tamagawa.ac.jp

Tsutomu Munakata
Faculty of Engineering, Tanagawa University,Japan
kreuz@eng.tamagawa.ac.jp

Katsuya Hakozaki
The Graduate School of Information Systems
University of Electro-Communications, Japan
hako@is.uec.ac.jp

Abstract: Internet has brought language learners great benefits such as instant access to global information and many chances to come in contact with their target language. In order to improve language ability effectively, making good use of these benefits, some system of encouraging learners' pre-knowledge to develop and expand is required. This paper introduces a distributed notebook system for vocabulary learning, which integrates electronic dictionaries and database and is implemented by Java RMI technology. Since this system can work on different operating system, it can be used for not only self-learning but also as group ware. Possible use of this system will be listed.

1. Introduction and background of this study

The wide spread of internet has brought great benefits to language learners, in particular, who study a target language in a non-native environment (foreign) such as EFL (English as a foreign language) learners. For example, since the internet enabled language learners to easily access and to get information written in target language, they became to have many chances to encounter new words and to expose to the target language in daily life. Since the use of the internet is also not influenced by the restriction of time and place, learners are able to study target language with internet at any time and any where they want. Recent trend of language learning and teaching makes use of information got from internet as "authentic materials" instead of ordinary materials such as textbook. The internet has really influenced the way of language learning and teaching which we have been doing.

However, though internet has provided the benefits and useful chances for language learners, these factors neither directly encourage learners to deep understanding of words nor improve their language ability. In other words, only increase of the browsing and exposing time can not lead learners to improvement of language skills. Thus, we think that some system or tool of encouraging learners' pre-knowledge to develop and expand should be introduced in the now environment in order to improve language ability effectively.

In this paper, we introduce a distributed notebook system for vocabulary learning. This system focuses the purpose of use on vocabulary learning. There are several reasons for this. First, the vocabulary learning is an important key to improve language skill such as reading and speaking. To deep understanding of words means to know the concepts behind words, the types of collocation and language use as well as their meanings. To acquire these knowledge facilitates communication, and moreover, leads improvement of language skill. Second, vocabulary learning is suited to an environment like internet, which has good chances of encountering frequently "unknown words" and repeatedly "previous words" which learners have already learned. Hatch and Brown 1995 stated that the important point to deep understanding of words is to encounters with the same word in multiple sources rather than in just one source. Internet meets this requirement. Third, vocabulary learning need constant practice. Thus, learners should keep on learning wherever they are. Since the use of internet is not influenced by the restriction of time and place, it will be helpful to learners for constant practice. Fourth, vocabulary learning involves activities of repetition and confirmation when learners memorize new words and review the previous learning. If database is used for these purposes, learners are able to access the previous learning easily and to confirm the specific words repeatedly. That encourages learners to give any further attention the previous learning. Thus all the effort given to the previous learning will not be wasted.

Based on these reasons, we implemented a distributed notebook system for vocabulary learning. This system consists of two parts functionally: the electronic dictionary part working on network; the notebook part connected with remote and local database, which can exchange data with each other. When to encounter new words, language learners are able to look it up easily with the electronic dictionary of this system, and to write information, the result of learning such as word meaning and its use in the notebook. Since the information written in the notebook by learners are stored in either remote or local database (elective), learners need not to worry about loss of the data, different from the data written in paper. It is also possible for learners to see the stored information again and to add new information to it. Thus, the past effort given to the learning of new words are not wasted. This system is also implemented in Java and learners are able to use this system at any time and anywhere without restriction of operating system, if they use different types of operating system between home and school.

2. Distributed notebook system for vocabulary learning

2.1 Concept of this system

It is said that vocabulary learning is a difficult part of teaching in language learning. Because there are a lot of words that.learners need to know and it takes much time to teach them in classroom activities. In most cases, vocabulary learning is left entirely to learners' effort and their self-study.

We develop a distributed notebook system for vocabulary learning, which is designed for every learner to learn vocabulary effectively and is based on Nation's methodology (1990) and McCarthy's (1997). According to their methodologies, vocabulary learning is involved in two kind of learning : receptive learning and productive learning. "Receptive learning involves being able to recognize a word and recall its meaning when it is

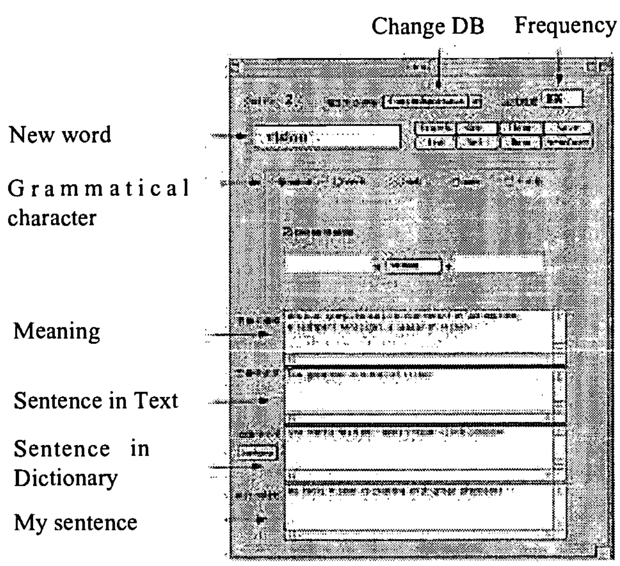


Fig. 1: Notebook client

met".(Nation 1990) On the other hand, "Productive learning involves what is needed for receptive learning plus the ability to speak or write needed vocabulary at the appropriate time." (Nation 1990) They stated that in order to make their receptive vocabulary (acquired by receptive learning) productive, learners should learn not only the meaning of word, but also how it is used, its grammatical characteristics and which words it is usually associate with etc.. They also stated the importance of dictionary use, of vocabulary note book for writing down new words and expression, and moreover, of reviewing vocabulary repeatedly and increasing in the frequency of encounter.

Taking account of what has been said above, we designed a distributed notebook system for vocabulary learning. This system consists of three components:

1) WWW as information resources and learning-materials
2) Electronic dictionaries on network
3) Vocabulary notebook connected with database on network.

This vocabulary notebook (See Fig. 1) includes some checkbox of choice (noun,verb,adj,adv....) for concentrating learner's awareness at grammatical characteristics of the word. It also includes some textfields for writing the word, its meaning, the sentence containing the word the sentence found in the dictionary, new sentence containing the word.

2.2 Learning process of when using this system

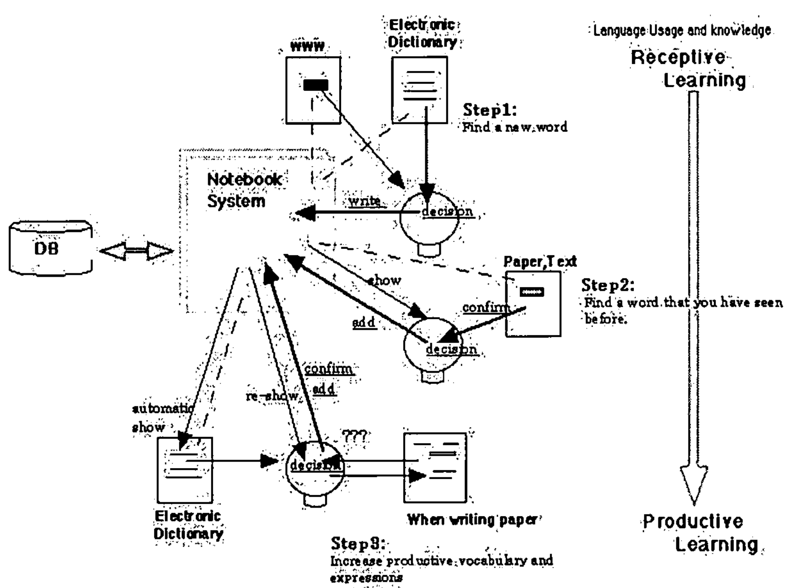


Fig. 2: Learner's learning process of when to use the notebook system

Learner's learning process of when using this system (See Fig.2) can be performed the following three steps. Repeated these steps, you can be getting acquired from receptive vocabulary to productive vocabulary.

Step1: When you find a new word in WWW and other resources that you are reading.

(System) open the dictionary, if necessary. Look carefully new word in the sentence and judge whether it is noun, or verb, adj, adv... Mark the grammatical characteristic of the word on the check box of vocabulary note. Next, write in vocabulary note the word, its meaning, the sentence containing the word in WWW and resources, the sentence found in the dictionary, new sentence containing the word. Then, push the save button and these information are stored in remote database. As URL of WWW and frame number of the dictionary are also stored with time stamp into database, you can easily see these resources again.

Step 2: When you find the word again you have seen before.

Though you know the word as receptive vocabulary, as you need to learn other expressions of the word and appropriateness, open the vocabulary note. Vocabulary note automatically counts the frequency of encounter of the word. The frequency can motivate you to fix the word in your memory. (System) open the dictionary, if necessary. It is also possible for you to open some dictionaries at the same time. Look carefully the word in the sentence, concentrating on which words it is usually associate with . You find that the word is another kind of part of speech. Mark the grammatical characteristic on the check box of vocabulary note , and add another meaning, another sentence containing the word in resources, another sentence found in the dictionary and make new sentence containing the word yourself. Save them and these information are added to database.

Step.3: When you need to know the expressions of the word

When writing essay, you suddenly become want to know the meaning of a word and expressions. Look at the list presented from your database and look for an appropriate word and expressions. If necessary, search dictionaries and compare with them. You will find the appropriate expression in the context.
If you find a new expression in another resources, add them to database again.

This system provides learner with many chances to remember the word: for example, letting learner judge grammatical characteristic of word, and write a new expression, reconfirming other expressions that have seen before, and moreover, showing frequency of encounter, showing window(vocabulary note and dictionary) as the need arises.

3 System architecture

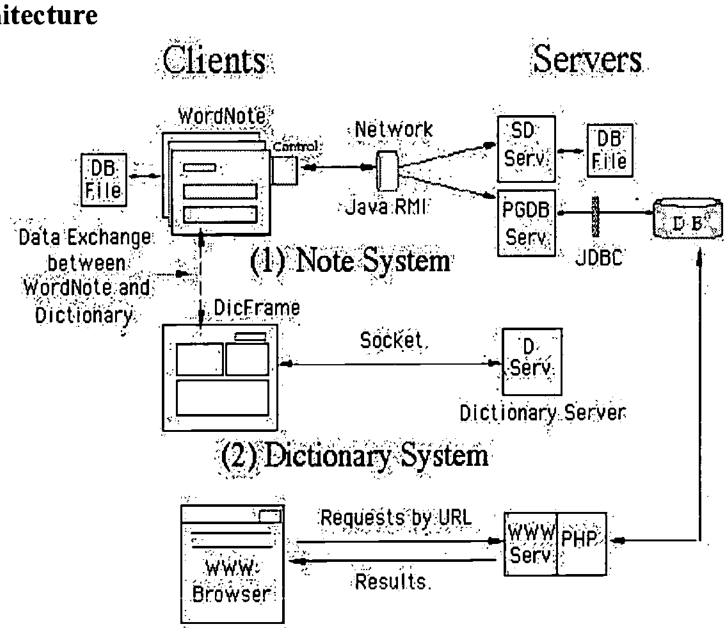


Fig. 3: System architecture and components

This distributed notebook system (See. Fig 3) consists of two parts functionally: (1) the Notebook system part, which is connected with remote and local database; (2) the Dictionary system part. The notebook part is further divide into three components: the database for storing vocabulary and data, the server, and the client for inputting new words and showing data. As Fig. 3 shows, there are two kind of database: SQL database and simple Hashtable database. These databases/servers can be selected with easy operation, according to the user's purpose

BEST COPY AVAILABLE

and environment. On the other hand, the client consists of two parts: the notebook client and the dictionary client, which are integrated with each other (See Fig.4). The interface of notebook client is designed as card type of GUI (See Fig.2) in order to input and see new words and data easily. Since it also provides user with flexible operation that user are able to open any client window s at the same time, user can work efficiently, comparing one window with another. Dictionary client is connected to the dictionary server by Java socket interface. The dictionary server system (Dserver) is available for CD-ROMs in EPWING. Dictionary client can switch any dictionaries from one to another and also use them at the same time. The shown data on the dictionary client can be handled with simple operation: Copy and Paste. Thus user can paste a sentence from dictionary into vocabulary notebook. In addition to these two functions mentioned above, this system provides a function of accessing information stored the database via WWW browser (See Fig. 4 below) .

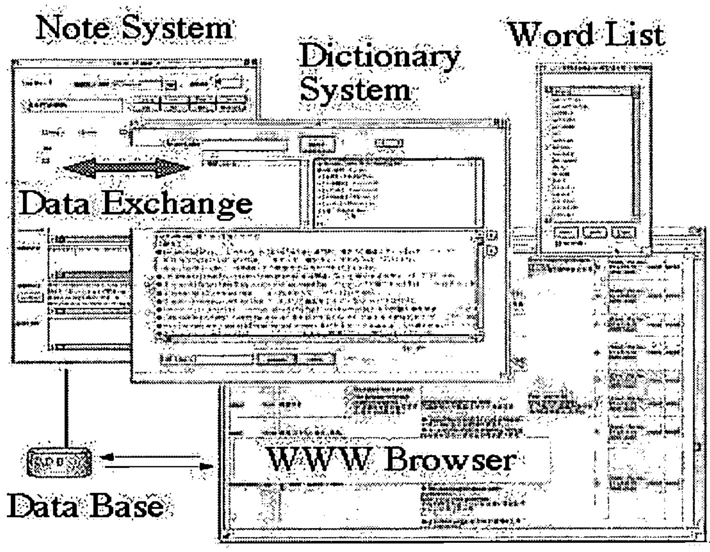


Fig. 4: Data exchange between client cards

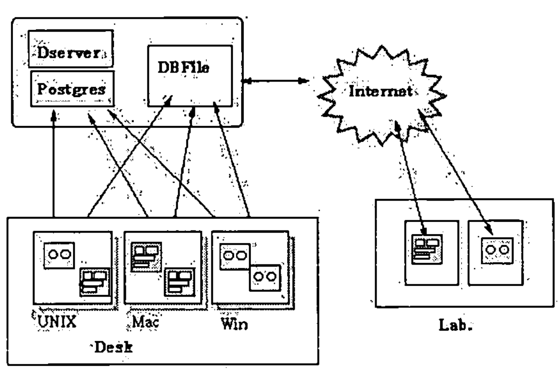


Fig. 5: Example: a use of notebook system

Since this notebook system is implemented in Java, all system components (database, server and client) can work on different operating system (Mac, Windows, and Unix). Since whole system is also made by Java RMI technologies, it is possible to arrange or rearrange the working position of system components on the network, according to user's the purpose/environment of use. For example, database and server component can be put on Unix system. Notebook client can be put on Macintosh system, dictionary client on Windows (See Fig 5). That is, it is possible to put each system component on different operating systems. (Actually, we always use this system like this)

This distributed notebook system provides learners with the new studying environment, which frees learners from the restriction of studying location and using systems. Because of the system being unrestricted from the working platforms, learners can use the system not only computer in the school, but also their own computer in the home. This means that after the classroom learners can continue to use the same system and continue to study in their own house.

This system can be applied not only for learner to study vocabulary as self-learning, but also for teachers to use as group ware in classroom. If user change the interface of vocabulary learning into that of another purpose, this system can be applied to different fields. For example, a notebook for collecting information, glossary of technical terms, and collaborative tool.

4. Future work

We now develop a new system which connects the distributed notebook system for vocabulary learning with small PDA terminal. This future system will make it possible for learners to study the vocabulary from the mobile environment. In Japan, it generally takes a lot of time, approximately one hour or more, to commute from home to school/company. Many students always spend such long time learning something (ex. learning language) in bus and train. Thus the learning system with PDA will be very useful for them.

On the other hand, voice memo system with small IC recorder is available on the market. We think such equipment with audio tones will be also useful for vocabulary learning. We also now try to integrate this voice memo with our notebook system. Moreover, in the near future, the integrated system will be combined the sound tool for editing speech signal called "Sound Cutter" (Sagisaka and Munakata 1999) which we developed last year. As the Sound Cutter is also written in Java. Our goal is to realize the distributed environment for language learning, which includes not only text but also sound.

5. Conclusion

In this paper, a distributed notebook system for vocabulary learning was introduced. This system was developed for vocabulary learning, making good use of network and Java technologies. It also provided learners with new learning environment, which freed learners from restriction of place and time, and moreover defferent platforms. This system can be applied to different fields, if user-interface is changed for different purpose of use. Further development of this system will bring language learners more useful environment.

6. References:

Nation I.S.P.(1990), Teaching & Learning Vocabulary, Massachusetts, Heinle & Heinle Publishers.

Hatch Evelyn and Brown Cheryl (1995), Vocabulary, Semantics and Language Education, New York, Cambridge University Press.

McCarthy Michael, Felicity O'Dell and Ellen Shaw(1997), Vocabulary in user upper intermediate, Cambridge University press.

Sagisaka Tomoko, Munakata Tsutomu (1999), Two types of Sound Tool for Editing Speech Signal: Sound Cutter and Symbolic Sound Editor, IEEE Multimedia System '99, Italy

Munakata Tsutomu , Oda Masaki and Sagisaka Tomoko (1998), On a Language-Learning project Based on Hypermedia and Computer-Network, Tamagawa University Research Review, No.4, 133-154.

A Case Study on Building an Organizational Learning and Information Support System (OLISS)

Mark Salisbury and Jan Plass
Organizational Learning & Instructional Technologies
University of New Mexico
Albuquerque, New Mexico, USA 87131-1231
salisbu@unm.edu
jan@unm.edu

Abstract: In this paper, we describe the development of an Organizational Learning and Information Support System (OLISS) that serves a diverse group of users for a wide variety of purposes. Designed for a government agency, the system is developed to support the application of "standard" business policies and practices across the organization. The system provides "just in time" capabilities for users of the system to apply these standard business policies and practices within the ongoing context of their everyday work. Users come to the system from different jobs, experience levels in their jobs, and knowledge of the standard business policies and practices. All the capabilities, in one form or another, provide not only a mechanism for individual learning but also a means for capturing and disseminating newly created knowledge in the organization.

Introduction

The growth and sharing of knowledge is recognized as an important element in becoming a "learning organization" (Easterby-Smith, 1997; Marsick and Watkins, 1994; Senge, 1990). However, what is missing, according to many researchers and practitioners in the field, is the development of theoretical frameworks for thinking about how people learn and perform in an organization (Raybould, 1995). Furthermore, the few theoretical frameworks that have been developed and presented for consideration are highly abstract and lack a description of a practical mechanism for the capture and dissemination of organizational learning. To address this situation, this paper uses a case study to describe a theoretical framework with a practical mechanism for capturing and disseminating learning at the organizational level. The theoretical framework includes a knowledge creation process that can be used to grow and share knowledge -- an essential part of becoming a learning organization. The framework relies on technology -- a Web-based Organizational Learning and Information Support System (OLISS) -- to assist in the capture of expertise from individuals and make it available to other members of the organization.

In the following paragraphs, we describe how the capabilities of a Web-based OLISS serve a diverse group of users for a wide variety of purposes. Designed for a government agency, the system is developed to support the application of "standard" business policies and practices across an organization. It is performer centered (Laffey, 1995) and its use applies the principles of situated cognition (Brown, Collins, & Duguid, 1989; Laffey, 1995). That is, it supports "just in time" capabilities for end-users to apply standard business policies and practices within the ongoing context of their everyday work. All the capabilities, in one form or another, provide not only a mechanism for individual learning but also a means for capturing and disseminating newly created knowledge in the organization. This continuing knowledge creation and capture process becomes an organizational performance/learning cycle (Raybould, 1995) as members access expertise in the system, modify that expertise, apply it to the problem at hand, and add their learning to the system. In this cycle, the Web-based OLISS is an enabling technology that provides the link between individual learning and organizational learning (Kim, 1993).

The OLISS Capabilities

In Figure 1, we list the major capabilities of the Web-based OLISS and the categories of end-users for the system. End-users are "members," "managers," and "customers." Members are members of the organization and are directly responsible for correctly applying the business policies and practices on an everyday basis. Managers are supervisors of the members that apply the policies and practices but managers do not use them as part of their own daily work. Managers are, however, responsible for the correct application of the policies and practices by the members of the organization that they supervise. Customers take possession of the products that result from the application of the policies and practices by the members of the organization. Customers have a vested interest in the correct application of these policies and practices since it affects the quality of the product that they receive.

A checkmark in the intersection between the row of a capability and the column of an end-user category indicates that it is a capability designed for that type of end-user. For example, in the second row of the reference materials capability, related materials, there is a checkmark for the members category and no checkmarks for the categories of managers or customers. This means that members of the organization will use the related materials but managers and customers will probably not use them. Managers and customers will probably get all the reference documentation that they will require by accessing the procedure & policy documentation on the OLISS Web site.

We believe that having online reference materials is an important capability for a Web-based OLISS site. As Figure 1 shows, all end-users will benefit from easy access to online documentation describing the policies and practices. Organizational members, however, will also benefit from the easy access and cross-reference of related online materials. It will help them to ensure that the application of the policies and practices are consistent with the other regulations that they must follow. Managers and customers do not benefit as much from access to these related materials.

Figure 1 also shows that the search capability provides an important service to all end-users of the OLISS Web site. It allows a free-form text search where end-users can input keywords or phrases to the search engine and receive references to all the pages on the site that match the search criteria. It provides quick access to materials that relate to specific topics.

Capabilities	**End-Users**		
	Members	**Managers**	**Customers**
Reference Materials			
Procedure & Policy Documentation	√	√	√
Related Materials	√		
Search (Free Form Text)	√	√	√
Communication			
Points of Contact (e-mail)	√	√	
Threaded Discussion	√		
Frequently Asked Questions	√		
Instruction			
Instructor Led (Synchronous)	√		
Stand Alone (Asynchronous)	√	√	√
Decision Support			
Guided Search for Policies & Procedures	√	√	√
Guidance in Completing Policies & Procedures	√		
Knowledge Acquisition			
Case Studies	√		
Real Life Examples	√	√	

Figure 1. Capabilities of a Web-based Organizational Learning and Information Support System

The communication capability of the OLISS Web site has three features. The first one is a "points of contact" e-mail feature -- allowing users to contact experts within a subject area. The second feature is a threaded discussion list that allows users to follow ongoing discussions of those issues that concern them. The third feature provides a means to collect frequently asked questions into a "FAQ" list.

As shown in Figure 1, these communication features extend the methods available for end-users of the OLISS Web site to grow and share knowledge. Members, however, will benefit the most from using the features. Previously, members communicated only through face-to-face meetings, telephone, or mail. Now, members increase their productivity by sharing with one another about lessons-learned in conversations that are easily assessed, organized, and not bound to specific time frames.

Instruction is an important capability in the design of our OLISS Web site. In Figure 1, we see that members of the organization will benefit from all the instruction that is available -- instructor led and stand-alone. One advantage of instructor led instruction for members is that it provides an opportunity to ask questions concerning specific details about applying the policies and practices. Managers and customers, in general, can meet their needs with stand-alone instruction.

The decision support capability for the OLISS Web site has two types of features that benefit organizational members the most. The first one provides a guided search option for policies and practices. The second feature provides guidance in the completion of the steps for a policy or practice. These features facilitate knowledge transfer in the organization. Experienced members provide the expertise for the decision support capability. Members with less experience use the embedded expertise to find and complete the policies and practices. Managers, with less detailed knowledge of the policies and practices may also benefit from use of the expertise in their supervisory role.

The knowledge acquisition capability of the OLISS Web site also has two types of features that mostly benefit the members of the organization. One feature is a means to organize and store case studies. Case studies are general examples that illustrate the correct application of a policy or practice. Most of the time they are created for use as examples during instruction. The other feature enables the organization to store "real life" examples that illustrate the correct application of policies and practices in the field. With these two features, the knowledge acquisition capability facilitates the capture and sharing of new knowledge as it is created in the organization. Managers, who are not creating new knowledge from direct application of the policies and practices, may improve their decision-making through access to this expertise.

Example Scenario with the System

In the following paragraphs, we describe how organizational members may use the capabilities of an OLISS Web site to capture and disseminate knowledge across the organization. In this case study, other categories of end-users (e.g., managers, customers, etc) typically do not create new knowledge but access the knowledge created by the members of organization that directly apply the business policies and practices in their daily work.

In the following scenario, shown in Figure 2, the organizational member is not sure exactly what policy or practice they are looking for, but the member has a vague idea what it is and where in the larger work process it is used. For example, a member knows that he or she will need to complete a change document that describes the changes that have been done to a design document but the end-user is not sure what kind of change document should be completed. The organizational member begins looking for change documents by clicking on a menu selection that brings up the entire process of producing a product. The end-user then selects the sub-process that contains the design document. The member clicks the design document option and is given a list of two selections for design change documents (change document A and change document B). Here, the OLISS Web site prompts the member with the following guidance to assist in determining which change document to complete: "If you have not released the design document, then complete change document A, else (you have released the design document) complete change document B."

After selecting change document A, the member now sees a description of change document A on the screen. Along the sides of the screen are menu selections for the other capabilities: reference, instruction, knowledge acquisition, and communication. The member selects the reference materials option and views all the references in the related design documents that refer to change document A. Afterwards, the member clicks on the instruction menu and decides to take a five-minute tutorial on change documents.

Next, the member clicks on the knowledge acquisition menu, selects examples, and the OLISS Web site provides a list of example groupings. The member clicks on one of the groupings and sees a list of examples (additional levels of groupings can be used to differentiate examples). The metaknowledge, used to group the examples into meaningful categories, provides guidance for members to find examples that closely relate to the task at hand. The member examines these examples and finds an example of change document A that is very similar to the one that the member will have to create. Finally, with one question left unanswered, the member clicks on the communication menu, selects "points of contact," and posts the question to another member of the organization. When the answer is returned, the member has all the knowledge that he or she requires for developing a solution to the current problem, i.e., create a change document A. Lastly, the member updates the system by uploading the new solution; thereby, creating a new unique example that will be available during the next time the system is accessed.

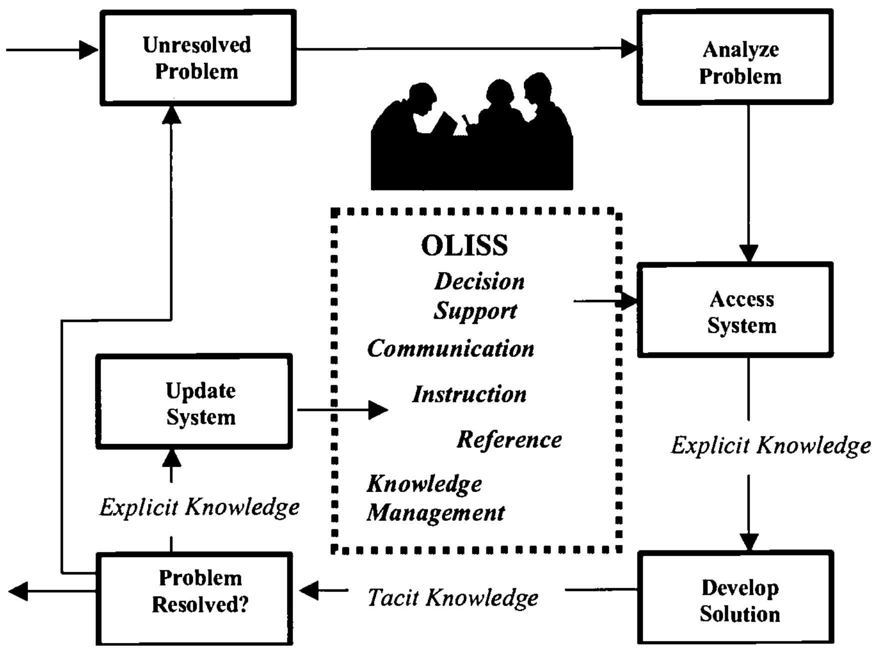


Figure 2. Work Flow with the OLISS Web Site

Discussion

Does the case study presented in this paper provide any insight into how organizations can use technology to support the process of creating new knowledge? Or how organizations can make knowledge explicit once it has been created? And finally, how they can convert knowledge into different forms for effective dissemination across the organization?

What has been retrieved from the OLISS Web site in the scenario is what Nonaka and Takeuchi (1995) describe as "explicit knowledge" -- a meaningful set of information articulated in clear language including numbers or diagrams. Note that the member did not find a complete solution from the OLISS Web site -- requiring no modification -- to his or her current problem in the example scenario. The member found an example with guidance from knowledge supplied by the system, gained knowledge through reference materials and instruction, then modified the example to create a unique and new solution for his or her current problem.

This new solution is the creation of knowledge; however, this new knowledge is tacit and cannot be used by anyone since it resides in the head of an individual. It is knowledge that needs to be made explicit. Furthermore, it needs to be converted to several types of knowledge before it can be effectively disseminated across the organization. The first step is that the solution itself needs to become an example for the next time the member, or another member, is confronted with a similar problem. To accomplish this technically, an online form is filled out and the new solution is attached, which is then uploaded to the OLISS Web site. The solution becomes a form of explicit knowledge; what was implicitly known by only one individual is now available in an explicit form for the other members of the organization. The process of placing the new example in the correct category of examples, or creating a new category for the example, is the creation of new metaknowledge -- knowledge about how to find the new example. This is the knowledge that is traditionally thrown away. Organizations may keep the new example but later don't know under what conditions it should be used.

The second step is to ask if the other members of the organization will use the new knowledge often. If the answer is yes, then it may be analyzed and converted to other types of knowledge that are represented in the OLISS Web site. For example, the new solution may be analyzed to determine what steps are necessary to arrive at the new solution. These steps are documented as procedural knowledge and placed in the online reference materials. Furthermore, if the new solution will be frequently used, then this procedural knowledge may also be placed in the decision support capability to guide members to the new solution. Finally, if the new solution represents a new approach to conceptualize problems, then it would be analyzed for the general truths and associations that describe this new approach. The resulting declarative knowledge would form the basis for creating new online instructional materials for inclusion in the OLISS Web site. In this way, the OLISS Web site supports the process of creating new knowledge, making it explicit, and converting the knowledge into different forms for effective dissemination across the organization. It becomes thc mechanism that provides the rapid capture and dissemination of organizational learning that Raybould (1995) describes in the fifth phase of his Organizational Performance/Learning Model.

References

Brown, J. S. , Collins, A. and Duguid, P. (1989) 'Situated Cognition and the Culture of Learning', *Educational Researcher*, January-February.

Easterby-Smith, M. (1997) 'Disciplines of Organizational Learning: Contributions and Critiques', *Human Relations* 50(9): 1085-1113.

French, R., and Bazalgette, J. (1996) 'From 'Learning Organization' to 'Teaching-Learning Organization?', *Management Learning* 27(1): 113-128.

Hudzina, M., Rowley, K., and Wager, W. (1996) 'Electronic Performance Support Technology: Defining the Domain', *Performance Improvement Quarterly* 9(1).

Kim, D. H. (1993) 'The Link Between Individual and Organizational Learning', *Sloan Management Review* 35(111).

Laffey, J. (1995) 'Dynamism in Electronic Performance Support Systems', *Performance Improvement Quarterly* 8(1).

Marsick, V., and Watkins, K. (1994) 'The Learning Organization: An Integrative Vision for HRD', *Human resource Development Quarterly* 5(4): 353-360.

Nonaka, I., and Takeuchi, H. (1995) *The Knowledge-Creating Company.* New York: Oxford University Press.

Norman, D. (1993) *Things That Make Us Smart – Defending Human Attributes in the Age of the Machine.* Reading, MA: Addison-Wesley Publishing.

Raybould, B. (1995) 'Performance Support Engineering: An Emerging Development Methodology for Enabling Organizational Learning', *Performance Improvement Quarterly* 8(1):.7-22.

Senge, P.M. (1990) *The Fifth Discipline: The Art and Practice of the Learning Organization.* New York: Doubleday/Currency.

Developing And Evaluating An On-line Cross-Cultural Collaborative Course

Adrian Sallis, Faculty of Business, Auckland University of Technology, New Zealand
Adrian.sallis@aut.ac.nz

Jenny Bygrave, Faculty of Business, Auckland University of Technology, New Zealand
jenny.bygrave@aut.ac.nz

Grant Carran, Faculty of Business, Auckland University of Technology, New Zcaland
grant.carran@aut.ac.nz

Abstract: The development of online courses is becoming increasingly popular. In addition to the multimedia benefits that the WWW offers, institutions can enhance existing courses using WWW technologies such as chat and discussion tools. These tools can allow students from different institutions to participate in group work which is pedagogically sound as well as a valuable cultural experience. On-line collaborative courses are an ideal way to expose students to different cultural perspectives.

This paper discusses the development and implementation of an online collaborative course used to teach advanced international business at undergraduate level at Auckland University of Technology. The paper discusses the nature of the collaborative exercises undertaken by the students and concludes with a reflective evaluation of the course.

Introduction

The Bachelor of Business (BBus) is a four year undergraduate degree in business which has seven majors, including International Business. It is offered by the Auckland University of Technology, Auckland, New Zealand.

The aim of the BBus is to develop confident capable learners who have a broad understanding of business and of the relationships between business disciplines, specialist knowledge in one or more fields of business, and personal and professional capabilities in communication, team work, interpersonal skills, critical thinking, research and use of technology.

The approach to learning in the BBus is student-centred and reflects a philosophy that knowledge and understanding are constructed by the learner, not supplied by the teacher. Students learn through action, interaction and reflection (Ramsden 1992). The teacher is a facilitator of learning as students interact with each other, develop ideas from their reading and discussion and work with peers.

Computer Mediated Communication

Studies show that classroom learning improves significantly when students participate in structured learning activities within small groups (Brown & Palincsar 1989). The educational value of the collaborative process has led to the development of computer-supported collaborative learning (CSCL) tools (Lund, Baker & Baron 1996; McManus & Aiken 1993). These tools enrich learning in a setting that encourages students to communicate with each other (Goodman et al. 1998).

Studies of computer mediated communication and computer conferencing (Harasim 1995), identify benefits to students such as convenience and flexibility. Higher levels of student-student interaction and of teacher-student interaction have been reported and linked to the electronic environment. It is perceived as less intimidating and allowing more equal participation. Other benefits include improved learning through the opportunity to reflect, especially critically, on material and discussions and to develop understanding through sharing diverse views, collaborating in writing and re-thinking and re-writing one's ideas. Disadvantages include technical difficulties in gaining access, the extra time it may take compared to face to face classes, the lack of the social, visual and aural cues which assist discussion, lack of immediate feedback in asynchronous communication, dealing with information overloads and tracking the flow of discussions.

The way in which computer mediated communication is included in thc structure of learning and teaching in the course is important. (Savard 1995) and (Ruberg et al. 1996), report that using computer mediated communication does not necessarily lead to increased student participation or interaction between students. They argue for the importance of integrating computer mediated communication activities with the rest of the course, especially in the assessment programme ensuring that students perceive its benefits. (Tagg 1994) reports on a postgraduate course where a change to having students, rather than the teacher, facilitate discussions and summarise results encouraged students to be more active in discussions and eliminated some of their reluctance to subject their ideas to critique and questioning by other students.

International Business Major

The international business major of the BBus aims to provide the BBus graduate with a broad set of cross-cultural capabilities developed through international experiences. Working with students from other countries challenges students' ideas, values and judgements and enables them to understand and develop sensitivity to different cultures, respect for difference and flexibility in working with people from different cultures.

Increasingly international business requires effective use of communications technologies. These include email, for discussion, establishing, negotiating and monitoring contacts, contracts and other business interactions. The use of computer mediated communication for collaborative team projects can involve people from the same or different organisations working in different countries and time zones. The ability to use these technologies to achieve organisational goals in the complex cross-cultural e-business environment is a key to successful international business in the future.

Advanced International Business (AIB) is the capstone course in the BBus major in International Business. The course aims to examine theoretical and practical problems in international business through multi-disciplinary perspectives. Planning of the online development was carried out in Semester 1 (February–June), 1999. The first stage was then implemented in July 1999.

During the semester three forms of computer mediated communication were used. They were:

- Online participation in synchronous (real time) class chat discussions.
- Leading a threaded discussion using an asynchronous discussion tool (BSCW) with a group of five other students.
- AUT students working asynchronously in pairs with students from International Business Academy, Kolding, Denmark to jointly analyse an International Business case and write a report.

In addition to the online work, AUT students had one scheduled class of two hours per week for classroom activities. These included case analyses, class and group discussions and individual and group presentations. Students are accustomed to and expect that their learning in the BBus will be interactive and involve group work. What we were adding was experience in carrying on such activities online using asynchronous and synchronous communication tools.

Synchronous chat

During the course there were two online chat sessions to enable the class to participate in discussions on international business issues. These were not assessed as part of the students' grades but intended to assist their learning, develop skills in online synchronous communication and identify students who had difficulty with the electronic environment so that they could be given help before they undertook assessment in online work.

Electronic Discussion Leadership

During the first week of the semester, each student identified an international business issue relevant to the course. The teacher clustered these into groups of three to five ensuring that each group had a range of different issues. Over five weeks students took turns as online discussion leader, introducing a topic, managing the different discussion threads, motivating group members to participate, commenting on group members' contributions, developing depth of analysis in the discussion, summarising and drawing conclusions.

Leadership of the electronic discussion comprised 30% of the course grade. The students submitted a report of the discussion, included a transcript of the discussion and a statement in which each student reflected critically on the content and process of the discussion which they led.

Case Analysis Report

The case report was prepared in pairs – one student from IBA in Denmark and one from AUT. The students undertook this collaborative assignment in the context of their different courses, using agreed case materials and guidelines for writing a case analysis report. It required students to manage a cross-cultural group task, deal with communication and technology issues and negotiate with another student a report on a complex international business case.

The case analysis report comprised 35% of the final course grade and, like the e-discussion, included a reflective statement evaluating the content and process of the collaborative work.

Evaluation

Student evaluation of the course and the online components was conducted through surveys at the beginning and end of the semester, an in-class discussion on the chat sessions and the reflective statements submitted with the e-discussion and case analysis. The results are set out below.

Beginning of the semester

The AIB class in semester 2 1999 comprised 21 students in their third or, more typically, fourth year of undergraduate study in the BBus. Nineteen students were aged 20-24 with two students aged 18-19. There were fourteen women and seven men. At the beginning of the semester students were asked about their level of comfort with electronic communication and expectations of the course. All but two of the class reported that they were either comfortable or very comfortable with the use of email and approximately one quarter had experience with chat groups. All students but one had used the WWW for study or leisure.

All students were excited by the online collaboration and saw in it the opportunity to develop effective communication and cross-cultural skills relevant to e-business and the changes in the international business environment. Women were more likely to identify the development of communication skills and cross-cultural capabilities. Three particularly expressed interest in learning to communicate and achieve group goals without the usual visible cues such as facial expression, body language.

Online chat

The students were positive about the online chat sessions. Students felt that more of them were able to participate in the discussions and as a result the discussions included a wider range of ideas than a face to face classroom discussion. They felt freer to put their ideas, there was more input from students, and it there was less guidance from the teacher.

Concerns were expressed that the sessions went too fast, students could not always keep up, there was no time to reflect and at times there were private conversations going on as well as the class discussion.

In discussion about how to improve the chat sessions, students agreed that each entry into the chat should contribute to both the content and the process of the discussion. They felt that this would slow down the discussion, reduce casual chatter and lead to more thoughtful replies.

E-Discussions

Students' comments on the e-discussions were similarly positive. These comments were made in the reflective statements submitted by each student and in the end of semester evaluation. All students said e-discussions were better than face to face discussions. They found facilitating the discussions was fun, interesting and motivating.

Students reported higher levels of motivation and enjoyment than with traditional group assignments. They felt that they learned more. Some students felt that the electronic format gave them more control over their learning as they set the direction of discussion and managed others. One student however, felt uncomfortable with this and wanted some supervision by the teacher of the discussions.

There was more time to read, think and reflect on the comments of others before responding. Students felt they were more careful in writing their submissions and responses to ensure that they clearly communicated their ideas. They had a record of the discussion. One student commented that he learned better this way because he was writing down his ideas more clearly so that others could understand, then he received comments back from other students which assisted his understanding.

Students said that the lack of body language and social cues meant it was harder to check understanding and move the discussion along. Students reported that they could not always get access to the discussion site, email messages were lost and they sometimes resorted to the telephone to keep the discussion going. The most commonly reported technical concern related to frequency of logging-in and slowness of the process. Students had to wait for a response and did not know when that would come so they had to log in frequently. If they checked in too late other students might have responded and they lost their opportunity to contribute. Information overload was an issue as responses got longer and managing the multiple discussion threads became difficult.

Case Analysis

The case analysis exercise provided the online cross-cultural collaboration we considered important to international business graduates. It had an uncertain start as the first business school partner we had arranged, withdrew at the last minute. We were very lucky that IBA Kolding, Denmark agreed to participate at short notice. However, there were difficulties with this arrangement as the IBA students were not as advanced in their international business studies as the AUT students and consequently their understanding of international business issues was less sophisticated.

AUT students commented that the main benefits of collaboration with the Danish students were receiving ideas and critique from a different cultural perspective and learning to deal with differences in English language and the misunderstandings which occurred. One student said that he and his partner avoided this problem by always providing examples to illustrate their ideas. Another observed that because he had to ensure the Danish student understood his messages, he felt that he put more time into thinking them through and keeping them as concise as possible. He felt that this had enhanced his learning from the case and illustrated the benefits of peer tutoring. Other students talked of the increased understanding they achieved through having to carefully explain and justify their ideas and arguments. Students commented that they had to learn to be more patient with each other and aware of each other's needs.

AUT students found the exercise more difficult and frustrating than they had expected yet still rated the exercise highly in its contribution to their learning. Time management and differing levels of participation by students were obstacles to easy completion of the task. One student observed that this was an issue with face to face group work so she was not surprised to encounter it in the electronic working environment. Another student said she did not want to appear too pushy and risk losing the contribution of her partner but felt that she had a greater sense of urgency and commitment to the task because of its significance in the AUT assessment programme. Most AUT students reported difficulty in contacting their Danish partners and in receiving responses which advanced the discussion. They felt that the Danish students were not as committed to the exercise. On the other side the Danish teacher reported to AUT that their students thought the AUT students did not seem to be as hardworking or conscientious in applying themselves to the task.

AUT students said that responses which were timely, not too long, provided critique and new ideas rather than constant agreement were best for advancing the discussion. They recommended that the teams agree, at the beginning, the roles of each student and expectations for the communication and work. Also attention should be paid to creating rapport and attending to the social side i.e. getting to know the other student not just attending to the work. Showing your partner that you valued their opinion assisted their motivation and prevented major misunderstandings according to one student.

Students experienced lack of control of the group process in the electronic environment. They observed the importance of developing trust that your partner would contribute. This was more difficult because all communication was remote and the students could not meet.

End of Semester evaluation

At the end of the semester students were asked to complete a detailed evaluation questionnaire. Responses were received from 8 students out of 21. This low rate of return occurred because the survey had to be posted out after the end of the semester rather than being handed out and completed in class time. However, the results of the survey mirror comments in the reflective comments that were received from all students.

Students approved of the electronic environment, the way in which it was introduced and the innovative and challenging nature of assessments. Students indicated that they were satisfied or very satisfied with the module. In evaluating the contribution made to their learning by the online strategies, students were most positive about the e-discussion and case analysis. They were less positive about the chat sessions.

All the students said they would like more courses to use electronic discussion tools and to be made available online. Some commented on the need for training of students so that they can be successful. Internet access at home was another issue. Students commented that online communication means less time in class and gives students more flexibility. All commented that familiarity with use of synchronous and asynchronous discussion tools was important for their futures, in both social contact and work. One student was concerned not to lose face to face contact with lecturers and other students.

Discussion software was useful because it made it easier to organise discussions, you could see all contributions at once and students could contribute whenever they were ready rather than having to wait to receive an email. Many students preferred email because of its familiarity and ease of use. Email did not require them to go to a different site and log-in and it did not crash as often as did the discussion software.

Changes to the course

As rcsult of our experience in 1999 and student evaluations we have made changes to the online course for 2000.

These include:-

- an improved look to the online site and navigation
- synchronous chat and asynchronous discussion tools are integrated with the site so that students only log-in once and have all the communication tools available
- when students first log-in they get a list of new messages and the week's programme for their course. This includes reading, online and other activities
- a messaging system has been incorporated into the site
- each student has a personal journal for their notes and work
- teachers and students may upload and download files of course materials or other work on to the site for others to access
- online help and tutorials

- students may choose a different look or skin for the site
- dedicated technical support on site
- teachers are able to monitor the progress of the students and obtain reports on how long students spend on-line, how they use the course, information on the use of the chat and discussion groups.
- Incorporation of a dynamic roster (study guide) containing class preparation, in class activities, assessment and weekly reviews.

The online collaboration in the case analysis is being continued. We have arranged a different partner in France where the students will be of a similar level to those at AUT in international business. The 1999 pilot demonstrated the importance of students having a similar commitment to participating and seeing the analysis completed to a good standard, so we have ensured that it forms part of the assessment requirements for all students. (Collis & Remmers 1997) suggest that, in courses which require this type of cross-cultural collaboration, care should be taken to ensure that students understand the expectations of the communication, formality, who initiates, length, style and level of debate. They point out that we should not assume that more interaction is better than less and to be aware of the difficulty of communicating across language and cultural barriers. While we did provide guidelines on the case analysis for both groups of students and the teachers spent time with the students to assist their understanding, this is an area we will aim to improve in 2000. Having teachers monitor the discussions will be easier because of the integrated site in 2000. This will also enable us to address a concern of the teacher that the depth of analysis and critical thinking displayed in the online work was not consistently of the level to be expected of senior students.

Next Steps

Our evaluation of the 1999 course consist mainly of survey data together with examination of the students' reflective statements submitted with the e-discussions. The next phase of evaluation will aim to investigate the effects on student learning of the use of the collaborative tools. This will use online evaluation tools which examine registration data, session log data and analyse patterns of use and types of student interaction. (Sallis & Masi 2000) have used text processing algorithms from computational linguistics research and the application of connectionist methods, especially fuzzy labelling and neural network simulation to analyse the students' reflective statements and provide feedback for further refinements to the course. This approach will be developed further. Structured interviews will be used to examine student perceptions in more depth. The curriculum development team is also aiming to develop evaluation tools to assist in assessing the extent to which learning has been promoted and particularly the effects on higher order thinking. (Burge 1994), (Ruberg et al. 1996) and (Webb et al. 1995) provide examples of studies attempting to evaluate these more complex aspects of computer mediated communication in learning.

The curriculum team encountered difficulties in developing and delivering the course. It took a great deal of work to set up and maintain the online course compared to the classroom-based course. The development team was, in 1999, based in different countries and this placed a huge strain on communication and teamwork. This has changed in 2000 and the team is now all based in Auckland.

Our experience in 1999 with Advanced International Business demonstrated the value of using online forms of collaboration to enhance learning in international business. More importantly students enjoyed it and appreciated its benefits.

References:

Brown, A. and Palincsar, A. (1989). 'Guided, Cooperative Learning and Individual Knowledge Acquisition' in Lauren B, Resnick (Ed.), *Knowledge, Learning and Instruction*, Hillsdale, NJ: Lawrence Erlbaum.

Burge, E. (1994) 'Learning in Computer Conferenced contexts: The Learners' Perspective', *Journal of Distance Education,* vol. IX no.1 pp 19-43.

Collis, B. and Remmers, E., (1997) 'The World Wide Web in Education: Issues in Cross-Cultural Communication and Interaction' in Khan, B., (ed.) (1997) *Web-based Instruction,* Englewood Cliffs, New Jersey: Educational Technology Publications.

Goodman.B, Soller.A, Linton.F. Gaimari.R. (1998) 'Encouraging Student Reflection and Articulation using a Learning Companion', *International Journal of Artificial Intelligence in Education*, vol. 9.

Harasim, L, (1995) *Learning Networks: A Field Guide to Teaching and Learning Online,* Cambridge, Mass.: MIT Press

Lund, K., Baker, M., and Baron, M. (1996). 'Modelling Dialogue and Beliefs as a Basis for Generating Guidance in a CSCL Environment', *Proceeding of the ITS-96 Conference* Montreal, pp 206-214.

McManus, M., and Aiken, R. (1993). 'The Group Leader Paradigm in an Intelligent Collaborative Learning System' Ohlsson, S., Brna, P., and Pain, H. (Eds.), *Proceedings of the World Conference on Artificial Intelligence in Education, Edinburgh, Scotland,* pp249-256.

Ramsden, P. (1992) *Learning to Teach in Higher Education,* London: Kogan Page

Ruberg, L.F., Moore, D.M. Taylor, C.D. (1996) 'Student Participation, Interaction, and Regulation in a Computer Mediated Communication Environment: A Qualitative Study', *Journal of Educational Computing Research,* vol. 14 no. 3 pp 243-268.

Sallis, P.J. and Masi, C., (2000 in press) 'A Rule-Based Method For Determining the Degree of Student Satisfaction of a Web-Based Learning Environment' *AIS Conference*

Savard, M., Mitchell, S.N., Abrami, P.C., Corso, M., (1995) 'Learning Together at a Distance' *Canadian Journal of educational Communication* vol.24 no. 2 pp 117-131.

Tagg, A.C., (1994) 'Leadership from Within: Student Moderation of Computer Conferences' *American Journal of Distance Education,* vol. 8 no. 3 pp 40-50.

Webb, B., Newman, D., Cochrane, C., (1995) 'Using a Post-Experience Questionnaire to Measure the Quality of Student Learning in a Computer Conferencing Environment', *Higher Education Research and Development* vol. 14 no. 2 pp 255-267.

Cooperation Model for Learning: A System of Patterns

Flávia Maria Santoro
Universidade Federal do Rio de Janeiro
COPPE/Sistemas
Rio de Janeiro -Brazil
flavia@cos.ufrj.br

Marcos R. S. Borges
Universidade Federal do Rio de Janeiro
Núcleo de Computação Eletrônica
Rio de Janeiro - Brazil
mborges@nce.ufrj.br

Neide Santos
Universidade Estadual do Rio de Janeiro
Departamento de Informática
Rio de Janeiro – Brazil
neide@cos.ufrj.br

Abstract: Learning is frequently assumed as a natural result of projects performed by groups, and cooperative work tools availability within a computational environment is enough to motivate or to induce cooperation among participants. However, many times cooperation simply does not happen within the environments, or it has to be externally articulated by a tutor. We claim that CSCL environments should be built under an explicit cooperation model to be efficient. The goal of this work is to present a Cooperation Model for Learning which is described through a system of patterns.

1. Introduction

Learning is frequently assumed as a natural product of projects performed by groups, and the availability of cooperative work tools within a computational environment is enough to motivate or to induce cooperation among participants. However, as literature tells (Roussos, 1997), in many situations the cooperation either is non-existent or needs to be promoted out of the environment by a tutor. Even in these cases, the role that the teacher should carry out to guarantee cooperation is not explicit. Besides, many proposals neither have been proved yet, nor present an explicit cooperative process model to clarify how they would operate.

We identify the following reasons to the problem of low cooperation level within CSCL environments: **Culture**- one of the difficulties that determine negative results in the use of CSCL environments is that people are not used to working in groups; **Stimulus** - most CSCL environments exclusively offer tools to support group tasks execution, instead of mechanisms that favor group functions such as cognitive activity, support to individuals and well being of the group; **Context** – CSCL environments usually have a specific educational objective or an organizational practice training goal, but besides it, they must be integrated within other activities on which students participate; **Technology** - there is no tool integration within environments, and in general, people have difficulties to deal with it.

We claim that CSCL environments must address issues related to these problems in order to promote learning in a real cooperative way. So, we understand the necessity to provide a Cooperation Model specific for Learning, where solutions for identified problems should be contemplated. The goal of this paper is to describe a Cooperation Model for Learning composed by a set of elements, which characterizes most CSCL study areas. For each of these areas, the model includes descriptions of problems and their corresponding solutions in a pattern format.

The model will work as a repository of problems and solutions patterns found in the literature or specifically developed for the area. The resulting patterns are interrelated, forming a system of patterns, which aims at addressing several CSCL issues. The system of patterns can be used as basis for CSCL environment development process. The rest of this paper is divided in 4 sections. In section 2, the Cooperation Model for Learning is described. In Section 3, some related works are presented. Section 4 concludes the paper.

2. Cooperation Model for Learning

Kumar (1996) emphasizes that one of the most important fields for research in CSCL is the cooperative activity modeling. According to him, modeling should involve among other things, the representation of cooperative actions, such as conflicts, resolutions and cooperative pair roles, that could be modeled according to characteristics and deepen of the cooperation process.

This work is concerned to a representation of most CSCL issues in such a way to make it easier for those who want to develop an environment not to skip important aspects, such as cultural ones. Regarding this goal - to facilitate development - the model is described through data elements. Each of these elements represents one CSCL study area, which are expanded in deeper levels of details and can be described by a system of patterns.

The core of this model is the **objective** and the **cooperative process** proposed within an environment. These two elements will determine all the characteristics that the CSCL environment should have. So, the first level of granularity of the model is presented in Figure 1, where issues Context, Culture and Stimulus are addressed:

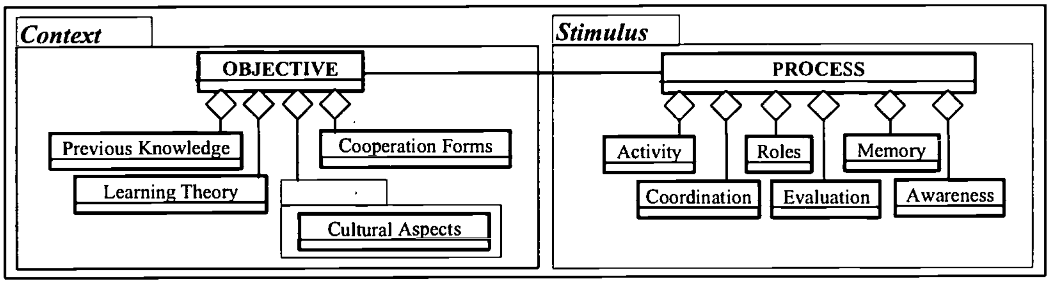


Figure 1 – Generic Cooperation Model for Learning

The Cooperation Model is based on the **Objective** that one wants to reach, for example, learning a certain concept; and on the **Process,** that is related to the cooperative actions, for example, cooperative edition of a text. The **Objective** of the proposal brings all the issues related to group **Context** and **Culture**, which will determine how the process should be implemented in order to stimulate cooperation. It is related to 4 aspects: **Previous Knowledge** - background knowledge representation of the group; **Learning Theories** - a learning theory should give basis to the learning environment; **Cooperation Forms** – the cooperative way chosen by the group to work; **Cultural Aspects** - the cultural factors, which determine the context on which the group is inserted.

The Cooperative **Process** is the element that describes "what people is going to do" within the environment. So, its components must define everything related to the flow of work, such as tasks to be performed, how to know if they are being rightly done, and mechanisms to support the work. A good flow of work definition, in which interdependencies are established, allied with mechanisms to support work in-group, guarantee that cooperation process will be stimulated. The **Process** element is related to 6 issues and is linked to the problem of **Stimulus**: **Activity** – activities to be developed by the group; **Roles** – functions that group members can assume, which can be different according to process diverse stages; **Memory** - storage of everything related to the way activities happen; **Coordination** - related to process controls and help to the learner; **Evaluation** – mechanisms to support evaluation of learning; **Awareness** - elements responsible to guarantee that people understand, and are conscious of the process.

Now deeper level elements of the model, which correspond to expansions of the first level, are described.

2.1. Activity

Activity refers to the learning tasks proposed within an environment, which will be developed by participants during cooperative learning process. Actually, there are moments to work individually (**Individual**) and other ones to work in group (**Cooperative**). Besides, activities can generate **Products**. Cooperative activities own a special **Dynamics**, because of the interaction among people, which involves **Protocols** and **Shared Objects**.

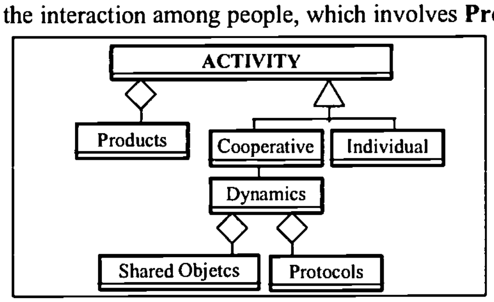


Figure 2: Expansion of the element *Process*

2.2. Roles

According to the activity proposal, it can be necessary that group members play different **Roles**. Defining roles within an environment makes it possible to designate specific tasks and to best coordinate the execution of them. It is also important that people can assume different roles during the process in order to try different responsibilities. The model should make a description of the different possible roles (**Definition**), provide ways to nominate roles (**Nominating**), and define how these roles will stand along the process (**Formation Rule**).

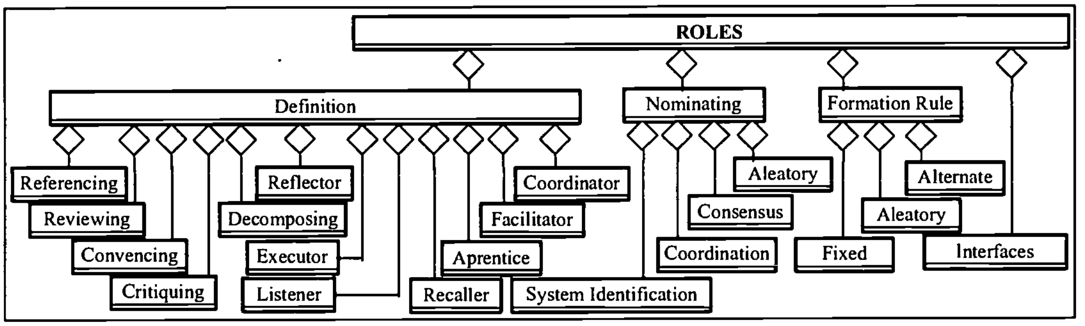


Figure 3: Expansion of the element *Roles*

In addition, it is necessary to implement **Interfaces** appropriated to each role, and to supply necessary awareness mechanisms to the various tasks performed by the group.

2.3. Memory

The cooperative activity development should be traced and stored. It is very important to preserve not only the products generated during an interaction, but the way it took place. Saving the memory of an activity might be very useful as it makes the produced material available, and shows how the process of cooperation happened to other groups. The **Memory** of the activity involves the following aspects: **Elements** related to the Activity that one wants to keep persistent; **Capture** of these elements; **Storage** and **Retrieval**, that are related to how to store and to retrieve elements.

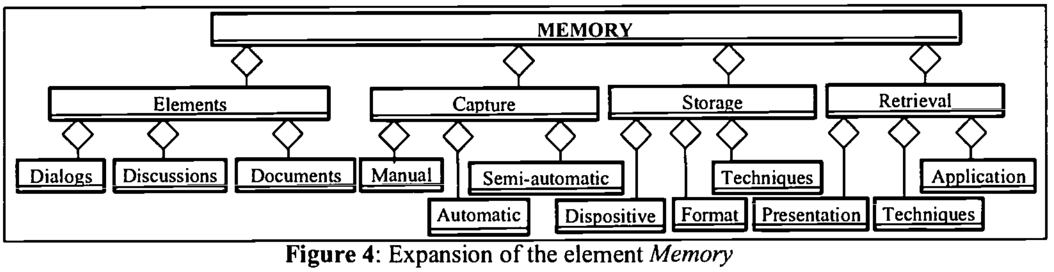


Figure 4: Expansion of the element *Memory*

2.4. Coordination

Coordination is related to process controls and help to the learner. This is done using **Guides** or agents that should monitor accomplished tasks and supply help or procedure indications.

2.5. Evaluation

Evaluation is composed of important mechanisms, that measure whether objectives are being reached or not, and because of this it should be done during the whole process. It is expected that each individual reach a certain knowledge level about concepts presented, so **Individual Results** should be measured. Besides, the group as a whole must produce some results, which must also be observed (**Group Results**). The evaluation is made by mechanisms that analyze the **Process** and the **Products** generated by the group.

2.6. Awareness

Awareness is the element responsible to guarantee that people understand, and are conscious of the process, and of the participant's interaction within the environment (Figure 5). Four types of awareness must be provided: **Social-** social connections within the group; **Tasks-** the way tasks should be taken; **Concepts-** how knowledge is distributed within group members; and **Workspace-** interactions within the shared environment.

2.7. Previous Knowledge

A learning environment will propitiate a specific content knowledge gain. Even so, this content appropriation will only be possible depending on previous knowledge that people have. This way, it is very important to provide support to identification of group members' background. This background can be appraised under appropriated methods - **Previous Knowledge Evaluation**. The group as an entity also owns characteristics that evidence its knowledge background. **Group Formation**, which refers to scholarship level, group interest areas, and homogeneity, can configure three kinds of knowledge: **Acquired Concepts; Acquired Abilities** and **Meta-abilities** (Figure 6).

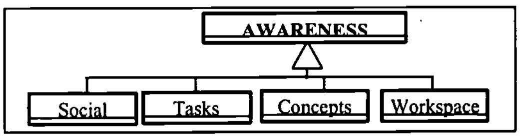


Figure 5: Expansion of the element *Awareness*

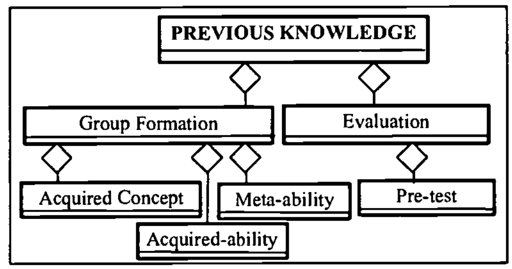


Figure 6: Expansion of *Previous Knowledge*

2.8. Learning Theory

A cooperative learning proposal should be based on a learning theory that supports social interaction elements. **Learning Theory** should supply subsidies for composition and structures of learning activities, indicating how interaction can be accomplished, what should be avoided, and what is or not important in this process. There are many leaning theories that mention interaction and cooperation as means to promote. To represent them in this model, we choose Dillenbourg's work that indicates three basic approaches. Dillenbourg et al. (1994) state that there are three different theoretical approaches able to understand the nature of cooperative learning: either focusing on the individual's vision (independent cognitive systems that interact), or on the group (cognitive system with own characteristics): **Socio-Constructivist Approach**; **Socio-Cultural Approach;** and **Shared Cognition Approach.**

2.9. Cooperation Forms

A Cooperative learning proposal can be centered in different forms or models. This is related to level and engagement in the cooperation process. Depending on how the group has been working or how a new proposal is made, a work configuration can be defined. Brna (1998) describes some of these models and affirms that being conscious of which one is used can improve computational support.
In the context of this work, six **Cooperation Forms** will be considered: **Work Division** – in this case a division of tasks is made, and each member of the group is responsible for a task; **Cooperation State** – there are individual and in-group work moments, but the group is sharing a cooperative state; **Cooperation as Final Purpose** - the work objective is to learn how to cooperate; **Cooperation as Means** - the objective is to learn something, using cooperative techniques; **Formal Cooperation** – group members make an agreement to accomplish a work cooperatively; **Informal Cooperation** - group members work cooperatively, but there is not a formal agreement, the cooperation happens spontaneously.

2.10. Cultural Factors

A proposal that involves interaction among people cannot avoid considering cultural factors related to context where the group is inserted. Some problems that may arise within the group could be predicted if the culture was previously identified. Besides this issue, the group can be motivated according to its necessities and expectations. The environment can develop ways to integrate people using common communication patterns. According to social sciences researchers (McGrath, 1993) and works on organizational culture, a set of **Cultural Aspects** (Figure 7) specifically for cooperative learning environments was specified. These factors are divided in **Individual Properties** (each person owns individual components that will influence group behavior), and **Group Structure** (demonstrate how the group is organized, and how people fit within it).

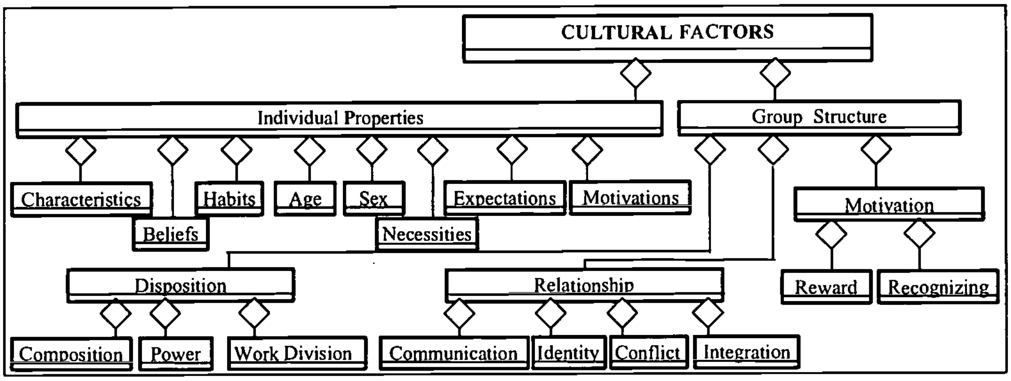


Figure 7: Expansion of the element *Cultural Aspects*

2.11. Description of the Model through Patterns

For each element of the model described, the most important problems are identified and described as patterns, like the example presented bellow ***Pattern Workspace Awareness in CSCL*** (Figure 8), related to the element Process-Awareness-Workspace (in Figure 5).
According to Johnson (1997) patterns are attempts to describe a problem to be solved, a solution, and the context in which it is applied. A pattern captures, structures and presents key information about a domain familiar to specialists. There are some kinds of patterns (conceptual, design and programming). The patterns of the Cooperation Model for Learning are in conceptual level. Conceptual Patterns are standards whose forms are described through terms and concepts of an application domain; they are set in metaphors and restricted to an application domain.
The patterns are interrelated, forming a system of patterns developed from an analysis of several environments described in literature, accomplished under the optics of the Conceptual Frame for Analysis of Computer Supported Cooperative Learning Environments proposed by Santoro et al. (1999). Some patterns of the system are being directly transformed into design patterns, while others will be used just as a guideline to the implementation. As an example for the first case, the conceptual pattern of Figure 8 will have an associated design pattern representing the software design of the solution. As an example of the second case, a pattern related to a learning theory approach will only guide how to deal with evaluation techniques.

Pattern Name: Workspace Awareness in CSCL
Problem: What elements should be disposed in a CSCL environment in order to guarantee workspace awareness among the members of the group?
Context: In a CSCL environment, awareness of participants is one of the key elements to propitiate an effective interaction. Knowing what someone is doing in a certain moment can make people interact easily. The access to information on contributions and tasks already completed is also an important factor, because it can approach people with common interests.
Forces: Workspace awareness reduces the overhead of the work in-group, allowing a more natural and effective interaction. Workspace awareness facilitates students' practices that allow cooperative learning to occur.
Solution: The environment should provide a representation of each member of the group within the workspace, so that the whole group can visualize "where he is", "what he is doing ", and "what he had already done ". This representation can be graphic, iconic, through windows, or virtual reality.
Related patterns: Social Awareness in CSCL, Task Awareness in CSCL
Known uses: CSILE implements workspace awareness through structured message notion, where an author is represented by its initials, and therefore other members get to know what he is doing or have already done. Following the same line, CSILE, Collaboratory Notebook and CaMILE also implement structured messages where the authors are identified for its names.
In NICE (Roussos, 1997), the participants of a work section are represented by avatars and everybody can visualize their movements and actions inside of the workspace. CLARE supplies a vision of all the works accomplished by group members in a specific window.

Figure 8: A Pattern Example

3. Related Works

In the literature we can find some works on development of groupware for learning. Becker and Zanella (1998) introduce a structured cooperation model to aid the teaching/learning process of modeling disciplines.

The process is defined through development of exercises, criticism and discussion of them. A general framework defining a process, roles, and shared objects are provided. This work is restricted to a domain of applications (modeling) and to a specific kind of process.
SECAI Model is defined within CLARE Environment, which is a distributed learning environment which goal is to facilitate learning through collaborative knowledge construction (Wan and Johnson, 1994). The SECAI Model (Summarization, Evaluation, Comparison, Argumentation, and Integration) defines an explicit model of process for collaborative learning of scientific texts, that metaphorically "pulls " the apprentices of an external, isolated and individual position to an internal, integrated and collaborative perspective. This model is limited to represent some issues of the cooperation process. Our proposal goes further than these works defining a complete conceptual model, addressing issues, such as cultural ones, learning theories, roles and evaluation of learning.

4. Conclusions

Research in the area of CSCL found that many of the developed environments do not reach the intended success, that is, to promote cooperation among members of a group to improve learning. Most of the problems are related to **stimulus**, **context**, **culture** and **technological** problems. We present a Cooperation Model for Learning as part of a proposal to solve some problems in the area of CSCL. The goal is to facilitate the development of cooperative learning environments, supporting the aspects mentioned previously.
We claim that building CSCL environments based on a safe model should produce effective learning by cooperation as a result. One major contribution of our proposal is to analyze non technical problems- cultural influence, educational approach, environmental context - and conjugate them to cooperative activities and the issues associated to them- objects sharing, coordination, evaluation, awareness - providing guidelines for implementation of the activities with a good theoretical basis.
Comparing related works with our proposal, we conclude that few of them are based on an explicit model, and also none of them address all the issues that we intend to support, even for a specific domain. Despite the number of computer supported cooperative learning environment proposals, the use of patterns was not yet explored in CSCL, and specific frameworks practically does not exist for CSCL processes.
Our model includes a series of learning theory approaches, cooperation forms, cooperative activities, and context issues. The system of conceptual patterns obtained from the model will be translated into design patterns and then a software framework can be developed. The framework should be restricted by a set of choices made from those available in the model and should be defined to a particular domain of tasks in order to implement an environment. The resulting environment will be used in a real situation in order to demonstrate the advantages of our approach.

References

Becker, K., Zanella, A.N. (1998). A Cooperation Model for Teaching/Learning Modeling Disciplines. *Proceedings of CRIWG'98 Cyted Ritos International Workshop on Groupware, Brasil.*
Brna, P. (1998). Modelos de Colaboração. *Revista Brasileira de Informática e Educação, No.3, pág.9-15.*
Dillenbourg, P., Baker, M., Blaye, A. e O'Malley, C. (1994). The Evolution of Research on Collaborative Learning. (WWW document) http://tecfa.unige.ch/tecfa-research/lhm/ESF-Chap5.text
Johnson, R.E. (1997). Components, Frameworks, Patterns. *ACM 0-89791-945-9/97/0005.*
Kumar, V.S. (1996). Computer-Supported Collaborative Learning: Issues for research. *8th Annual Graduate Symposium on Computer Science, University of Saskatchewan* http://www.cs.usask.ca/grads/vsk719/academic/890/project2/project2.html
McGrath, J. (1993). Groups and Human Behavior. *Readings in Groupware and Computer-Supported Cooperative Work Assisting Human-Human Collaboration* (Excerpt from Groups: Interaction and Performance, 1984, Prentice Hall), Edited by Ronald M. Baecker, Morgan Kauffman Publishers, Inc.
Roussos, M. (1997). Issues in the Design and Evaluation of a Virtual Reality Learning Environment. *Master Thesis, University of Illinois, Chicago, USA.*
Santoro, F.M., Borges, M.R.S., Santos, N. (1999). A Framework for Analysis of Computer Supported Cooperative Learning Environments. Educational Multimedia and Telecommunications '99, Seattle, USA.
Wan, D., Johnson, P.M. (1994). Computer Supported Collaborative Learning Using CLARE: the Approach and Experimental Findings. *Proceedings of 1994 ACM Conference on Computer Supported Cooperative Work, Chapel Hill, North Carolina.*

Initiating Constructivist Learning Strategies through Computer Generated Concept Mapping

F. Thomas Scappaticci
King's College Education Department
U.S.A.
ftscappa@kings.edu

Abstract: We have all felt movement of the tide in education toward resurrecting the concept of constructivism in the hope of increasing meaningful learning for our students. The question of why it has met with so little success in the past has to be pondered, and we have to ask what it is that has to be done if such a worthwhile concept is to prevail in the future. One speculation as to why constructed learning has not met with success in the past is that it may have been over sold as unstructured discovery learning. Discovery learning may be an ideal, but too often the approach is just too impractical. Perhaps we need to bring educators into discovery-learning constructivist practices more gradually. This paper deals with one attempt to do so by introducing constructivist learning strategies more gradually through a guided discovery approach that employs computer-generated concept mapping.

The constructivist view of learning holds that meaningful learning occurs when people use existing knowledge schemes and the viewpoints of others to interpret the world around them with the result being the active creation of knowledge structures from personal experiences. This is at the very core of constructed learning. A "constructivist approach" is a general term used to label all those approaches that hold to the assumption that students should build, that is construct knowledge for themselves. While constuctivist explanations of learning are not new, since noted scholars such as John Dewey, Jean Piaget, Lev Vygotsky, and Jerome Bruner to mention a few, have given support to the approach; there has been a resurgence of constructivist thinking in recent years. More and more contemporary theorists and practitioners have been holding to the idea that children do construct their own knowledge rather than simply learning what someone tells them to learn (Ormond 1995). The personal construction of knowledge concept is based upon the belief that the essence of one's knowledge can never be totally transferred to another person, because knowledge is the result of a personal interpretation of experience that is influenced by a myriad of factors such as age, gender, ethnic background, and knowledge base (Snowman 2000).

Since constuctivist approaches are basically discovery oriented (Lefrancois 1997), the question that we as professors and teachers have to ponder is, "How will this affect our own personal teaching styles and approaches to student learning?" Most of us who teach, whether we care to admit to it or not, tend to fashion our pedagogical approaches to reflect the way in which we were taught, namely via the transmission model. However, even if we were to adopt a more discovery oriented constuctivist leaning approach, we still would have to deal with the fact that discovery learning is not without a problem. A faithful application of Piaget's and Bnruner's ideas suggests an unstructured discovery approach, but research does not support its efficacy (Resnick & Klopfer 1989)(Brown and Campione1994). Students engaging in unstructured discovery activities tend to become lost and even frustrated which can lead to misconceptions. Therein lies the dilemma. The basic underlying assumption of discovery learning, which is at the core of constructivist learning philosophy conflicts with strong evidence that suggests when discovery is presented in the unstructured manner as suggested by Piaget and Bruner, is less than compelling. This paper suggests a more balanced structured discovery-based approach; one that mitigates the problems of an unstructured discovery approach and yet still encourages discovery learning. It is called guided discovery. While it is not an unstructured discovery approach it still embodies the essence of student centered discovery learning (Branford 1993). Studies have shown that when utilizing guided discovery approach students have achieved more transfer of knowledge and more long-term retention than those taught with a more traditional transmission of knowledge model. (Hillocks 1984) (Alexander&Murphy, 1994).

One specific method that seems to have promise in promoting the basic tenets of guided discovery learning is concept mapping. Basically, concept mapping is a technique that allows one to understand the relationships of ideas by creating a visual map of the connections among these ideas. Concept mapping allows students to see the relationship between the knowledge they already posses and the knowledge to which they are trying to connect, what ever that source might be. Concept mapping can also organize a myriad of ideas in a logical kind of structure employing a type of visual language that also encourages students to operate at all six levels of Bloom's Taxonomy of the Cognitive Domain (Bloom 1956) (Gaines, Shaw, 1999)(Novak and Gowin 1984). Concept mapping focuses on a topic or an area of interest, and involves input from one or more participants. It can be utilized by an individual student or any number of people in a cooperative learning strategy. The result is an interpretable pictorial view of the ideas and concepts constructed; it graphically shows how the ideas that have been generated from one's own knowledge schemes are related to the environment attempting to be explained. (Trochim 1999). A well-conceived concept map graphically reveals the shape of the structure, the relative importance of the information and ideas, and the way that the information relates to other ideas. They can be used to think through complex problems by viewing the overall structure of the subject and to associate ideas and make connections that would otherwise appear to be too unrelated to be linked. Another strong advantage of using concept maps is that once a student either individually or cooperatively has developed a concept map, the organization and details of the map tend to be remembered for a much longer period of time than is usually the case when trying to remember the material in text form. (Mind Tools, 1995). The concept maps when utilizing a guided discovery format promote constructivist thinking because it is still the students themselves that build or construct the map with all of its relationships, but the students are not far afield because they are still receiving guidance from the instructor.

In the field of education, the use of concept maps probably began with Ausubel's learning theory treatment of advanced organizers and meaningful learning which holds that in order for meaningful learning to take place, students must relate new knowledge to relevant topics that they already know, and that teaching strategy in and of itself does not necessarily result in meaningful learning. (Ausuble1963)
Ausubel's work in turn prompted Novak (1977) to develop a system of concept maps which have been applied in a variety of ways within the school setting. (Lambiotte, Dansereau, Cross and Reynolds, 1989)
However concept mapping did not have the success that it deserved, namely because they were cumbersome and difficult to draw by hand. This was the case in the past, but fortunately, today we have software that is capable of generating concept maps easily and efficiently. One such program is ***Inspiration.***

Inspiration (1999) is a software package that is specifically designed to facilitate the construction and use of concept maps. It is a powerful visual-thinking tool that helps clarify and organize ideas and information. It helps facilitate brainstorming, planning and the explanation of relationships between processes, variables and events by providing some basic tools in the application that make the process of graphing the concept map a relatively easy one. It can easily be adapted by teachers to promote student-centered, discovery based, constuctivist, type learning.

Some of the Basic Tools of *Inspiration* That Can be Used to Facilitate the Construction of Concepts Maps

A. **Diagramming:** Helps you to quickly record, link and map out concepts within a symbol, and the rapid fire element allows you to put the ideas down as fast as you can think of them while constructing the proper linkage among the ideas.
B. **Moving a symbol:** A symbol can be moved at any time and when it is moved, ***Inspiration*** automatically adjusts the link to clearly show the new relationship.
C. **Adding Unconnected Ideas:** Sometimes you may have an idea, but are not certain about where it belongs in the whole scheme. The program allows you to add an idea anywhere within the diagram and adjust it at a later time.
D. **Changing Symbol Shapes:** Inspiration provides a large menu of symbol shapes to represent any number of concepts. These shapes can be easily changed at any time in order to further clarify or emphasize the relationship of ideas or concepts.
E. **Drawing A Link:** Symbols are connected automatically, but unconnected links can be connected manually at any time, and the program will make the link precise.
F. **Adding Text to A Link:** When additional information needs to be added to a link in order to further clarify or emphasize the relationship, as is the case in many concept maps, the program easily allows for it.
G. **Scrolling and Magnification:** The application allows you to move the diagram around within the window or zoom in or out of the diagram.
H. **Formatting Symbol Text:** Text font, and font styles can be set for the entire diagram or selectively.

I. **Printing to fit:** The print to fit option allows you reduce the diagram to fit to one page or to any number of pages specified before printing.

J. **Switching Between Diagram and Outline Views:** You have the option of working in either outline view or diagram view for your text, and you can alternate at any given time.

K. **Importing and Installing Graphics:** Color or black and white graphics created in other applications can be imported into the ***Inspiration*** diagram or installed in the ***Inspiration*** User Symbol Menu.

A thorough grounding in the techniques of concept mapping and the ***Inspiration*** program will provide all the foundation necessary for utilizing concept mapping successfully in the classroom.

With proper preparation, concept maps that are computer generated can be effectively used as a teaching tool in classes from elementary through college to promote more efficient learning through a constructivist guided discovery approach.

References

1. Ausubel, D.P. (1963.) *The psychology of meaningful learning*. New York: Holt Reinhart and Winston

2. Bloom, B.S. (1956.) Taxonomy of educational objectives. The classification of educational goals., Handbook I: Cognitive domain: McKay

3. Gains, B.R., and Shaw, M.L., (1995)
" WebMap: Concept Mapping on the Web"
Sept. 6, 1999
http://ksi.cpsc.ucalgary.ca/atricles/ConceptMaps/html#references

4. Inspiration (1998)"Professional Edition"
Sept 5, 1999
http://www.inspiration.com/biztest.html

5. Lambiott,J.G., Dancereau, D.F., and Reynolds.S.B., (1989). Multirelational semantic maps. *Educational Psychology Review* 1(4) 331-367).

6. McCabe, D.,(1999) "Introduction to concept mapping." Concept Mapping Workshop.
Sept 7, 1999
http://158.132.100.221/CMWshp folder/cncpMapp.Wkshop.htmt

7. Mind Tools. (1995) " *Improving Note Taking with Concept Maps*."
Mind Tools Ltd. 1995-98
Sept.7, 1999
http://www.mindtools.com/mindmaps.html

8.. Novak, J.D., (1977). *A Theory of education. Ithaca*, Cornell
University Press

9. Novak, J.D. and Gowin, D.B. (1984). *Learning how to learn*. New York, Cambridge University Press.

10.Trochim, W. M., (1999) *"Concept Mapping."*
Research Methods Knowledge, 2nd Ed
Sept 6, 1999
http://trochim.human.cornell.edu/kb/conmap.html

Certifying Technological Proficiencies of K-12 Teachers

Carol Scheftic
University Center for Teacher Education
California Polytechnic State University
San Luis Obispo, CA 93407-0389 U.S.A.
scheftic@calpoly.edu

Abstract: New technologies are regularly introduced in the home, community, workplace, and educational settings. How do teachers, in particular, learn to appropriately integrate new technologies into their personal, instructional, and professional activities? How does a current or potential employer determine the level of proficiency that a given teacher has achieved in a range of technology-based areas? This paper describes how one local educational agency, the San Luis Obispo County Office of Education, has approached those questions, and how their answers fit into guidelines currently under development by the state of California.

The Context

Excerpts from two reports will be used to describe the context in which the work reported in this paper was undertaken.

> "Any nine year old who has ever commandeered her parents' computer to surf the Internet, asked a NASA scientist about acid rain, or designed a multi-media language arts project knows what dozens of blue-ribbon panels have concluded in vastly more syllables: 'Computers are cool!' Technology has the power to teach, to motivate, to captivate and to transform an ordinary classroom into a training ground for the next generation of artists, entrepreneurs, and government leaders.... The ability of teachers to use technology to promote students' acquisition of basic skills and subject-matter content is critical to education's success. Accomplishing this objective requires front-end preparation, as well as ongoing training opportunities and incentives... to integrate technology into the content and performance standards that will be used as the basis for setting policies for preparing, hiring, evaluating, and promoting teachers." (California Education Technology Task Force, 1996, p.1).

> "The California Commission on Teacher Credentialing was mandated ... to establish 'standards of program quality and effectiveness relative to the use of computers in the classroom for preliminary credential candidates, and to establish standards of program quality and effectiveness relative to advanced computer-based technology for professional credential candidates'. As provided by law ... and practice, the Commission elected to select a 'Computer Education Advisory Panel' which was charged to make a comprehensive review and make specific recommendations with regard to computer competency standards." (Computer Education Advisory Panel, 1998, in the Foreword). This report was adopted by the California Commission on Teacher Credentialing [CTC] in December, 1998, and on July 12, 1999, the CTC issued official guidelines describing the new technology standards and the process and timeline for implementing them (Swofford, 1999).

The Issue

Knowing that performance standards for educational uses of technology were coming, in the Fall of 1997 the San Luis Obispo County Office of Education [SLOCOE] put together a group to look at the potential impact this would have locally, on both pre-service and in-service teachers. This group included classroom teachers and technology mentors from the public schools, building principals and district supervisors, technology specialists from the county office and faculty from local teacher training institutions. This Advisory Board proposed a "Technology Certification Program" for teachers, site administrators, and other instructional staff (San Luis Obispo County Office of Education Technology Certification Advisory Committee, 1999).

In developing its recommendations, the Advisory Board first agreed on a number of parameters for a certification program. It was seen as important to provide for multiple levels of certification: basic-level personal computing skills, intermediate-level skills specific to the teaching and learning process, and advanced-level skills relevant to various types of leadership roles. Training would be provided to help educators reach the various levels, but the times, locations, and designs for such training had to be highly flexible. Entry to and exit from training programs had to be as open as possible, and it was important to provide opportunities for people with experience in an area to demonstrate their proficiencies in meaningful ways outside of a formal training program. Finally, evaluation of whether or not people had acquired various skills, either on their own or as part of a formal training program, had to be based on actual performance.

The Process

Based on the recommendations of the Education Council for Technology in Learning [ECTL], a three-tier structure was developed for evaluating the level of proficiency with technology of both educators (California Technology Assistance Project, 1997a) and students (California Technology Assistance Project, 1997b). The educator levels are:

Level One:	Personal Proficiency
Level Two:	Instructional Proficiency
Level Three:	Leadership Proficiency

Educators at Level One are able to use a range of tools for their own purposes. They are able to send and reply to electronic communications in a number of contexts (e.g., personal mail, threaded discussion groups, online chat rooms), and to use basic Internet tools (e.g., web browsers, file transfer protocols). They can use common productivity and display tools. They need not, for example, be true experts at desktop publishing, but they are able to put together a simple newsletter to send home with their students or to help promote a school club's activities. They need not be able to use all the advanced features of spreadsheet and database packages, but they can use a gradebook program that incorporates those kinds of features. They do need to be aware of legal and ethical issues in computer use, and they must know how to use various tools in a responsible and professional way. They also need to know how to use a range of resources such as manuals, help files, tech support lines, and how to provide a meaningful bug report when seeking assistance. They should feel comfortable with technology: they don't need to know and remember every trick for every program at their disposal, but they should have both the skills and the confidence to learn new features or programs as the need for them arises.

Educators at Level Two are able to take their Level One skills and extend them to a range of specific instructional settings. They can design and implement activities where students use desktop publishing or display tools to present reports, where they use the Internet to gather and share information or data in various ways, or where the students use a database to organize information and/or a spreadsheet to help analyze it. They know how to appropriately integrate into their instruction and manage a carefully selected set of tutorial and practice software available at their site. At this level, the educators' own basic technology skills are also improving: they can install, configure, and run more products, and they can do more basic hardware and software trouble-shooting on their own instead of typically reporting problems to a support person.

The expectations, both in the original ECTL report and in the local committee's recommendations, were that all teachers should be able to reach both Levels One and Two. The SLOCOE panel said nothing about how long it should take everyone to achieve this, nor about whether schools could or should require their employees to do so. It did, however, offer mechanisms for both helping schools to provide opportunities for their instructional staff to improve their skills and for certifying achievement of the proficiencies.

Educators at Level Three were the keys to this plan. This was perceived as a special category, one that only some educators would be expected to reach. The people at this level are those who act in a mentorship or leadership role with respect to the uses of technology at their individual schools or across their district. Indeed, it was even proposed that there would be at least two such types of high-end proficiencies. To present the differences via an example: a mentor might develop and offer a workshop on personal or instructional uses of databases, while a leader might review a series of gradebook packages and recommend one for district-wide use. Mentors would model and serve as advocates for effective and efficient uses of technology, and serve as a coach to their peers. Leaders would have a major role in development of technology plans, policies, budgets, etc., and would systematically manage a range of technology resources. A given person who achieved Level Three might function as a mentor or as a leader, or as both, and there would be distinct certificates to represent each role. But one key to achieving Level Three status involved being someone who helped to support those striving for Levels One or Two, or even three, and who understood the certification process well enough to be able to determine if individuals were meeting the various criteria. Level Three status, furthermore, would need to be re-evaluated on a regular basis. In order to have their certification at that level renewed, every two years Level Three educators must submit evidence of the things they are continuing to do to provide such support and of their growth in knowledge of appropriate emerging technologies. On an ongoing basis, then, individual schools and districts could use their Level Three people to help identify and meet the professional development needs of those teachers wanting to learn the material for the various proficiency levels, and the regional certification team could use the Level Three people to do initial screening of those seeking certification.

Portfolios were chosen as the mechanism for documenting achievement of the various proficiencies. For each level, there exists a list of competencies, and a number of suggestions for artifacts that can be used to demonstrate each one. The artifacts are to be assembled into a binder that can be viewed by a Level Three person doing the preliminary verification, by the regional certification team that reviews portfolios before issuing a certificate, and by other appropriate people involved in the hiring, evaluating, and promoting of the person. Considerable effort went into developing the competencies so that they were both specific about the type of skill to be demonstrated, yet open-ended about how achievement could be demonstrated so as to accommodate site-specific variations in both expectations and resources. Considerable time also went into determining the possible formats for a portfolio: although they are being used to demonstrate proficiency with electronic media, it was decided that there needed to be print-based evidence of the various skills. A few of the criteria can be documented via letters of recommendation; several others, by having a Level Three educator sign a form stating that the skills have been demonstrated in person. The majority of the proficiencies, however, are to be demonstrated by hardcopy documentation. Additional artifacts in electronic form may be included (e.g., on diskette or CD, via URL), but the panel felt it was important for the portfolios to be able to stand on their own to avoid the restriction that a person reviewing a portfolio might need a particular computer system or software tool or net connection to view the material being used to document a given competency.

Once the proficiency levels were defined, the criteria for each level determined, and the process for evaluating portfolios developed, the next step was to start soliciting portfolios and evaluating them. Since the program was still in the beginning stages, a small group of Level Three candidates was identified first: people already clearly recognized as technology leaders in several local districts. The panel worked with this group as they developed their portfolios, documenting issues that arose and revising the guidelines as needed. These people were required to submit portfolios that addressed all of the Levels: One, Two, and Three. As the advisory board evaluated the portfolios, they continued to look both at how well the person met the requirements and at issues in how the process itself seemed to be working. Once the panel refined the evaluation guidelines, these educators were issued certificates at all three levels. They were also given guidance on how they were to evaluate the future applicants. People assembling a portfolio do not have to complete a level before getting a preliminary review. Instead, they can have a Level Three educator "sign off" on individual competencies to get ongoing feedback on their progress towards the requirements at a given level. An applicant can, in fact, have different Level Three people sign off on the various individual competencies: as part of the classroom observation process, during in-service workshops, after independent study, and so on. All complete portfolios at each level are then reviewed by the program certification team. This is done to maintain quality control on the process: if a certain Level Three person seems to be signing off on competencies without documentation that is consistent with the overall guidelines, then action can bc taken to make sure that everyone understands the expectations and the need to uphold standards in a consistent manner. When a portfolio passes the certification team's review, the educator is issued an appropriate certificate from the SLO County Office of Education.

The Next Phase

The SLOCOE process was begun barely two years ago. The Advisory Panel hoped that it would eventually grow into a widespread program, but they did not anticipate the speed at which it has already spread both locally and regionally. In the meantime, as stated in the background section above, the state of California has recently come out with its official standards. The certification panel is currently reviewing the state standards to determine how, if at all, the local proficiency criteria must be adjusted to be in alignment with those. Once that is sorted out, the group will return to the development of a set of recommendations for artifacts that would be appropriate for administrators to assemble into a portfolio demonstrating the technology proficiencies appropriate to their responsibilities.

Some Already-Known Consequences

Some Local Consequences

Individual districts have adopted the certification process in their own individual ways. For example, a few have said that Level One and Two certification will be required within a given timeframe, regardless of any exceptions to such requirements that the state might eventually permit. Others say that a person need not go through the program, but only those who have a certain level of certification are eligible to get new hardware or software. Some offer actual salary increases to those achieving certification, while others provide time or money incentives to attend workshops for developing proficiencies. Some have tried to implement their own version of the program in a certain way, but have had to change their process due to conflicts with things like state formulas for how funds can be allocated or specifics of union contracts. Nonetheless, every district in the region is participating in the process in some way.

The San Luis Obispo County Office of Education has developed a Tech Mentor Program that is designed to give additional help in using technology for the improvement of student learning to schools and districts in its local service area. Each district (according to its size) is allocated a certain number of Tech Mentor service days during which support or training can be provided at no cost to the district using money from several local funds; districts can also buy additional days from their own funds if desired. Tech Mentors are chosen from a pool of Level Three Educators who have registered a list of specific workshops they can offer under various general categories. A school or district person contacts a potential Tech Mentor to discuss the local needs (e.g., dates and times, how much customization is needed, etc.) and to complete a SLOCOE service contract. Since all the Tech Mentors are certified as Level Three Technology Educators, they offer not only the specific training requested but also any needed guidance on how participants can demonstrate relevant proficiencies in their technology certification portfolios.

Some Regional and State-Wide Consequences

In part because of their work in developing this local process, one member of the SLOCOE Advisory Panel was invited to be a member of the California Computer Education Advisory Panel [CEAP] that developed the recent state-wide technology standards, and several others served as reviewers of CEAP's preliminary recommendations. While the new state-wide technology standards do not mandate a proccss of portfolio evaluation such as SLOCOE developed, those standards are consistent with such a method.

Word of SLOCOE's work has spread, and the education offices in several other counties have either adopted a similar program or are looking into the possibility of doing so. The new regional group will typically set up their own certification team that will meet with the San Luis Obispo group to go over the process and consider the impact of variations the new group would like to propose. (Some of those ideas have been good enough that the SLOCOE board has revised its process to match. Others have been ones the SLOCOE group already tried and discarded, and they are discouraged. And a few have been accommodated as minor variations in the programs across different counties.) The new group and the SLOCOE panel also typically meet to review the first round of a region's Level Three portfolios together, discussing how to handle any issues that arise.

So far, such certification of in-service teachers is still being handled regionally. The state, through the California Technology Assistance Program [CTAP], has begun to look at ways to handle it state-wide. The initial developers of this process are hoping that CTAP will do something along the lines of SLOCOE's design: CTAP could review and approve a series of regional programs (as regional groups do for Level Three personnel), CTAP could let the regional panels handle local reviews (as Level Three educators can initially sign off on Level One and Two competencies), and CTAP could still review select procedures and artifacts to make sure the regional programs are maintaining the common standards (as the regional groups do across their local districts).

References:

California Education Technology Task Force. (1996). *Connect, Compute, and Compete.* Sacramento, CA: California Department of Education. [Online]. Available: http://goldmine.cde.ca.gov/ftpbranch/retdiv/ccc_task/ccc.htm [2000, March 20].

California Technology Assistance Project. (1997a). *ECTL Technology Based performance Standards for Educators.* Sacramento, CA: California Department of Education. [Online]. Available: http://ctap.k12.ca.us/grants/teachstds.html [2000, March 20].

California Technology Assistance Project. (1997b). *ECTL Technology Based performance Standards for Students.* Sacramento, CA: California Department of Education. [Online]. Available: http://ctap.k12.ca.us/grants/stdntstds.html [2000, March 20].

Computer Education Advisory Panel. (1998). *Final Report of the Computer Education Advisory Panel.* Sacramento, CA: California Commission on Teacher Credentialing. [Online]. Available: http://www.ctc.ca.gov/ceap/ceap.html [2000, March 20].

San Luis Obispo County Office of Education Technology Certification Advisory Committee. (1999). *San Luis Obispo Technology Certification Program.* San Luis Obispo, CA: San Luis Obispo County Office of Education. [Online]. Available: http://www.slocs.k12.ca.us/edtech/techcert/ [2000, March 20].

Swofford, S. W. (1999). *New Technology Standards, including a Plan for the Implementation of Programs to Meet the New Technology Standards. (Coded Correspondence 99-9916).* Sacramento, CA: California Commission on Teacher Credentialing. [Online]. Available: http://www.ctc.ca.gov/codcor.doc/999916/999916.htm/ [2000, March 20].

Acknowledgements:

The work reported in this paper was supported by the San Luis Obispo County Office of Education [SLOCOE] and the California Technology Assistance Project [CTAP]. SLOCOE has an Instructional Technology Specialist position that is staffed on a rotating basis by local educators, and reports to Gary Schonfeldt, Director of Educational Services. The Technology Certification process was conceived, and the original advisory panel was organized and led, by Sheldon Smith (ssmith@mail.slocs.k12.ca.us), Director of Technology and Information Services, Paso Robles Public School District, during his term as IT Specialist (1997-1999). The program is continuing under the direction of the current IT Specialist (1999-2001), Cheryl Hockett (chockett@mail.slocs.k12.ca.us), while she is on leave from the Atascadero Unified School District. The local advisory panel that developed and maintains the program typically has about eight members at any given time, and thanks are due to about two dozen local educators who have participated on the panel at various points along the way. Sheldon Smith, Jim Martin (of Atascadero), and the author of this paper are the members of the current panel who have served with the group continuously since its inception.

Organisation, Collaboration and Learning - Shaping Education and Learning in Virtual Environments

Friedrich Scheuermann
Institute for Organisation and Learning
University of Innsbruck, Innsbruck
Austria
friedrich.scheuermann@uibk.ac.at

Ken Larsson
Dept of Computer and Systems Sciences
Stockholm University/Royal Institute of Technology
Sweden
kenlars@dsv.su.se

Roxanne Toto
Education Technology Services
Center For Academic Computing
The Pennsylvania State University
U.S.A
rytl@psu.edu

Abstract: This paper looks at the connection between organisation, collaboration and learning in virtual learning environments (VLEs). Our main points of focus is investigating the extent to which course developers and course instructors need to consider organisational measures and design to trigger (self-guided) learning and collaboration of participants within online learning environments and how deeply individual learning processes are stimulated by intercultural collaboration in multinational groups. The design of these virtual learning environments or learning networks involves an intricate balance between the organisation of the content; how the instructional activities are sequenced; how the interactions between students, tasks, and materials are structured; and how the learning process is evaluated. Mentorship must be present throughout this process. Aspects of mentorship can manifest themselves in a variety of ways including: asking an expert, true mentoring, tutoring, and peer to peer support.

Introduction

Our starting point and subject of this study is the "Online Seminar" of the University of Innsbruck and the Saarland University, which has run six times over the past few years, and has dealt with various topics (http://seminar.jura.uni-sb.de). Special concerns for this course include:

- It is directed towards an international audience
- It accommodates a large number of participants (100-250 people)
- It has diverse student profiles, i.e. a mixture of students and people already working in their profession (mixture of university and continuing education)
- It actively integrates all participants
- It utilises collaboration as a vital part of the course concept
- It is transparent in all activities
- It provides constant evaluation
- Keeping the course concept as flexible and open as possible

One advantage of online courses is the potential for communication, collaboration, and the constant exchange of knowledge between students and educators, which brings them closer to (and perhaps supersedes) "real life" teaching. The Online Seminars has opened up new possibilities for students and teachers, and permit inter-disciplinary and international collaboration but have also proven to be far more time and personnel intensive than regular courses. Computer-Mediated Communication (CMC) therefore becomes an important research area for education. In this paper some basic thoughts about the development of communication-centred online web-based courses will be discussed and related to some of our experiences concerning the development and administration of such courses. For this purpose the structure and content of the recent online course will be described identifying problematic aspects specific to online courses and how those issues might be resolved in future courses. Our investigation explores the role of organisation of communication and moderation, the analysis of interactivity and working styles, and the results of the learning process. The questionnaire filled out by the participants points out student opinions and finally adds another perspective concerning the effectiveness of such kind of courses.

Designing collaboration and learning

These issues are complex and varied. Some of the requirements for designing and developing effective online courses are, attention to motivation and that it must afford interactivity. A vast investment of time and energy during the design, development and the realisation of such online courses are mandated to ensure organisational and support activities to ward off potential problems. Online VLEs present technical, transitional and pedagogical concerns. As (Harasim et al. 1995) notes, "an online mentor is a professional in a particular subject area who provides on-going feedback until the apprentice (student) masters the learning task. At that point the mentor fades away, and the apprentice engages in the exploration of expert practice." Mentorship then takes on several added dimensions within a virtual learning space. The VLE presents a new atmosphere that the student and teacher must learn how to navigate. Online support must, on one hand, mentor technical work and on the other hand provide online course support to mentor content and guide the learning process. This melding of mentorship and purpose begins to reshape the face of learning and education. Without the active help of professors and lecturers (occupied with content support, management and didactics) as well as a number of students who volunteered to assist as moderators during the online course the high goals set for the course could not heave been reached.

In an online environment you can expect mentoring to take on a new dimension. Here we are challenged to mentor in ways that (Feuerstein et al. 1980) and others define as mediation. By facilitating, modelling, and coaching we begin to have new insights into mediation, instructional strategies, response to learner queries, and facilitating online discussion and fostering critical thinking. We anticipate, through an analysis of the discussion threads and collaboration threads, that we will be able to identify types of dialogue as well as a framework for guidance to support and facilitate a collaborative online environment.

Dialogue and inquiry become a powerful medium for collaborative learning. Discussion begins to carry a flow a meaning. Threads of conversation can be woven together. Opinions and points of view become circulated as observations, assumptions and interpretations become visible. Effective guidance and mentoring can be achieved through selective intervention. A skilled moderator is a mentor who can keep the fragile balance between advocacy and inquiry. The moderator must facilitate rather than dominate the discussion. When we focus on (Vygotskys 1978, 1986) idea of the learner's zone of proximal development, scaffolding, and dialogue, we have to turn our attention to fostering learning via virtual discussions, using strategies that include "voice", address learning and writing styles, and utilise Socratic dialogue. These ideas require us to tend to both the individual and group learning process. If we want to further online discourse, it is important not to forget that this learning process is complex, social and interactive. Research in social collaboration and negotiation in the vein of (Slavin 1987) and others, calls attention to the design and support of what these learning environments require. Responsibilities for discussion become shared, feedback becomes integral, and all participants, including the moderator, are equal. Both instructor and learner are challenged to grow and develop in this environment. Instructors grow to become moderators and guides and students grow as learners.

Our goals as moderators and discussion facilitators is to keep the "conversation" flowing, focus and refine ideas, challenge/ask learners to explore deeper into critical issues, and support and scaffold an online community. Facilitating this critical thinking begins with the questioning process. Questions need to stimulate creative thinking and exploration of a topic. Marrying strategies related to electronic communication and critical thinking will help foster a community of learners in a virtual environment. If the moderator demonstrates skilful and thoughtful questioning to engage discussion participants, learners begin to learn how to ask questions of each other. Engaging questions will stimulate discussion and participation, if discussion lags; the attentive moderator will step in to perturb the process. Although there are no right or wrong answers, there are right and wrong questions. The "right" questions provide the seeds for conversation that empowers the learner to actively participate and contribute. Student ownership of information, their ability to present and defend a position, and the exchange of ideas all enhance the learning process.

Online collaboration as well as effective moderating *must* be designed if it is to have comparable impact to face-to-face instruction. Through conscious effort and application "virtual" moderators can bring voice and tone into an otherwise sterile and distant environment, accompanying the learner as a reflective guide or maybe even much like a personal muse. Moderators are mediators and facilitators; generative guides and conceptual facilitators. The same issues that can be a weakness in a virtual learning environment can be exploited creatively to make learning come alive.

Active learning is at the heart of the design of the Online Seminar. Designing activities that ensure active participation is part of the moderation and discussion process. Facilitating the discussion is one aspect. Another aspect is making the discussants responsible for their own learning by sharing the responsibility and leading group discussion and work. Roles that are scaffolded and modelled by the facilitators become shared then taken over by the participants. All participants in the course are provided the opportunity to experience being facilitators in discussion, team leaders, presenters of information, observers, and all are responsible to provide feedback and input into the learning process. However, for any of this to occur, a certain amount of control needs to be relinquished and turned over to the group. Moderators must stay in the shadows allowing the learner to shine.

But perhaps at the heart of design is the feedback, feedback that the moderator needs to provide in order to support the learning process. Feedback that promotes and encourages continued growth as a learner and encourages collaboration. Substantive feedback not only needs to be built into the course design, but also needs to be modelled by the facilitators if we are to expect quality feedback from students. Feedback needs to be constructive. Connections need to form between participants; commonalties as well as differences need to be discussed. A shared interdependence creates a collaborative environment.

Our goal was that course design and development would reflect a commitment to high quality related to state of the art research for teaching and learning. Hence, "active learning" and a focus on the "communicative process" between and among students and teachers were considered to be essential as we investigated designing "rich online learning communities". Since it is a virtual environment to be implemented based on the Internet, it was clear that quality could be enhanced if the potentials of the Internet could be exploited. Those potentials include information and communication potential; the flexibility of time and space of learning; and access for everyone without the need of additional financial investments in equipment or tele-communication. Therefore the design of a flexible learning environment needs to consider:

- *Openness in design* towards; user-groups to address needs (cultures, disciplines, professions, number) for teaching and learning, media being integrated, implementation of pedagogical features and feedback from learners and other participants
- *Flexibility* towards; applied educational concepts and their evolving updates, contents to be delivered, applied pedagogical modes and methods for teaching and learning, duration of courses, application of (and changing) technologies and evolving design
- Realising an *active participation* of all persons by; supplying and integrating the communication tools needed and integrating motivational features for improving/enhancing interaction
- *Easy-to-use* for learners and instructors, in form of low technical barriers, motivational atmosphere and providing administrative tools
- Taking into account *existing resources* concerning, technology, personal and finances with a clear perspective for future continuation (no project status!)
- *Integrating a platform* for following research interests and improving education (e.g. via evaluation).

There is a tension between pedagogical needs and resources and efforts in regard to finances, organisation and technology. Therefore a compromise must be found for defining the requirements taking into account economical and technical issues as well as specific legal regulations in formal education that define obligations related to privacy, fees, etc. when running an online course.

As (McGreal 1998) notes that commercially available integrated distributed learning environments such as CourseInfo (http://www.blackboard.com/) are popular given: the lack of sustained yields for individual course development within curriculum, the high time investment for instructors, and the lack of a supportive technology infrastructure. Despite the administrative and implementation advantages these course management systems offer, these packages lessen the authoring power of the instructor, assume specific pedagogical approaches, confine in some ways the delivery of instruction, and limit the control of the instructor over the learning environment. Given our requirements and needs, we wanted control over the tools and delivery method to be able to be responsive and adaptive to learner and instructor needs relative to the content being presented. We wanted the learning environment to be able to evolve and grow. We also wanted the environment to be learner centered and learner driven – hence our focus on creating community and a collaborative learning environment. Subsequently design looked to the aforementioned needs for input rather than limiting the design and development to adhere to a singular learning theory. Rather, we focused on developing a set of tools for the learners and designed how we asked that learner to engage the information to create the kind of interactivity and the level of ownership needed within the learning process. We intended to create a "rich" learning environment, which Wilson describes as a setting in which the student is "engaged in multiple activities in pursuit of multiple learning goals, with a teacher serving the role of coach or facilitator" (Wilson 1996).

Since the idea is the building of "learning communities" to achieve better and more active learning processes by the students a definition of constructivist learning environments given by (Wilson 1996) would fit best to the Online Seminar environment: "a place where learners may work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities". However, not all tasks performed within the courses are constructivist. It is Apparent within the design the influences of other learning theories and pedagogical assumptions e.g. such as cognitivism and social constructivism. Cunningham et al. (1993) listed several principles for the design of a learning environment:

- Provide experience with the knowledge construction process,
- Provide experience in and appreciation for multiple perspectives,
- Embed learning in realistic and relevant contexts,
- Encourage ownership and voice in the learning process,
- Embed learning in social experience,
- Encourage the use of multiple modes of representation
- Encourage self-awareness of the knowledge construction process.

These principles becomes instructionally designed focused and more concrete when taking a look at (Xiadongs 1995) presentation of a typical instruction design process:

- Identify objectives (e.g., what do you want students to be able to do when they have completed the instruction?)
- Assess students' prior knowledge and skills (e.g., determine whether the target students have the prerequisites to benefit from the instruction)
- Specify the content to be taught (e.g., what content skills should be taught to students?)
- Identify instructional strategies (e.g., what instructional methods should be used?)
- Develop instruction (e.g., a learner's manual, instruction materials, tests, and an instructor's guide)
- Test, evaluate, and revise (e.g. how should students be evaluated to determine the degree to which students have meet the performance objectives?)."

It must nevertheless be stated that providing education in virtual learning environments requires a multitude of facets to be considered as can be seen from this preceding list.

Organising collaboration

The online seminar is a co-operative international venture. The roles of each of the co-operating institutions dependent on the focus, resources, personnel, and disciplines of these institutions. Currently (Summer 2000) this collaborative venture involves participation of Higher Education institutions in Germany, Austria, Sweden and Kazakhstan. Each of these institutions may in turn collaborate with other local institutions. Co-operative decisions are based on common educational and research interests, competence, persons in charge, technical resources and the cultural background. Educational interests can therefore be implemented in ways not known before ICT (Information and Communication Technology) and the Internet was available.

On a broad scale, collaboration takes place among students, between students and teams, and among team-members. Student collaboration needs to be organised and co-ordinated too. No learning environments are known in formal education, where students meet voluntarily in order to collaborate for performing certain certified tasks. Taking a closer look at the role of collaboration will show considerations to be globally viewed on four levels; On the students level within the course, on the team level within the course, on a local level and finally on an institutional level: i.e. collaboration between international universities.

The Online Seminar-environment different teams consist of some 30 individuals from many different countries. These team members are lecturers, agents, volunteers, former seminar participants and students doing research work. Most of today's volunteers in the moderation of group discussions are former students of the seminar. Several tightly bonded groups have been formed as a result of the seminar on varying levels. For example "Cyber Grannies" was formed by some of the student cohort during the 1999 seminar. Consider too, this paper is a result of collaboration between the principal project investigator, and two former students of the seminar who are now members of the team. Learning processes are also encouraged for the team – currently we are developing training for moderators. As you can see, design is complex and multi-faceted.

Learning within the environment is structured to be multi-levelled and complex. Learners are learning from the team, but also from other learners. The team is learning from learners and other team members and participating institutions are learning from learners, teams and other institutions. These complex webs of different learning levels are intimately related to the collaboration taking place across all these levels. Meta-learning is built into the design. Feedback has shown that learners rate this collaboration structure highly.

Learner Profile of participants in the 1999 summer term Online Seminar in short are; 224 students from 46 different universities, 19 academic specialties were represented from humanities to technology, 88 participants held some form of employment, 37 countries were represented an the ages ranged from 20 to 64

A questionnaire was administered to determine attitudes towards the Seminar and the model of online collaboration and learning. Seminar students where asked to grade the seminar on a scale from 1 (very bad) to 10 (excellent). Of those grading the seminar (80 respondents), 70,1 percent gave a grade of 8 or above, and only 5 percent gave a grade below 5. Apparently the participants have high regard for the Seminar. Still the really interesting question is whether the participants perceive any improvements in their skills. The theme for 1999 Online Seminar was "Using the Internet in Professional Life", and the participants where asked a few questions on whether their abilities in using the Internet had changed. Most of the participants were active students, and their professional use of the Internet is primarily for studies. This activity may or may not include using Internet in their chosen field of future professional careers. Two question on this subject where given to the participants, who using a 5 point scale where, 1 = no improvement and 5 = very much improved. On the question if the Seminar helped improve the participant's ability to use Internet in studies, 77,6 percent gave a grade of 4 or 5:

This seems to indicate that a goal of these participants was to learn new ways to use the Internet to facilitate studying. The 1999 Seminar topic was in Legal work, participants were also asked if their knowledge in this area improved during the Seminar. Although the answers on this question were a bit more evenly distributed, the overwhelming majority responded that their skills had improved.

Group work is central to the Online Seminar. Given that the requirements are to collaborate with "strangers", this requirement becomes embedded in the strategy of the course design to promote active learning. Given this social dimension, it is critical that design supports this framework for building learning communities. As already stated by (Hermes 2000) students learn "to take responsibility in their hands and work in groups as autonomous learners". They build "virtual teams" (Berg 1999) and follow strategies in completing their tasks by developing and transforming their ideas.

A lot of planning and creativity has gone into the design of the tasks for participants. Special care has been given to developing questions that require the active use of Internet, and facilitate extensive co-operation of group members. This deliberate design opens up the possibility of meta-learning, i.e. changed knowledge regarding online group work. And it is interesting to find out that the students, in general terms, are grading their improvements higher in these areas. Almost half of the respondents (44,7 percent) graded their improvement as high as 5 (on the 5-point scale) and another 34,2 percent graded the improvement as high as 4. Additionally, when participants are asked if the seminar should be offered in the future, 68% of respondents have rated this response with a 5.

Conclusions

We have investigated several aspects related to creating a socially constructed course design model. We have also reflected on, and asked if teachers and learners are flexible enough to adapt to these innovative forms of education. Active learning needs to be encouraged and facilitated through supportive design. This design needs to have structure and clearly demarcated support, the learner, especially within the current education system, cannot solely construct it. But there need to be guidance for teachers as well in order to get acquainted with and used to new methods and attitudes of learning.

The future of learning is still to be found by exploring the connection between organisation and collaboration. Organisation will be facilitated through carefully constructed collaboration. There are still questions to be answered. How are media selections for communications viewed and preferred by participants – and why? The research related to administrative functions is sparse. Collaboration needs to be organised on three levels: institutional, conceptual, and on an individual level. Investments of time, money, and effort need to be considered.

As we consider the Online Seminar several things have become apparent to the team in the design, development and delivery of this course. Current work and research has been based on face-to-face instruction, we are only just beginning to compile information and experience for virtual learning environments. Adapting pedagogy from face to face instruction to virtual environments is first step in the emergence of a pedagogy that is rooted in VLE's. For example, research in computer-mediated discussion in quasi-synchronous environments has found that the learner assumptions and interpretations are very different in a VLE because their assumptions and interpretations are based on face-to-face interactions. Continued efforts and investigations will help refine the research process.

The courses within this collaborative learning environment demonstrate that there is no need to discuss whether there will be a future for teacher's profession competing with online courses. The concept of this environment foresees a very active role of the teacher as an organiser, mentor and/or moderator. But there are still strides to be made in the research on applying effective methods for teaching in collaborative learning environments.

What has the Online Seminar accomplished so far? It is believed that progress to date has produced a very good test bed for investigation of the following aspects: the organisational methods for this kind of activity, methods of training teachers in online teaching, and how to use available resources more effectively.

References

Berg, G. (1999). Community in Distance Learning through virtual teams. *Educational Technology Review.* Autum/Winter 1999, No 12 (pp22-30).

Cunningham et al. (1993). Cunningham, D., Duffy, T.M. & Knuth, R. Textbooks of the future. In McKnigth, C. (ed) *Hypertext: A psychological perspective.* Ellis Horwood Publishing, London.

Feuerstein et. al. (1980).Feuerstein, R., & Jensen, M.R. Instrumental enrichment: Theoretical basis, goals, and instruments. *The Educational Forum*, 46, 401-423.

Harasim et al (1995). Harasim, L., Hiltz, R., Teles, L., & Turoff, M. *Learning Networks: A Field Guide to Teaching & Learning Online.* Cambridge, MA: MIT Press.

Hermes, L. (2000). What do students learn in groups? Assessment of quality in higher education. *International Journal: Continuos Improvement Monitor.* 1:4, December 1999

McGreal, R. (1998). Integrated Distributed Learning Environments (IDLEs) on the Internet: A Survey. *Educational Technology Review*, Spring/Summer, 9, (pp 25-31).

Slavin, R.E. (1987). *Cooperative learning and the cooperative school.* Educatinal Leadership, 45(3), 7-13

Vygotsky, L.S. (1978). *Mind in society.* M.Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.). Cambridge, MA: Harvard University Press.

Vygotsky, L.S. (1986). *Thought and language* (rev. ed.). A Kozulin (Ed.). Cambridge, MA: The MIT Press.

Wilson, B. (1996). What is a Constructivist Learning Environment? In: Wilson, B. (ed) *Constructivist Learning Environments: Case studies in instructional design.* Educational Technologies Publications, 3-8.

Xiadong, et.al. (1995). Instructional design and development of learning Communities: An invitation to a dialogue. In Wilson, B. (ed) *Constructivist Learning Environments: Case studies in instructional design.* Educational, Englewood Cliffs, New Jersey. (pp 203-222).

Flaming, Banter, And Bonding: Understanding The Rhetoric Of Electronic Groups

Rae C. Schipke
Department of English
Central Connecticut State University
Schipker@ccsu.edu

Abstract: This paper, discusses group process and development from the perspective of language use in the networked interactive writing context over time. It asserts that cohesion is a significant factor in group development and that the degree of peer pressure in the form of "writing behaviors" is very strong at the beginning of a group but lessens over time to bring about a cohesive functioning of that group. It begins with a definition of what a small group is, continues with an overview of the research on classrooms, socio-psychological environments, and computer-mediated versus face-to-face groups. It provides an overview of several applicable models in the group development literature as a conceptual framework for studying how students communicate in electronic groups, and concludes with suggestions for needed research on electronic groups.

Introduction

The advantages of working together for common benefits are often unmistakable. Collaboration allows students to combine intellectual expertise and material resources to accomplish a project or task of mutual interest (Kraut, Egido, and Galegher 1990). It also allows them to undertake problems that they are incapable of working on alone because of limitations, resources, and time. When students work together on electronic networks, teachers need to view communication and development as part of a larger phenomena--small group process. To successfully manage electronic groups, teachers need to understand both the nature of the electronic classroom context and the behavior of the students in it. It is through the language-based dynamics and variables that are at work in these contexts that teachers can become aware (1) that language use in the form of "writing behavior" reflects the process of group development in electronic group situations and (2) that time and peer pressure are two key factors which seem to directly affect the development of the electronic group. This understanding will require considerble study.

The Small Group

The term small group applies to both face-to-face and electronic groups. A small group is usually considered small if it has 2-30 members. However, even larger groups can have small group characteristics. What differentiates a collection of individuals from a group is that "group members (1) have shared values that maintain an overall pattern of activity, (2) acquire or develop resources or skills to be used in their activity, (3) conform to norms that define roles to be played and have a sufficient level of morale to provide 'cohesiveness,' and (4) have a specific goal with the coordination, usually through leadership, to combine the resources and the roles to accomplish the goal" (Hare, Blumberg, Davies, Kent, 1996). Most group members also need time to develop intimacy.

The Nature of Classrooms

Like networked environments, regular classrooms are very unique environments for learning in their own right. Doyle (1986) in his work on classroom management and organization, notes that there are six features that make any classroom a unique environment of its own. These features are:

1. Multi-dimensionality -- many different events and tasks occurring
2. Simultaneity -- many things are happening at the same time

3. Immediacy -- events are taking place at a rapid pace
4. Unpredictability -- events are taking unexpected turns
5. Publicness -- events are witnessed by many
6. History -- classes develop their own past--early events shape subsequent actions

In a sense, then, any classroom is a highly complex and potentially unstable environment. This is even more true of the computer classroom, for when we add network technology, we create even more complex types of social forums. On electronic networks students can enter a group, experience group process dynamics, and engage in social discourse without ever having encountered another human being in face-to-face interaction. Given the complexity and unpredictability of such classroom environments, the teacher understandably is going to be concerned primarily with classroom (or network) management--taking the necessary steps to ensure that the students are both attentive and not disruptive. Leadership and management skills, then, take on a whole new dimension in these classrooms, as do the underlying social philosophies and pedagogies.

Classroom Environments: The Research on Socio-Psychological Environments

If most classrooms provide highly complex and potentially unstable environments, requiring such management skills, there would be benefit in knowing what factors suggested in the literature contribute to a more simple and stable environment for students. The research on socio-psychological environments suggests that the socio-psychological environment, for example, correlates highly with both student attitudinal and achievement outcomes. Hattie, et al. (1987), who looked into perceptions of students' preferred learning environments, concluded that students preferred environments that provide more teacher friendliness, less competition, and greater cohesiveness. A research synthesis by Haertel et al. (1981) found that improved achievement was present in classes where there was greater satisfaction, more goal direction, less disorganization and friction, and greater cohesiveness. Moos (1980), who evaluated 200 classrooms using the Classroom Environment Scale (CES)(Moos and Tricket, 1974) concluded among other findings that classrooms that combined warm supportive relationships with a focus on academic tasks and accomplishments in well structured surroundings tended to lead to a gain in achievement and led to personal and creative growth as well (see Figure 1). What is suggested by the findings of this research is the general importance of the socio-psychological environment in student learning and a general consensus that an effective environment addresses both student perceptions and results in better achievement.

Supportive relationships
+ Well Structured Surroundings
= Achievement, Personal Growth & Creative Growth

Figure 1: Components of an effective learning environment.

Networked Environments: The Research on Computer-Mediated and Face-To-Face Groups

While classroom environments solely involve face-to-face interactions between and among students and the teacher in the classroom, computer-mediated groups in networked environments (with the exception of classroom-based LAN's), have primarily electronic interactions. In addition to the research on socio-psychological environments, there are findings in the research on computer-mediated and face-to-face groups which suggest the highly complex potentially unstable nature of the electronic environment (see Figure 2). For example, studies using small experimental groups of variable duration found that computer-mediated groups had a more equal participation rate (Easton et al.; Hiltz, Johnson and Turoff 1986; Siegel et al. 1986) and took longer to reach consensus (Gallupe et al. 1991, Siegel et al. 1986) than face-to-face groups. They also found that computer-mediated groups engaged in more inflammatory communication (Siegel et al. 1986), task-oriented behavior (Hiltz et al. 1986), and socio-emotional communication (Hollinshead, McGrath and O'Connor 1993). The lack of consistency in these findings in terms of task and communication variances can be explained in Walther and Burgoon's (1992) research which found an interaction effect of social behaviors and task orientation. They found that in extended time asynchronous computer interactions, computer-mediated groups became less inflammatory, less task oriented, and more social.

Findings compared to Face-To-Face:	Over Time
more equal participation rate	no comparison
more time to reach consensus	no comparison
more inflammatory communication	lessened
more task oriented behavior	lessened
more socio-emotional behavior	increased

Figure 2: Research findings on face-to-face and computer-mediated groups.

The Common Ground

What is apparent from these findings on both classroom environments and computer-mediated versus face-to-face groups is that communication is at the heart of any group situation, whether it is a traditional classroom or an electronic group, particularly as it relates to the human intimacy in the interaction. What is also apparent is that all types of social interaction are an attempt by participants to 'fit in', much in the same way that teenagers attempt to fit into the peer group. According to communication theorists, all behavior is communication and all effective communication requires a shared culture. If cohesion is a consistent outcome in student perception of what constitutes an effective environment as well as in achievement ("a shared culture"), then time will play a significant role in achieving cohesion. If behavior is communication, then the students' writing will reflect that behavior. Lastly, if peer pressure influences behavior, it also makes sense that students' "writing" behavior will change over time in the electronic group context.

Working Within Established Models and Formulations on Group Development

Face-to-face group development research suggests that groups do, indeed, move through stages associated with specific turning points in group activity. Many researchers, for example follow the formulation of Tuckman (1965). Farrell, Heinemann, and Schmitt (1986) following the formulation of Tuckman, distinguish four phases which identify the change in salience of roles. In phase one, referred to as testing and dependency, group members are uncertain by what is entailed in group membership and what is to be gained by it, while at the same time trying to gain some sort of orientation and guidance. In phase two, or conflict, there is a great deal of polarization and conflict, which is followed in phase three, known as cohesion and consensus, by members beginning to trust one another and to master work demands. In phase four, referred to as functional role relatedness, group members have achieved a structure and culture for the group and fully cooperate on tasks.

Robbins (1993), also proposed a model using the terminology of Tuckman (1965) and also the theoretical underpinnings of Gersick, whose work addressed the factor of time. Tuckman's stages of development include (1) forming, (2) norming, (3) storming, (4) performing, (5) and adjourning, and according to Gersick (1988,1989), group development is underscored by periods of inertia and highlighted by periods of change. The model proposed by Robbins, therefore, addresssed both the sequential and cyclical aspects of Tuckman and Gersick and had five stages which included (1) forming and norming, (2) low performing, (3) storming, (4) high performing, (5) and adjourning. (see Figure 3)

Tuckman

FORMING
NORMING
STORMING
PERFORMING

ADJOURNING

Farrell, Heinemen, Schmitt	**Robbins**
PHASE ONE: Testing and Dependency	FORMING AND NORMING
	LOW PERFORMING
PHASE TWO: Conflict	STORMING
PHASE THREE: Cohesion and Consensus	HIGH PERFORMING
PHASE FOUR: Functional Role Relatedness	ADJOURNING

Figure 3: A Comparison of Group Development models (Tuckman, Farrell et. al., and Robbins).

Srivastva, Obert, and Nielsen (1977) offer another valuable perspective on group development by presenting their five stages both in terms of the structural issues and in terms of the basic issues that are being dealt with by the group (see Figure 4). They suggest that group members move from wanting inclusion, to dealing with influence, finally arriving at intimacy.

Stage	Structure of Group	Basic Issues
1	Each person for him or herself	inclusion
2	Dyadic relationship	inclusion--> influence
3	Coalition and clique formation	influence
4	Spread effect (enlarging membership to entire group)	influence--> intimacy
5	Goal-directed task group formation	intimacy

Figure 4: Group development from both a structual and basic issues perspective.

Needed Research

Each of the previously discussed models, focuses on various factors in group development. They suggest as did the literature on socio-psychological environments and computer-mediated groups the central importance of communication and time in the group development process and the important role communication and time play in lessening peer pressure and thus creating cohesion in groups. However, social understanding of student behavior will only come with the study of the interactions of students within smaller communities such as the classroom (face-to-face) or within the shared culture of a small electronic "peer" group. One study which began to address this need, Schipke (1992), summarized the characteristics of student writing behavior and language use over time on a computer network. Based on a review of electronic transcripts and data it was found that when the group lacked cohesion and peer pressure was strong students engaged in unproductive writing behavior and language use. When group cohesion was attained after a period of time, peer pressure lessened and students began exhibiting more positive and productive writing behavior and language use. These findings applied to the revelation of thoughts and ideas; to response time, length, correctness, direction and focus; and to language choice and use (see Figures 5 and 6 for a presentation of the specific characteristics in the context of the Farrell et al. and the Robbins models respectively).

Conclusion

Understanding what transpires in electronic groups will take considerable investigation. The literature suggests that such investigation will need to be conducted over time to understand the growing pains of the electronic group through the kinds of communication taking place in that context. It also indicates the importance of such factors as cohesion, peer pressure, and writing behavior in furthering our understanding. These aspects will be important, but will only be a small piece of the research understanding necessary to teach effectively using electronic groups. Understanding will also require the study of assorted types and sizes of groups, different technological platforms, diverse communication processes, various roles and behavior, group tasks, group functions, socio-emotional variables, and comparisons to face-to-face and/or classroom contexts, just to name a few. However, these kinds of longitudinal observations can reveal valuable insights into effective pedagogy and management for the electronic instructional context.

PHASE ONE: Testing and Dependency

Self-conscious about revealing their thoughts and ideas
Lag time in response to posted comments
Express themselves using brief comments or short sentences
Overly concerned with grammatical or spelling errors
Discussions seem chaotic and undirected
    Lack focus and commitment
Tend to play using language

PHASE TWO: Conflict

Engage in grandstanding behaviors through
    Disruptive comments
    Obscenities
    Iconoclastic use of language

PHASE THREE: Cohesion and Consensus

Enthusiastic and willing to share thoughts and ideas
Quick response time to posted comments
    A more fluid dialogue tempo is maintained
Write longer, more reflective comments
Less concerned with surface errors/more concerned with expressing their
    ideas correctly
Discussions and interactions appear to have direction and purpose
Tend toward playful use of language/compete for originality of content and form

PHASE FOUR: Functional Role Relatedness

Engage in group and task maintenance procedures through
    Supportive and focused comments, Constructive criticisms,Suggestions
Engage in Closure through
    Ending comments including reflections, congratulations, goodbyes.

* Identifies the four phases in group development (farrell et. al) following the formulation of Tuckman (1965), and notes the language behaviors (Schipke 1982) that are prominent during each phase.

Figure 5: Group development from the perspective of student writing behavior over time In the context of Farrell et al.'s four categories.

FORMING AND NORMING:

Self-conscious about revealing their thoughts and ideas
Lag time in response to posted comments

LOW PERFORMING:

Express themselves using brief comments or short sentences
Overly concerned with grammatical or spelling errors
Discussions seem chaotic and undirected
    Lack focus and commitment
    Tend to play using language

STORMING:

Engage in grandstanding behaviors through
    Disruptive comments
    Obscenities
    Iconoclastic use of language

HIGH PERFORMING:

Enthusiastic and willing to share thoughts and ideas
Quick response time to posted comments
A more fluid dialogue tempo is maintained
Write longer, more reflective comments
Less concerned with surface errors/more concerned with expressing their ideas correctly
Discussions and interactions appear to have direction and purpose
Tend toward playful use of language/compete for originality of content and form
Engage in group and task maintenance procedures through
Supportive and focused comments, Constructive criticisms, Suggestions

ADJOURNING:

Engage in Closure through
Ending comments including reflections, congratulations, and goodbyes.

* Identifies the Five Stages in group development (Robbins 1993) who used the terminology Tuckman (1965) and the theoretical underpinnings of Gersick (1988, 1989), and notes the language behaviors (Schipke 1982) that are prominent during each phase.

Figure 6: Group development from the perspective of student writing behavior over time in the context of Robbins' five stages.

References

Doyle, W. (1986). Classroom management. In M.C. Wittrock (ed.), Handbook of research on teaching (3rd Ed.) (pp.392-431). New York: MacMillan.

Easton, G., George, J., Nunamaker, J. & Prendergast,M.(1990). Using two different electronic meeting system tools for the same task: An experimental comparison.
Journal of Management Information Systems, 7(1), 85-100.

Farrell, M.P., Heinemann, G.D., & Schmitt, M.H. (1986). Informal roles, rituals, and styles of humor in interdisciplinary healthcare teams: Their relationship to stages of group development. International Journal of Small Group Research, 2, 142-162.

Gallupe, R.B., Bastianutti, L.M., and Cooper, W.H. (1991). Unblocking brainstorms. Journal of Applied Psychology, 76(1), 137-142.

Gersick, C.J.K., (1988).Time and transition in work teams: Towards a new model of group development. Academy of Management Journal, 31(1), 9-41.

Gersick, C.J.K., (1989). Marking time: Predictable transitions in task groups. Academy of Management Journal, 32(2),274-309.

Haertel, G.D., Walberg, H.J.,and Haertel, E.H.(1981). Socio-sychological environments and learning: A quantitative synthesis. British educational Research, 22, 27-32.

Hare, A.P., Blumberg, H.H., Davies, M.F., and Kent, M.V. (1996). Small groups an introduction, Westport, CT: Praeger, p. 182.

Hattie, J.A., Byrne, D.B., and Fraser, B.J. (1987). Research into students'perceptions of preferred learning environment. In B.J. Fraser (ed.) The study of learning environments (Vol. 2) (pp.80-89).

Hiltz, S.R., Johnson, K., amd Turoff, M. (1986). Experiments in group decision making1: Communications process and outcome in face-to-face vs computerized converneces, Human Communication Research, 13(2), 225-252.

Hollingshead, A.B., McGrath, J.E., and O'Connor, K.M. (1993). Group task performance and communication technology: A longitudinal study of computer-mediated vs face-to-face work groups, Small Group Research, 24(3), 307-333.

Kraut, R.E., Egido, c., and and Galegher, J. (1990). Patterns of contact in scientific research collaboration. In J. Galegher, R.e. Kraut and C. Egido (eds.) Intellectual Teamwork: Social and Technological Foundations of Cooperative Work, Hillsdale, NJ: Lawrence Earlbaum, pp. 149-171.

Moos, R.H. (1980). Evaluating classroom learning environments. Studies in Educational Evaluation, 6, 239-252.

Moos, R.H., and Tricket, E.J. (1974). Classroom Environment Scale Manual. Palo Alto, CA: Consulting Psychologists Press.

Schipke, R.C. (1992). Frontiers in computers and writing. In C. Pickover (ed.) Visions of the Future: Art, Computing, and Technolgy in the 21st Century. London: Science and Technology Letters.

Tuckman, B.W., (1965). Developmental sequence in small groups, Psychological Bulletin, 384-399.

Walther, J.B., and Burgoon, J.K., (1992). Relational communication in computer-mediated interaction. Human Communication Research, 19(1), 50-58.

Building and Transforming Educational Web Sites with SATIRIC and Contextual Patterns

Jared Seaman, Vivek Venugopal, and Samuel A. Rebelsky
Glimmer: The Grinnell Laboratory for Interactive Multimedia Experimentation and Research
Department of Mathematics and Computer Science
Grinnell College
United States
rebelsky@grinnell.edu

Abstract: As faculty and institutions continue to adopt the World Wide Web for delivering course materials, they are encountering a host of related problems. Institutions must from everyone from novice users to faculty who want to go beyond the normal capabilities of HTML. Sites must often brand themselves with a uniform "look and feel" and also support easy updates to that look and feel. Sites must also support some form-based page generation.

In this paper, we discuss SATIRIC (Site Authoring Tool Incorporating Regular Expression In Context), a pattern-based translation language developed to support these and other activities. We argue that a pattern language is an appropriate solution for many tasks. Novices can write text files and use preferred shorthands; the transformation language can turn those shorthands into HTML, XHTML, or XML. Experts can write new tags and define transformations from those tags. Institutions can define standard page templates and transformations that convert inputs to those templates. For a new look and feel, they can just change the templates.

1. Introduction

Web authoring once was fairly simple: those who wanted to use the Web created a few pages a favorite authoring tool (or "raw HTML") and put it on the Web. The enormous growth of the Web has changed everything, particularly in academia. Institutions must now worry about supporting a wide range of page authors, from faculty reluctant to going online to faculty eager to adopt every new technologies. Similarly, the movement toward sites containing thousands of pages has led many to brand sites through uniform designs.

Unfortunately, support for these different issues is often handled in a somewhat ad-hoc method, often leading to contradictions. For example, novice faculty are often trained in simple packages (often PageMill or "save as HTML" in newer versions of Microsoft Word). But neither PageMill nor Word's save as feature make it easy for novice authors to adhere to a site style. (Thimbleby 1997) has suggested that we can support uniform site styles through *templates plus variables*. That is, we can extract information about a page (author, body, title, etc.) and then reflow that information into a template that provides the site style.

But this is not the only way to transform pages to meet stylistic needs. Pattern-based page transformation languages (e.g., (Rebelsky and de Beer 1998) can permit site designers to specify standard changes to pages, such as "change all body tags so that documents use the following colors and fonts" or "change all list items to use filled circles". By careful design of rules, it is possible to automate most important aspects of site design.

In this paper, we describe a particular pattern-based page transformation language, SATIRIC, the Site Authoring Tool Incorporating Regular Expressions in Context. Unlike general-purpose pattern-based languages, such as Perl and Awk, SATIRIC is designed specifically for developing and transforming formatted text. SATIRIC supports rich patterns through the use of regular expressions. It adds power to these patterns through the use of variables and by permitting regular expressions to be applied in only certain contexts.

SATIRIC is designed so that a wide variety of users can easily write rules. Typically, authors will describe their general intent and programmers will develop the rules to meet that intent. However, we are developing a user interface that permits authors to write English-like text to describe their rules. For example, someone might write that "A blank line signals the end of a paragraph" or "At the start of a section, increment the heading level and generate an appropriate heading tag; at the end of a section, decrement the heading level".

In Section 2, we introduce the contextual patterns of SATIRIC through a number of related examples. In Section 3, we delve more deeply into regular expressions, which serve as the patterns for SATIRIC. In Section 4, we describe the architecture of SATIRIC and the SATIRIC assembly language. In Section 5, we suggest applications of SATIRIC for advanced HTML authors. In Section 6, we discuss future directions for SATIRIC.

2. Supporting Novice Authors and Plain Text Authors

As institutions are moving toward online course delivery and support, they are finding it necessary to support faculty who are less comfortable with computers than early Web adopters. Some of these faculty don't see a purpose to Web-based delivery, and those faculty are a special problem. Others are interesting in going online, but don't have the time or energy to devote to learning a new computer program, even one as simple as PageMill or FrontPage. While it is possible for such faculty to use a favorite word processor and export as HTML, the resultant HTML is often unsatisfactory to both faculty member and site designer.

However, experience shows that most faculty (and most writers), use "shorthands" to indicate common typographical issues. Consider the sample text in (Fig. 1), which one might type in plain text to describe the formatted text in (Fig. 2). In (Fig. 1), a blank line indicates the end of a paragraph, an asterisk at the start of the line indicates a list item, text surrounded by underscores is emphasized, text in brackets is a link (to a bibliography entry), indented text is a quotation, the underscore indicates a subscript, the caret indicates a superscript, and so on. The first goal of SATIRIC and its predecessor, SiteWeaver/SH (Rebelsky and de Beer 1998) is to support the transformation of such shorthands to HTML or other markup language.

```
In our analysis of [Jones 1998], we found that it is trivial to improve
his algorithm from O(n^2) to O(n log_2 n), using a simple *divide and
conquer* strategy.  Jones writes,

  The algorithm must visit each element of the collection, one-by-one.
  Although a few elements need not be visited, because they are
  Irrelevant, the number of visitations in one round is clearly O(n).

However, we have found that it is possible to preprocess the data with
the following strategy:
* Select a _separator_
* Divide the collection into two equal halves using that separator
* Recurse on the two halves
```

Figure 1: Shorthands in plain text.

In our analysis of [Jones 1998], we found that it is trivial to improve his algorithm from O(n^2) to O($n\log_2 n$), using a simple *divide and conquer* strategy. Jones writes,

> The algorithm must visit each element of the collection, one-by-one. Although a few elements need not be visited, because they are irrelevant, the number of visitations in one round is clearly O(n).

However, we have found that it is possible to preprocess the data with the following strategy:

- Select a **separator**
- Divide the collection into two equal halves using that separator
- Recurse on the two halves

Figure 2: The same text, reformatted.

How do we translate these shorthands into HTML? We need patterns to describe the various shorthands. For example, in the standard *regular expression* notation, `^\*` represents "an asterisk at the start of the line" and `\n\n` represents "a blank line". Yet these patterns are not enough. Observe that the *context* of a pattern has some effect on the application. For example, any blank line you encounter signifies the end of a paragraph, *as long as you are in a paragraph*. Similarly, an underscore has two possible meanings: emphasis or subscript. How can we tell which the author means? Typically, through the context. For example, if the underscore is used as part of a mathematical formula, it is likely to be a subscript. (Fig. 3) shows the translation of the original text to HTML.

```
<p>In our analysis of [<a href="jones1998" class="cite">Jones
1998</a>], we found that it is trivial to improve his algorithm from
<span class="formula">O(<i class="var">n</i><sup>2</sup>)</span> to
<span class="formula">O(<i class="var">n</i>log<sub>2</sub><i
class="var">n</i>)</span>,  using a simple <em>divide and conquer</em>
strategy.  Jones writes,</p>
<blockquote><p>
  The algorithm must visit each element of the collection, one-by-one.
  Although a few elements need not be visited, because they are
  irrelevant, the number of visitations in one round is clearly
  <span class="formula">O(<i class="var">n</i>)</span>.
</p></blockquote>
<p>However, we have found that it is possible to preprocess
the data with the following strategy:</p>
<ul>
<li>Select a <strong>separator</strong></li>
<li>Divide the collection into two equal halves using that
separator</li>
<li>Recurse on the two halves</li>
</ul>
```

Figure 3. The HTML for (Fig. 2), created by SATIRIC from (Fig. 1).

The use of shorthands is common enough that major applications, such as Microsoft word, now include a small set of specified rules (such as the rule that an asterisk at the start of the line indicates a list item). However, authors cannot design their own shorthands; while they can use any shorthands they wish, they cannot make Word acknowledge them. By allowing authors (or their support staff) to write patterns, we allow each writer to design his or her own shorthands, or a group of authors to agree on a common set of shorthands.

Recent events on the Web suggest another important use for shorthands. There is a growing tendency to build new pages from input given on forms. For example, a student might submit short notes on a form, or add annotations to a page using a form. Unfortunately, malicious users have now targeted form-based authoring; such users add inappropriate scripts and links to pages (CERT 2000). This is because most form-based authoring systems take the form text "as is", allowing it to include HTML markup for more advanced authors. (CERT 2000) recommends checking for particular tags (e.g., script, applet, and form) and eliminating those tags. However, this strategy requires that site authors update their "disallowed tags" regularly as malicious users find new techniques. A better strategy is to disallow any HTML in forms. Instead, authors can use a shorthand like that given above.

The EdMedia 2000 submission process suggests a similar reason that shorthands are useful. Authors were required to submit only plain text files. Given that most authors are now accustomed to using formatting to highlight semantic intent (e.g., italicizing emphasized words) it is difficult and inappropriate to return to plain text. A set of common SATIRIC rules would allow authors to mark their plain text in such a way that referees can easily read formatted text.

We have used similar techniques to mark up text for a composition course. One of the lessons that students need to learn is to associate nouns with the actors in a sentence and verbs with the actions of those actors. SATIRIC permits us to mark the sentence once, using convenient shorthand (e.g., asterisks around verbs, brackets around actors) and then format it in different ways for presentation to students.

3. The Power of Regular Expressions

As (Sect. 2) suggests, we have chosen to use regular expressions for our patterns and then add a context to those expressions. Why regular expressions? Because regular expressions are a powerful but fast way to describe many different kinds of patterns. In particular, regular expressions support

- *Alternation*: Match "this pattern or that pattern". Takes the form `(this)|(that)`.
- *Sets*: Match "any one of these characters" or "any character between this character and that character". Takes forms like `[aeiou]` (any vowel) or `[a-z]` (any lowercase letter).
- *Elimination*: Match "anything but this character". Takes the form `[^c]`.

- *Sequencing*: Match "this and then that". Takes the form `(this)(that)`.
- *Wildcard repetition*: Match "as many copies of this pattern as you can". Takes the form `(this)*`.
- *Special characters*: Match "beginning of line" or "end of line" or "whitespace" or ....

Regular expressions have been used for a variety of different applications, from improved search and replace in BBEdit (Bare Bones 1999) to the sophisticated analysis of student hypertext use logs (Jones and Jones 1997).

But regular expressions cannot match all of the common patterns. Hence, we increase the power of regular expression by adding contexts to the patterns. This addition makes it easier and more natural to express many common patterns. For example, while a blank line typically indicates an end of paragraph, a blank line in a preformatted section should be left as is. Context also extends the computational power of the language.

In some cases, rules will need to keep track of what has been seen before (e.g., the title of the document) and use that value. We include rules that incorporate variables similar to those used in most programming languages. Rules can get and set variables, append to variables, and increment and decrement variables.

At first glance, typical regular expressions are difficult for human beings to read, although they are easy for computers to parse. Some describe complex regular expressions as "write only" in that you never modify a regular expression because it is too hard to figure out what is going on inside. However, it is also fairly easy to turn common English pattern descriptions into regular expressions. A current project is to identify common pattern utterances and write patterns to transform those utterances into regular expressions.

Let us consider a few examples of the relationship between English text and the corresponding regular expression. The pattern utterance "a body tag" can be represented as the regular expression `<[Bb][Oo][Dd][Yy]([^>]*)>`. This pattern matches text that begins with a less-than sign, then either B or b, then O or o, then D or d, then Y or y. Finally, there are an arbitrary number of non-greater-than signs (representing optional parameters), followed by a greater than sign. Other tags can be handled similarly. The utterance "text surrounded by asterisks" can be represented as the regular expression `\*[^\*]*\*`. The asterisks prefaced by slashes represent "just an asterisk". The asterisk without a prior backslash represents "as many copies of the prior thing as you can". Hence, this pattern is "an asterisk, followed by as many non-asterisks as you want, followed by an asterisk".

4. Architecture

Given a source file and a set of patterns, SATIRIC builds an HTML file using the steps (Fig. 4) illustrates. First, the English-language rules (typically entered in a Web page) are converted to high-level rules. The high-level patterns are then translated into simpler rules. Finally, the rules are applied to the file.

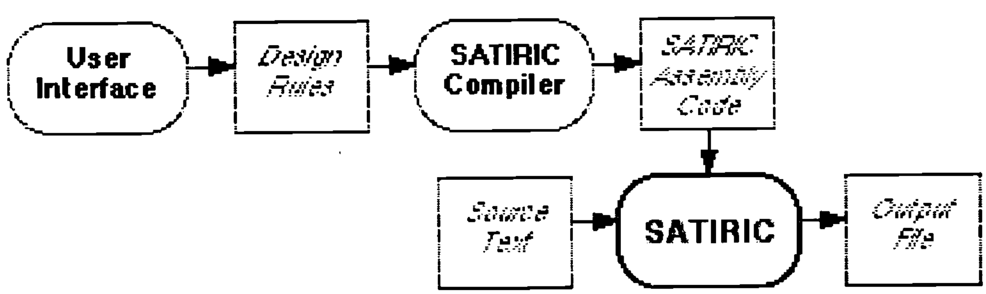


Figure 4: The Components of SATIRIC

What is a SATIRIC assembly program? It is a collection of simplified rules. These simplified rules provide all the power of the higher-level design rules, but are easier to implement quickly. There are a small number of assembly rules. Each rule has a pattern, an optional context, and a corresponding action. The basic SATIRIC assembly rules appear in (Fig. 5). Note that these differ slightly from the currently implemented version, which handles context in a different manner.

Replace:	Generate replacement text
Enhanced Replace:	Generate replacement text that may include part of the text as well as variables

Load Text:	Load replacement text from a file
Set:	Set the value of a variable
Update:	Update the value of a variable (increment, decrement, append to, etc.)
Apply:	Apply a set of rules (stored in a separate file) to a piece of text
Load Rules:	Load and begin to apply rules from a rules file
Start Context:	Start a particular context
End Context:	End a particular context
Close:	HTML-specific; close all open tags up to a particular tag

Figure 5: SATIRIC assembly code instructions.

The rules fall into a number of different groups. The first three types of rules (Replace, Enhanced Replace, and Load text) all generate replacement text for the matched text. The next two (Set, Update) modify the values of variables. There is no corresponding Get operation because variables can be used in replace and enhanced replace. The next four instructions provide control over the operation of SATIRIC, limiting the operation of rules with contexts and adding rules to the current rule set. The final operation is HTML-specific and was added to help support better HTML authoring; when authors close a tag, they can use this operation to ensure that all intervening tags are closed.

As this description suggests, the language includes rules to start and end contexts. In a related language (Rebelsky and de Beer 1998), HTML tags determine context. In that language each start tag begins a context and each end tag ends it. The new design possible to use a variety of different mechanisms for denoting contexts. However, we still typically use HTML tags to indicate contexts.

These rules are not applied to the whole file at once. Rather, the file is separated into smaller *chunks* and each chunk is processed in turn, as (Fig. 6) shows. The technique used to "chunkify" the file depends on the type of the input file. HTML files are typically split at each tag. In a future implementation, we anticipate providing rules that affect the technique used, so that different parts can be chunkified differently.

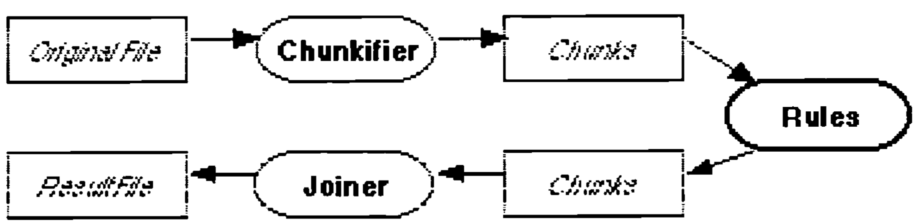


Figure 6: Inside SATIRIC.

5. Supporting Advanced Authoring

A key part of this design is that the source file need not be a plain text file. The transformations can be equally well applied to existing HTML files, and we have successfully used SATIRIC to reformat such files to add functionality. Typically, new tags provide this functionality. For example, we have used a version of SATIRIC to support footnote, tables of contents, and section tags. It is easiest to understand their implementation in the higher-level design language, which is less repetitious than the corresponding assembly language.

A rule for the footnote tag (or, more precisely, the end-footnote tag) does three basic steps. It increments the `footnum` variable. It appends an anchor and the footnote text to the footnote variable. Finally, it replaces that text in the main body with a link to the footnote, using `footnum`. How do we get footnotes? A rule for the end-body tag says to insert the footnote variable. Other special tags are implemented similarly.

While the current implementation of SATIRIC is targeted toward HTML, we have also used SATIRIC in selected experimental situations for other purposes. For example, we have used an early version of SATIRIC to turn text files into Microsoft Word RTF files. In this case, we can use the same patterns as we would with HTML, but write different result texts. For example, instead of "given text surrounded by underscores, generate the same text surrounded by `<i>` and `</i>`", we might write "given text surrounded by underscores, generate the same text surrounded by `{\i` and `}"`. Writing such rules requires some understanding of the output markup language, but the rules only need to be written once and then applied to as many files as are available.

SATIRIC is also being used within Web Raveler (Kensler and Rebelsky 2000) to provide a simple mechanism for transforming pages. Web Raveler permits readers to specify modifications to Web pages that should be applied before the pages are sent to the browser. The modifications include filtering of images and adding of interactive facilities. One such facility, Blazer (Glynn et al. 2000), allows faculty to create annotated *trails* on the Web. SATIRIC is being used for the annotations.

SATIRIC is also appropriate for transforming existing pages to meet new stylistic guidelines. Such transformations will typically be used with individual tags, although more complex changes are possible.

6. Summary

A number of common Web applications require Web authors and Web designers to convert existing files, from plain text files to existing Web pages. SATIRIC, our pattern-based page transformation language, supports a wide variety of transformations. SATIRIC has already been used for a number of simple but useful applications, from providing a shorthand for authors to supporting special features, including footnotes, on Web pages.

7. References

Bare Bones Software (1999). BBEdit 5.1. Computer software.

CERT (1999). Malicious HTML Tags Embedded in Client We Request. CERT® Advisory CA-2000-02. Pittsburgh, PA: CERT Coordination Center.

Glynn, C., Luebke, S., Heck, R., Ma, W., Mason, H., Nichols, E., Raulerson, E., Staicut, I., and Rebelsky, S. (2000). Blazing Trails on the World-Wide Web. In *Proceedings of the EdMedia 2000 World Conference on Educational Multimedia*. Charlottesville, VA: Association for the Advancement of Computing in Education.

Jones, T. and Jones, M. (1997). MacSQUEAL: A Tool for Exploration of Hypermedia Log File Sequences . In *Proceedings of Ed-Media 1997 World Conference on Multimedia and Hypermedia in Education*. Charlottesville, VA: Association for the Advancement of Computing in Education.

Kensler, A., and Rebelsky, S. A. (2000). Web Raveler: An Infrastructure for Transforming Hypermedia. *Proceedings of the EdMedia 2000 World Conference on Educational Multimedia*. Charlottesville, VA: Association for the Advancement of Computing in Education.

Rebelsky, S. A. and de Beer, C. (1998). A Customizable Shorthand System for Hypertext Authoring. In H. Maurer and R. G. Olson (Eds.) Proceedings of the WebNet '98 World Conference of the WWW, Internet, and Intranet (Orlando, Florida, November 7-12, 1998), pp. 744-749. Charlottesville, VA: AACE, 1998.

Thimbleby, H. (1997). Gentler: A Tool for Systematic Web Authoring. *International Journal of Human-Computer Studies.*

Acknowledgements

This work was supported, in part, by Grinnell College, the Grinnell College Capstone fund, and the Robert Noyce faculty study grant. We are also particularly grateful to our colleagues in Glimmer, the Grinnell Laboratory for Interactive Multimedia Experimentation and Research, for their helpful comments. Sarah Luebke, Rachel Heck, and Wayne Twitchell provided particularly valuable feedback.

Developing an Educational Multimedia Digital Library: Content Preparation, Indexing, and Usage

P. P. Semple and R. B. Allen
College of Library and Information Services
University of Maryland, College Park, MD 20742
United States
psemple@wam.umd.edu and rba@glue.umd.edu

A. Rose
Human Computer Interaction Laboratory and UMIACS
University of Maryland, College Park, MD 20742
United States
rose@cs.umd.edu

Abstract: The Maryland Electronic Learning Community (www.learn.umd.edu) is building a multimedia digital library of educational resources. Now in the fourth year of the project, we evaluate early decisions we made about segmenting and indexing videos. We also discuss an experiment in encouraging collaborative community indexing with a Quick Indexing Tool. We conclude that a broader base of users would better support the infrastructure requirements and we propose ways that such a broad base can be developed while also providing a framework for local learning communities. We propose a federated system of collaborative indexing communities.

Introduction

The Maryland Electronic Community (MELC) was designed to investigate how the professional development of teachers could be supported with information technology (Rose et al. 1999). One focus of this project has been the creation, maintenance, and cultivation of a digital library for the teachers to use as they develop interactive lesson plans (ILPs). While the original emphasis was on the needs of social studies and science teachers, in recent months the community has grown to include mathematics and language arts teachers.

The digital library contains over 3,200 multimedia resources, and by August 2000 this number is expected to exceed 6,300. The collection is comprised of text documents, audio files, video segments, still images, and Web sites. There are public domain items from the National Archives and NASA; proprietary items that have been contributed by project partners Discovery Communications and Maryland Public Television; and personal contributions from MELC members themselves. Each resource is identified by a set of standard metadata elements and then indexed according to Topic, Subtopic, and Standard (corresponding to national standards). Efforts at collecting and cataloging these resources was initially the responsibility of the team at the University of Maryland, but this work is gradually being handed off to the teachers as the external project funding ends.

By analyzing the Web logs, we can determined that the following resources as shown in Table 1. We are particularly interested in how the video clips are being used. Currently there are 50 videos in the library: 24 science, 25 social studies, and 1 language arts. Seven of these are in the public domain (from the National Archives and accessible by anyone) and 45 are private (from Discovery Communications, Inc. or Maryland Public Television and accessible only by MELC members). Of the video clips downloaded, only 10 were public domain. The average video clip is about two to three minutes in length and approximately 15 MB. The Web logs show evidence of teachers downloading new videos from the server even before CD-ROMs are available. Putting the clips on the server reduces the time it takes to make the videos available to the teachers since creating and distributing the CD-ROMs is time consuming.

In this paper, we examine issues related to the use and development of the resource collection including:

- the flexibility of digitized video segments (as opposed to full-length film on the VCR),
- appropriate indexing and metadata elements, and
- collaborative indexing and the Quick Indexing Tool (QIT).

Resource Types	Unique Resources Accessed	Total Resources Accessed
Video	158	457
Image	58	110
Web Sites	37	104
Lesson Plans	30	71
Student Activities	10	42
Audio	6	14
Other Libraries	3	4
Text	3	4

Table 1: Resource usage from September 1999 to March 2000.

Segmenting the Videos

While the library contains images, audio, and video, we focus here particularly on the video because it is attractive to students, adds a unique dimension to lesson plans, and is invaluable to visual learners. The full-length educational videos are divided in one- or two-minute segments for a number of reasons. First, we consider the video segments to be building blocks for the teachers as they construct their lessons. Second, our technology was inadequate for the task of managing digitized full-length videos, especially at beginning of the project. A third reason for using segments is that they encourage cross-curriculum tie-ins. For example, "The Real Ben Franklin" is a film about the life of a great American and as a whole is clearly within the purview of the social studies department. However, it includes several fine illustrations of scientific principles and inventions that would be useful in a science class. As a result of the segmenting, science teachers can now use resources that they otherwise might not have been aware of or able to access.

While there has been a great deal of research in computer science on segmenting videos based on scene changes, we felt that truly meaningful units could be obtained only by manual segmentation. Unfortunately, while this kind of segmenting yields useful material, it is very labor intensive, requiring approximately seven minutes of processing for every one minute of video. In order to standardize the process, we have developed a set of guidelines.

As we have teased out the threads of these educational videos (interviews with experts in the field, historical footage, animations, demonstrations, re-enactments, first-person narratives, etc.), we have come to realize many ways that these segments might be re-constructed or regrouped by the teachers. Perhaps they will string together the re-enactments of Singbe Pieh and his fellow Africans aboard the Amistad, or pull out the animated graphics that show how black holes warp time and space. Thus, we try to segment along the different interviews or footage or speakers.

There were times when we chose not to segment the most discrete pieces of information, as when the sum of the whole was greater than the sum of the parts. This was most often when the medium itself, video, was providing something that could not have been captured and conveyed by other media. For example, near the end of the video "The Real Thomas Jefferson," the narrator stands on a balcony in Jefferson's American Room in Monticello. The camera pans around the room and as it passes over the artifacts the narrator briefly identifies them. Important though the images and the identification of these ancient Indian artifacts are, of greater importance is the panoramic view of the room itself. Similarly, we tended to give priority to the video's visual presentation of information over the text or narration that accompanied whatever was happening on the screen. Words can be gleaned from books or audiotapes, moving images come only from video.

We have developed several search tools that allow teachers to view these relatively small and discrete pieces. The most ambitious tool, the Explorer (Rose et al. 1995), gives teachers a visual representation of the entire collection, allowing them to select the data elements that will be displayed on the axes. With this tool, they can isolate all of the photographs from the African Americans in World War II photograph collection from the National Archives, or the resources that deal with aquatic habitats and that also satisfy the Personal and Social Perspectives objective of the National Science Education Standards (1995).

Metadata and Indexing by Content

Effective indexing is essential for any digital library and, in general, metadata and indexing should reflect the likely information needs of the library's users. Because this project was started several years ago and was focused upon the needs of a single school system, we had to develop much of our own metadata. The original indexing system was created by library-science students who tailored it to the needs of a specific group of middle school teachers. They reviewed science and social studies curriculum objects and textbook headings to determine what the list of topics and subtopics would be and compiled a lengthy set of instructions for future indexers. The result was a 60-page manual that outlined a system for assigning metadata elements (see http://www.learn.umd.edu/blcmanual.html) and specific details for assigning the descriptive elements: Description, Topic, Subtopic, and Standard.

Although a 60-minute video in its entirety may clearly belong in the social studies category, many of the segments from it could be cross-indexed to other topics. Unfortunately, many times these topics are far beyond the scope of our index. While it is probably a hallmark of high-quality educational resources that they use the familiar to introduce students to the unfamiliar, for the MELC community this is at once a blessing and a curse. As indexers, it leaves us with lots of segments for which we have no appropriate Topic or Subtopic, or which we can only index partially. The Discovery video entitled "Unearthing South America" is full of curriculum-related segments about early Indian civilizations, but many of these segments also deal with the culture's traditions of mummification and the archeological digs that are revealing much about these ancient people. Archeology is not a unit of study in the middle school curriculum, and so we have no way of capturing this essential data. It most cases we have adopted a "best fit" mentality and tried to shoehorn these segments into related categories.

A second stress upon the indexing system has been our growth as a community. As our ranks have swelled in recent years, we have embraced teachers from other areas, most notably mathematics and language arts. We have a handful of alternatives to accommodate this expansion. One would be to slow down the processing of videos and take the time to construct an index that is similar in scope and detail to the indexes for science and social studies. However, not only is this a very labor-intensive task, but it would suggest that we have learned none of the lessons of our own recent history (what if the foreign language teachers join us next month?). Our discussions centered on two other viable options: (1) distill the descriptive indexing down to the most basic and community-specific of categories and simply assign segments to the curriculum unit(s) where they are most likely to be used; or (2) broaden the descriptive indexing structure to encompass all possible subject areas by using a scheme such as Dewey, which in theory covers the entire body of knowledge.

In retrospect, we might have limited our index to the broadest of categories for the subject areas, including many beyond the curriculum, and emphasized techniques for keyword searching in the Description field. Concurrently, we would have enriched the descriptions. Rather than simply giving a brief one- or two-sentence summary, we would have made a greater effort to get the transcripts for the videos and simply copied the relevant passages directly into the Description fields, thus providing the teachers with richer text to mine. Regardless, we have come to discover that having the transcripts for any sort of video indexing is highly desirable. Short of taking the time to implement a controlled vocabulary or develop an authority file, it is important to refer to the same entity in a consistent fashion. For example, a recent addition to the library has been a video on HIV and AIDS. In a system based on simple character string recognition, it is imperative that the teachers know if the film presents information on "CD4 T cells," "cd4 t cells," "C D 4 T-Cells." or "see, de four tea sells"?

Our custom-built indexing effort may not be sustainable. We feel our efforts would be better spent indexing to some national metadata standard such as the Dublin Core or GEM (Sutton 1999). While we do index to the National Science Education Standards and the Curriculum Standards for Social Studies, we do not have sufficient data to suggest that this field is being used by the community. Similarly, we have considered searching for an indexing system that would apply beyond our middle school teachers to a high school or elementary school community.

Collaborative Indexing

Our goal has been for MELC to become a self-sustaining community when the project funding ends. At the heart of this community of educators would be the digital library that supports their work in the classroom. In order for this project to be self-sustaining within the current framework of the Baltimore City Public School System, we believe that the indexing of new resources would have to be done collaboratively by members of the community.

While our effort is on a much smaller scale than the CORC project (OCLC 1999), we certainly share their vision. Perhaps there are even some parallels between the indexing of the multimedia content and the manner in which Varian (1999) has suggested that quality control in scholarly publishing can become self-regulating.

Quick Indexing Tool (QIT) and Collaboration

Our first effort at fostering a system of collaborative indexing, the Quick Indexing Tool (QIT) (http://209.48.188.166/blclib/quickindex/), is designed to let the teachers capture descriptive and bibliographic information (metadata) about resources as they add them to the digital library. Having come to know both the capabilities and needs of our users, we have designed a simple interface that lets them capture the greatest amount of information with the least amount of effort.

Along with several simple fields for each QIT submission, we have included a description field that encourages teachers to jot down a brief statement or vocabulary from the page itself (keywords) as a way of representing the content. In the second half of thc form, we ask the grade, subject area (social studies, math), and unit of study (Baltimore uses the Berri Curriculum) for which they envision this resource will be useful. We anticipate that these particular required fields will not dampen enthusiasm for the tool by implying that all teachers should be expected to know about the specifics of all units of study across all grade levels and all subjects. We anticipate that sixth-grade math teachers will be entering Web sites applicable to the sixth-grade math curriculum and seventh-grade science teachers will be entering Web sites applicable to the seventh-grade science curriculum units, and so forth. Having the resources selected by these subject experts should greatly increase the usefulness and quality of the library.

The QIT was introduced to the MELC teachers in August 1999. As of March 2000, 94 resources have been added using this tool including 25 of the 27 math resources. It has helped us expand the library to include the new content areas of math and language arts by having the new teachers themselves make contributions. Each of the 27 math resources in the library have been added by math teachers who used the QIT.

Pros and Cons of Collaborative Indexing

In a system of collaborative indexing, all community members would be responsible for resource acquisition and cataloguing. Resources can be found items, such as Web sites; proprietary items, such as the Discovery video segments; or self-generated items, such as the photographs of Baltimore and Europe taken by various teachers who scanned them and then entered them as digital images. The benefits of such a system are obvious and important:

1) In theory, it guarantees that each item will be have high relevance to some subset of users. Only resources that other members of the group have identified as being specifically related to the curriculum will be part of the collection.
2) Not only will the items all have high levels of relevance, but they will also be of high quality. Each item will have been judged useful by a subject expert.
3) Moreover, the activity of creating a QIT entry may lead to reflection by the teacher about the value of the item. The time involved in entering the bibliographic data, which includes their name and e-mail, will serve as further impetus for maintaining quality control.

However, there are a few difficulties in expecting teachers to use the QIT on a regular basis:

1) Becoming a contributing member of a digital library community means more work for a group that is habitually overworked. Society, school administrations, and parents already expect them to perform a myriad of functions within their classrooms. We are asking them to perform yet one more.
2) The community of users probably will not find as many resources as a library media specialist would. Although the community users will be able to index the resources they do find, they may be overlooking many others. For example, the media specialist knows that many valuable sites are only available to users who know to execute a search on the main page or by searching the site index, and that these pages cannot be found through the major search engines. Unlike today's librarians, teachers have not necessarily been trained to manipulate the search engine algorithms as a way to refine the search process.
3) The community users probably will not find resources of the same quality as a media specialist. The reason for this is similar to the argument made in the previous point.
4) The community of users and the QIT will not exist in an equilibrium. As we have discovered, changes in the environment can have messy implications for the system as it was originally conceived. If they are not provided with the technical skills or training to respond to these changes, then the slightest shift in the equilibrium may well overwhelm them.

Conclusion

Based on our experience, we envision an extended collaborative indexing system that is overseen by a professional librarian with whom they have ready access and easy communication. This professional librarian would serve as a resource to be used by the community members on an "as needed" basis, although this professional will also be an equal contributor to the endeavor and a person who will no doubt have many useful things to share when it comes to the selection, acquisition, organization, and use of resources. We envision an iterative process:

- an individual or subset of members approaches the media specialist with a request for information,
- the media specialist will interview them to further understand the nature of their information need,
- the media specialist will provide the user with a list of resources,
- the teacher will examine the resources,
- the teacher will select and index (with QIT) the ones that meet his/her need, including those that he/she may have found on their own.

This scenario strikes a balance between two extremes. It leaves ultimate responsibility for resource selection to the community members, thus ensuring high relevance and importance to the curriculum, but it lets them have the option of having input from a professional whose intervention represents a great deal of "value added" to the final product.

Finally, it also suggests a way that we can provide a useful framework for the local learning community, yet provide an infrastructure for a broader community. Once a media specialist has compiled a listing of resources that would be useful for an eighth-grade lesson plan on meteorology, it is a relatively simple task to share that list with other teachers in other local learning communities.

Perhaps the solution lies in a federated system of collaborative indexing communities. In this arrangement, many small groups of collaborative indexing communities join forces to benefit from the sharing of resources, expertise, and support that are inherent in a larger federation. Suppose an individual member of Community A has annotated and cataloged a resource in a way that has made it useful to the specific needs, parochial though they be, of the members of her immediate community. An individual in Community B, upon perusing the digital library holdings of Community A, accesses this same resource but represents the descriptive data differently in his catalog. For his users, he includes information about how the resource correlates to statewide standards outlined by the governor's task force. On a macro level, the members of Community B benefit from having access to the resources in the digital library of Community A; on a micro level, they benefit from the refining process that defines collaborative indexing systems.

We have plans for adding tools similar to QIT that will allow teachers to index video segments, materials from online archives, and other multimedia items. This will be accomplished by redefining the metadata fields in the top half of the form so as to prompt users to give more resource-specific information (e.g., audio tapes often have narrators, computer images come in varying file formats).

We continue to believe that educational video can be highly absorbing and can be an important resource for middle school teachers. However, many of the costs for the digital library (indexing, segmenting) would be better borne by a very large constituency. The issue becomes maintaining a sense of involvement from the local learning communities. The QIT is one example of a community-oriented tool. Other such tools might include social collaboration tools (see Allen 1997).

References

Allen, R. B. (1997). Mental models and user models. In M. Helander, T.K. Landauer, and P. Prabhu (Eds.) *Handbook of Human-Computer Interaction* (2nd edition) (pp. 49-63) Amsterdam: Elsevier Science.

OCLC (1999). Cooperative Online Resource Catalog (CORC), http://www.oclc.org/oclc/research/projects/corc/index.htm

MPEG7-7 Context and Objectives, http://www.darmstadt.gmd.de/mobile/MPEG7/

Rose, A., Ding, W. Marchionini, G., Beale, J., and Nolet, V. (1998). Building an electronic learning community: from design to implementation. *Proceedings ACM CHI,* Los Angeles, (pp. 203-210) ACM: New York.

Rose, A., Allen, R. B., and Fulton, K. (1999). Multiple channels of electronic communication for building a distributed learning community. *Proceedings Computer Supported Cooperative Learning*, Palo Alto, (pp. 495-502)

Sutton, S. A. (1999). Conceptual design and deployment of a metadata framework for educational resources in the Internet. *Journal of the American Society of Information Science*, (pp. 1182-1192)

Varian, H. R., (1999). The future of electronic journals,

Acknowledgements

MELC is part of the larger Baltimore Learning Community (BLC), a group funded by U.S. Department of Education Technology Innovation Challenge Grant (#R303A50051) to the Baltimore City Schools. The MELC partners are the University of Maryland at College Park (UMCP); Baltimore City School System; Apple Computers, Inc.; Discovery Communications, Inc.; National Archives and Records Administration; and Maryland Public Television.

COMPUTING ENVIRONMENTS FOR METALEARNING:

INTERCONNECTING HYPERMEDIA CONCEPT MAPS

Perla Señas - Norma Moroni
Dpto. Ciencias de la Computación – Universidad Nacional del Sur
Avenida Alem 1253
Bahía Blanca - Argentina
psenas@cs.uns.edu.ar moroni@sunny.criba.edu.ar

Computers in Education should go beyond task simplification in teaching-learning processes in order to become a strong and effective resource for the construction of knowledge. For computers to fit into a constructivist approach, it is necessary to find a way to develop computer tools in which dialog and comparison with the student's mental and formal models is possible, focusing on the achievement of meaningful learning.
Hypermedia Concept Maps (HCMs), as a way of representing ideas, have a great deal to offer to the development of models for diverse study phenomena and to the adoption of the appropriate pedagogical approach to include computer technology and adapt it to such approach. Here, we propose the use of HCMs to create, together with a specific platform for working with them, an open computing learning environment. New learning development implies, in some cases, a review of the previously acquired knowledge and, in all cases, an integration of newly and previously acquired knowledge. In order to work in this direction, we suggest an environment that supports HCM interconnection and we define the options required to enhance the existing platform.

Introduction

Few activities of man and society have escaped from the impact of computer technology. In education, the attraction of technical features presented by new tools has diminished the attention on how they should be incorporated to learning processes. Technology in itself does not give satisfactory results in education if it is not integrated to an approach in which we wonder about its real power in this field. Computers in Education should go beyond task simplification in teaching-learning processes in order to become a strong and effective tool for the construction of knowledge.

Computer technology should be understood as a means and not as the exclusive purpose of education. For teaching and learning this technology constitutes an additional tool, often appearing to reinforce behavioral and verbalist learning frameworks. To be in agreement with a constructivist approach, it is necessary to find a way to develop computer tools in which dialog and comparison with the student's mental and formal models is possible, not forcing the student to obtain a result but, instead, stimulating his or her knowledge building process and reflection on it. In order to achieve this, it is necessary to focus attention on how these tools are going to be added to the educational process and not only to the contents they are going to introduce.

It is worth remembering what Fenstermacher said about the relationship of ontological dependence existing between the concepts of teaching and learning, and how the central activity of teaching is to facilitate the student to develop learning tasks. That is to say, "to teach is to make learning possible, to provoke dynamics and situations in which the learning process can take place in the students". In this sense, the skill of the teacher in selecting the best tools for the achievement of meaningful learning is very important, [Fen86].

Hypermedia Concept Maps (HCMs), as a way of representing ideas, have a great deal to offer to the development of models for diverse study phenomena and to the adoption of the appropriate pedagogical approach to include computer technology and adapt it to such approach.
Neither computer technology in general nor hypermedia in particular can solve completely nor directly the problems posed by knowledge acquisition within the teaching-learning process; success depends exclusively on the way in which it is applied.

Learning Environments

The purpose of incorporating the computer to learning processes is identified with the development of thinking activities, and with the idea that a computer is a support for the student to build his or her knowledge in his or her mental model structuring process.

A learning environment can be defined as an environment formed by a non-homogenous set of elements that are able to create o recreate situations from which students can build knowledge. Although it is an expression that appears linked to Computers in Education, it is used in a wider sense and it can be used even without the use of computer technology. These environments are presented as sites with a great pedagogical value, extremely favorable for learning and metalearning experiences. Regarding computer learning environments, we can distinguish two large groups:

Closed Environments: those that consist of an integrated software and hardware system that does not require any other system outside it except for the students that interact with it.

Open Environments: the computer system forms part of the environment together with other elements and persons, and the rol of the teacher clearly stands out.

Within the second group we can include HCM work. In this case, the environment will consist of a computer with the specific platform to develop and read these maps, different kinds of bibliographical material, map authors or readers, and the proper participation of the teacher to assess the map semantically.

HCMs, as a way of representing knowledge, can cover the expectations of the meaningful learning model, and they constitute an important basis for computer technology introduction in new educational processes.

It has been proved that work with HCMs is very valuable for meaningful learning building. Concept selection and its correct hierarchical organization are directly related to the previous knowledge of the map's author and to the structural organization of this with the newly acquired knowledge.

On Hypermedia Concept Maps

HCMs preserve all the educational richness of Novak's CMs enhanced with the benefits of hypermedia technology: easier operational handling, greater richness and versatility for information patterns, and motivationally more attractive, especially for young learners, [Señ96a].

Definition

An HCM is a hypermedia document in which each of its nodes has a collection of no more than seven concepts interrelated by linking words. Each of these nodes is called a view.

There are two types of concepts: those owned by the view and those imported to the view. The former constitute the initial concepts of the view and the latter are the image of concepts that belong to another view that are created in order to establish relationships among concepts of different views.

Relationships among concepts of the same view are called internal and relationships among concepts of different views are called external.

In each view, the owned concepts are represented by means of labeled ellipses, imported concepts by labeled rectangles, both with the name of the concept that they represent, and relationships (internal or external) by arcs labeled with linking words.

In order to represent external relationships, a labeled arc is established between the owned and the imported concept. Such relationship appears in both views.

A name and a color identify each of the views. The name corresponds to the most comprehensive owned concept and the color is used in all the ellipses representing owned concepts. Imported concepts keep the color of the view where they were originally defined.

Given a view V1 and a concept C belonging to V1 we can say that C explodes in another view V2 when such concept C develops in V2, i.e. C constitutes the root node of the map developed in V2. In this case we can say that the map represented in view V2 is a submap of the one corresponding to view V1.

The ellipse representing an owned concept exploding in another view is an elliptical button that allows direct access to that view. The rectangle representing an imported concept C is a rectangular button that allows direct access to the view where C is defined as owned.

We can associate to a terminal concept (that is not a button) different features such as graphics, sound, animation, etc. Any concept can be associated to a feature since there will always be a CM view in which said concept is defined as terminal.

Each HCM presents two strata: the strictly speaking HCM and the underlying hypermedia database created from the resources that originated the HCM. Access to it can be achieved during map navigation. Thus, those concepts in an HCM that, due to their richness, can provide new information, can be more deeply explored by means of hypermedia. Both strata can be queried alternatively. HCMs go beyond the educational possibilities of Novak's traditional CMs. This hypermedia bibliography is extremely useful for those interested in reading further about the topic, as well as those assessing it, [Señ96b].

Elements in an HCM Learning Environment

In order to focus the HCM author's attention in the most important and richest aspects from the educational point of view -such as concept selection, hierarchical classification and relationship establishment- and, in order to avoid distractions in building aspects and implementation options that lack any pedagogical value, the platform for HCM work and a methodology for HCM development is introduced into the environment, in addition to bibliographical material on the subject and the corresponding simulation systems for HCM study.

Platform for HCM Development

The design of a specific platform for dealing with HCMs aims at having exclusively those resources necessary for HCM development. Those characteristics can be found in the specific platform for HCM development and reading presented in [Mor96a]. This platform has two work modes, one of them corresponds to the author -map development and modification- and the other corresponds to the reader -map perusal and inspection. Immediate interaction between the two modes is allowed. The author mode presents specific characteristics for HCM development that makes the user completely free from dealing with any aspect that goes beyond the understanding of the topic. It has a graphic interface that offers a tools bar with the different options available for map development and modification and pull-down menus for editing.

HCM Learning Environment Enhancement

New learning development implies, in some cases, a review of previously acquired knowledge, and, in all cases, an integration of newly and previously acquired knowledge. Thus, we propose an environment to develop HCM interconnections. The main reason for this task is given by the need to integrate new knowledge with previously acquired knowledge and the wish to relate different points of view of the same topic.

HCM Interconnection

The interconnection of two HCMs can be carried out from different situations. Let's consider A and B the topics -between these there is some semantic relationship- and HCMA and HCMB the corresponding maps already developed. The idea is to obtain only one HCM from the two existing ones, without having to do all the map again and leaving the corresponding relationships established. This can be done as follows:

i) Establishing a relationship R between a concept C1 of HCMA and a concept C2 of HCMB. From the point of view of learning psychology it is an integrating action that implies a semantic review of the newly learned knowledge in relation to the including knowledge. From the point of view of operation, it is equivalent to the establishment of an external relationship between two concepts of the same HCM, since C1 and C2 are in different views.

ii) Concept C is detected in HCMA and in HCMB. At first, we suppose it is the same concept and that it is represented by the same name; later we shall deal with concepts with synonym and homonym names. Then, there is a view V1 in HCMA and a view V2 in HCMB where C is represented by a labeled ellipse. We can also see that it is possible for another view with an elliptical button labeled C to exist; but in such case, C explodes in a view that contains it as an ellipse. That is to say, in all cases it is possible to find a view in the map where concept C is represented by an ellipse.

What are the possible solutions to keep the following properties P1 and P2 of the HCM in the map resulting from the interconnection?

P1: Each concept appears represented as an ellipse only once in the map.

P2: The maximum number of concepts of a view does not exceed from seven.

A first approach could be the following: Both views V1 and V2 are reorganized in one or two views according to the number of concepts that both views have.
For example, if V1 and V2 are the views in Figure 1, both could be replaced by the view in Figure 2.

If, instead, V1 and V2 were like in Figure 3, where the number of concepts gathered between both views largely exceeds the upper limit proposed, they could be replaced by the views in Figure 4, where the original hierarchy among concepts has been taken into account for its organization. We can see that in the first view C is represented by a buttom.

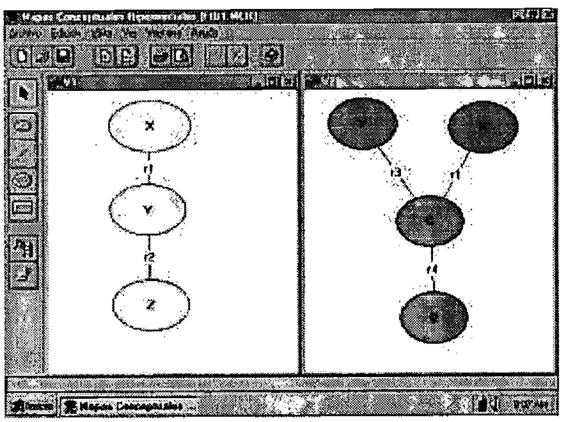


Figure 1: First approach - first case

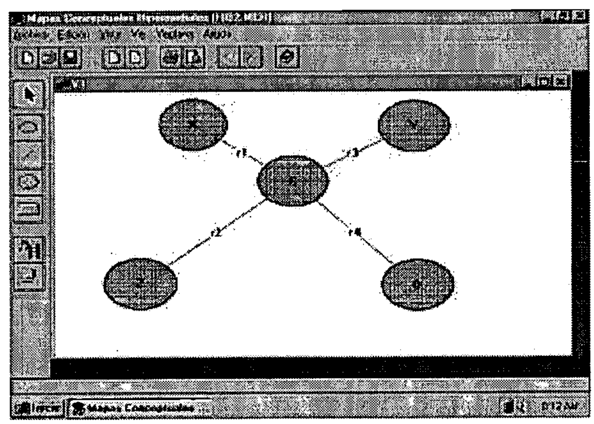


Figure 2: Result - first case

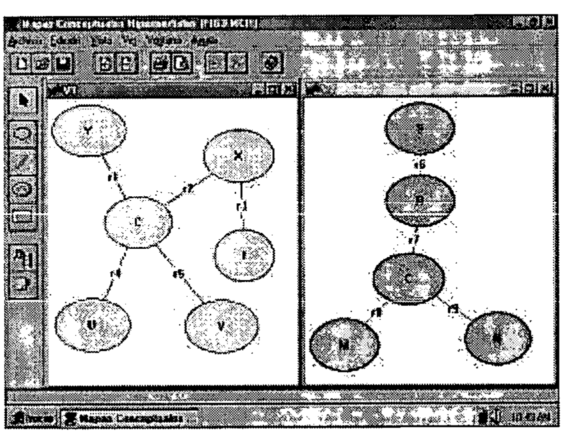


Figure 3: First approach - second case

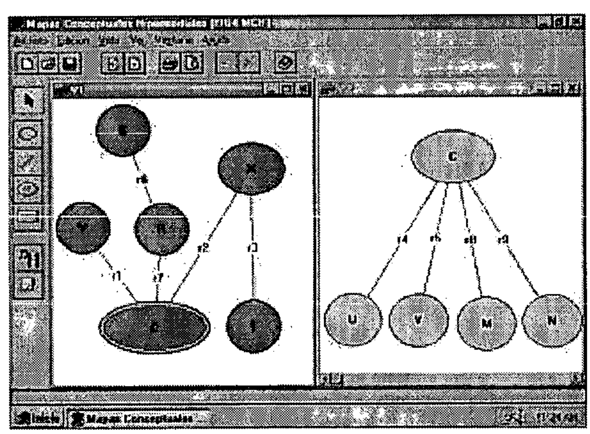


Figure 4: Result – second case

Problems arise with this approach when in HCMA or in HCMB there are views different from V1 and V2 that have an elliptical or rectangular button labeled C. In that case, two views with the same elliptical button exploding in another view will remain in the new map. Interconnection would imply redoing an important part of the map, loosing the pedagogical objective that we have in mind. This situation gets worse when the interconnected maps are in turn the result of previous interconnections, since a cascade effect takes place.

The following is a second approach in which the problem is solved: C is identified in both views by means of an external relation called "equal". In this way, in both views the rectangular button that will allow scrolling from one view to the other will appear, being possible to see C in both contexts, as we can see in Figure 5. The overlapping of the rectangle and the ellipse graphically reinforces the idea of referring to the same concept.

The establishment of an "equal" relationship between concept C of both maps determines a circular behavior in the access to the views from the use of rectangular buttons labeled C.
If HCMA and HCMB are connected and one of them is already the result of an interconnection (for example, HCMB) the following situation may arise: concept C appears in one HCMA view and in two HCMB Views.

We can see that access circularity through rectangular buttons involves the three views after the interconnection, as shown in Figure 6.

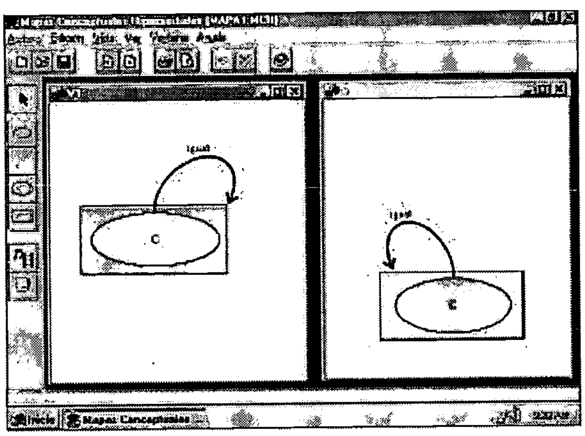


Figure 5: Second approach - general case

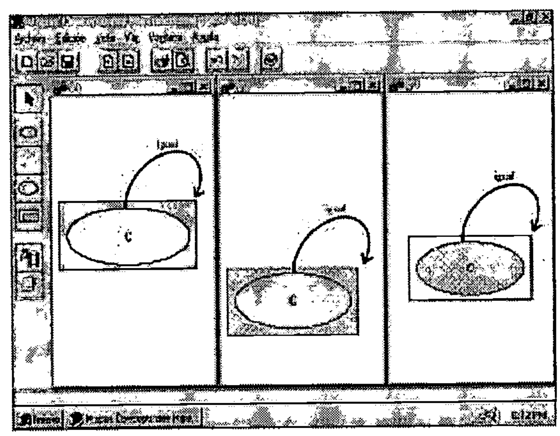


Figure 6: particular case

Now that we have discussed the advantages of this last approach over the previous one, we consider this is the solution for item ii).

The following special case may come up. In HCMA view V1 has a concept C represented by a labeled ellipse that is a leaf. The same concept C appears as root of view V2 in the HCMB and there it is represented by a labeled ellipse. In this case, the interconnection transforms the C labeled leaf of view V1 in an elliptical button exploding in view V2.

Synonyms: when two maps are interconnected, the same concept may appear represented by different names that are synonyms. In this case, the author may choose between:
- unifying the names and proceed according to ii).
- establishing an external relationship between both, such as "it is a synonym of"

Homonyms: if two different concepts appear represented by the same name, this does not require any special deal for the interconnection, the meaning of each concept will be shown through the concepts and relationships that form part of their respective contexts.

Adding the interconnection option to the existing platform. The current platform allows for HCM construction and reading. It is possible to open two already created maps, for example HCMA and HCMB, leaving all their views available.

Platform Enhancement
Interconnection: the choice of this option works on open HCMs. From there, the platform considers all the views of said maps as views of the recently created HCM. Then, the following interactive process begins: the platform asks the author a name for the new map. Once it is entered, if there is some pair of views with the same color associated, the list with the names of said views and a dialog box to allow for the color change in one of them automatically appear, so that different views do not have the same color. Next, the list of concepts represented by labeled ellipses that are present in two or more views of the new map appears on the screen. When selecting each of them, the corresponding views appear and the author, after analyzing them semantically, will decide the effective action to take.

Equal Relationship: the choice of this option will allow for automatic creation of the "equal" external relationship in each of the views, pointing out the equal concepts of the different views indicated and leaving the rectangular buttons with the proper references for a circular visit of the views.

If, instead, V1 and V2 were as in Figure 3, where the number of concepts gathered between both views largely exceeds the upper limit proposed, they could be replaced by the views in Figure 4, where concept hierarchy has been taken into account for organization.

Conclusions

The learning environment proposed for HCM work that includes the possibility of interconnecting maps and enhancing the platform with that objective, enlarges the richness of the work with these maps as a valuable and proven resource for the representation of ideas. It expands its potential since it allows to work expressly on the correct relationship between recently learned and previously acquired knowledge or between different approaches of the same topic. It is a proposal for Computers in Education that goes beyond task simplification in teaching-learning processes, and it appears as an effective tool for the construction of knowledge according to a constructivist approach.

Bibliography

[Nov85] Novak, Joseph. "Metalearning and metaknowledge strategies to help students learn how to learn". Cognitive Structure and Conceptual Change. New York. Academic Press. 1985.

[Aus78] Ausubel, D. P., Novak J. D. "Educational Psychology: A Cognitive View. 2nd Ed". New York: Holt , Rinerhart and Winston. 1978.

[Fen86] Fenstermacher, G. "Philosophy of Research on Teaching", en Wittrock. 1986.

[Laj93] Lajoie, Susanne. "Computer Environments as Cognitive Tools for Enhancing Learning". McGill. 1993.

[Mor96] Moroni, N. - Vitturini, M. - Zanconi, M. - Señas, P. "Una plataforma para el desarrollo de mapas conceptuales hipermediales". Taller de Software Educativo - IV Jornadas Chilenas de Computación. Chile. 1996.

[Reu93] Reusser, K. "Tutoring Systems and Pedagogical Theory: Representational Tools for Understanding, Planning and Reflection in Problem Solving" en Computers as cognitive tools. Lawrence Erlbaum Associates Publishers. 1993.

[Señ96a] Señas, P., Moroni, N., Vitturini, M. y Zanconi, M.: "Hypermedial Conceptual Mapping: A Development Methodology". 13th International Conference on Technology and Education. University of Texas at Arlington, Departament of Computer Science an Engineering. New Orleans 1996.

[Señ96b] Señas, P., Moroni, N., Vitturini, M. y Zanconi, M.: "Combining Conceptual Mappings and Hypermedia". ED-MEDIA96. Boston. 1996.

EDUCATIONAL TECHNOLOGY AND ITS TERMINOLOGY: NEW DEVELOPMENTS IN THE END OF THE 20TH CENTURY

Peter Serdiukov
School of Education
University of Utah
U.S.A.
serdiu_p@gse.utah.edu

Abstract: This paper is a report on the findings of a quantitative study of the Educational Technology terminology conducted on the materials of several AACE Conferences. These findings allowed us to single out different technologies used in education, to define the structure of the ET, observe the changes that have been taking place in this field over the years and describe the most important events. The list of the most frequent terms and their analysis are also presented.

Introduction

A language is like a living organism - incessantly developing and modifying, losing some elements and creating the new ones while adapting to the constantly changing environment. Terminology of a special subject field is a part of this organism that reacts most tangibly to the impact of the outside changes.

Educational Technology (ET) is a field that has been rapidly developing toward the end of the 20th century due to the outstanding innovations in Information Technologies (IT) and their growing application in general and professional education and training. These developments could not have failed to affect the ET terminology that reflects everything that is happening in this field. Yet, however important is the terminology itself for the functioning of this field, by studying terminology we can also judge of the latter's current state. Moreover, observing the development of terminology over the years, we take the prints of various periods of time and compare them, thus discovering similarities and picking out the differences, which report of the occurring changes. This paper is a further development of our research in ET terminology (2, 3).

Materials and Methods of Study

Our analysis of ET terminology is based on the Proceedings of the AACE EdMedia World Conferences that took place from 1996 through 1999 (1). Four years is certainly too short a period of time to make far-reaching conclusions – the last 15 years would have been much more demonstrative, still it was sufficient to discover remarkable changes in ET. The papers contained in these Proceedings were processed by a concordance program to obtain alphabetic and frequency lists of all the words that occur in these texts. The lists were then investigated by a number of parameters using expert and statistical methods. Some of the findings are presented in this paper.

The first observation was a sharp growth of the volume of these Proceedings: in 1996 the volume of the papers included in these Proceedings was 579,256 words, whereas in 1999 it reached 887,630 words (an increase of 53 percent). This increase reflects a rapidly growing activity in ET. The total volume of each of the Proceedings is statistically representative to make grounded conclusions regarding the issues of interest.

The Most Frequent Terms

We focused our attention on the terms specific for ET and attempted to observe how this field has changed in this short period of time. The terms of this field include both the terms characteristic of IT only and the terms pertaining to General Education, Psychology, Theory of Instruction and other relevant areas. One of the stages of the investigation was devoted to the analysis of the most frequent terms (frequencies ≥ 1000) from the 1999 file and comparing them to the most frequent terms from the 1996 file. This analysis yielded 39 words that are arranged below in the order of the decreasing frequencies. These words are very important for ET terminology as they reflect the most significant objects, phenomena and processes that are developing in it, thus allowing us to judge of the contents of this special subject field, its current state and changes that have taken place between the years.

1999	**1996**	**Ranks**
1. Learning	1. Student	1:2
2. Student	2. Learning	2:1
3. Course	3. System	3:8
4. Technology	4. Information	4:9
5. System	5. Computer	5:3
6. Information	6. User	6:4
7. Education	7. Multimedia	7:12
8. Web	8. Course	8:36
9. Environment	9. Technology	9:11
10. University	10. Knowledge	10:14
11. User	11. Environment	11:6
12. Computer	12. Education	12:5
13. Educational	13. Tool	13:18
14. Teacher	14. University	14:17
15. Design	15. Design	15:15
16. Project	16. Material	16:26
17. Group	17. Teacher	17:27
18. Tool	18. Educational	18:13
19. Research	19. Program	19:32
20. Teaching	20. Communication	20:29
21. Multimedia	21. Learner	21:7
22. Knowledge	22. School	22:10
23. Learner	23. Software	23:21
24. Support	24. Process	24:30
25. Material	25. Application	25:16
26. Process	26. Project	26:24
27. Activity	27. Group	27:-
28. Communication	28. Hypermedia	28:20
29. Program	29. Teaching	29:19
30. Online	30. Support	30:-
31. School	31. Video	31:22
32. Virtual	32. Research	32:-
33. Model	33. Model	33:33
34. Study	34. Study	34:34
35. Instructional	35. Interface	35:39
36. Content	36. Web	36:37
37. Internet	37. Content	37:-
38. Software	38. Interactive	38:-23
39. Distance	39. Instructional	39:-

Table. The most frequent words of ET field and comparison of their ranks in 1999 and 1996.

The position of each word in this list is taken as its rank that reflects the value of the term in a given list. The ranks of the words in the two lists were then contrasted against each other (1999:1996) to demonstrate the shift in their relative values over the three years.

Analysis of the most frequent terms and comparison of the two groups of the most frequent terms taken over a 3-year period, as we can see from the Table, allowed us to make the following conclusions:

1. The inventory of the group changed over this period by 12.8 percent (5 words of the 1996 list – *application, hypermedia, video, interface and interactive* were replaced with the words *activity, online, virtual, Internet and distance* in 1999). This change reflects the general shift of the ET focus in the direction of the Telecommunications Technology and Distance Education. It is interesting to note that all these changes concerned only the words in the bottom part of each list.

2. The most remarkable changes affected the value of the terms *Web, project, group* and *research* that moved up in the list during these three years, whereas *computer, multimedia, material, communication, software and model* moved down. This observation supports the abovementioned conclusion and also shows an increased interest in research and group activities in the area of ET.

3. No changes occurred in the value of the terms *design, mode and study*, and very small shift in the rank of the terms *student* and *learning* that replaced each other at the top of each list, and *content*. This is the evidence of the ET overall stability based on the student-oriented approach with attention to research in this field and to the content of education.

The terms from the 1999 list were later distributed into five topical subgroups (some words fall into different subgroups and are counted in each of them, e.g. information, system, user, etc.):

1. Education: learning, course, education, educational, teaching, knowledge, process, content, activity, material, *information, system, design, environment, support, instructional, communication, program*, development, study, problem;
2. Technology: Web, technology, computer, multimedia, virtual, Internet, software, tool, distance, online, *information, system, design, environment, support, instructional, user, multimedia, communication, program;*
3. Research: research, project, model, development, study, problem;
4. School: university, school;
5. People: student, group, teacher, learner, *and user.*

These groups define the basic contents of the ET field: there are general education terms (21 words), IT terms (20), research (6), schools (2) and categories of people involved in this field (5 words). The changes that had taken place in these subgroups since 1996 concerned only the first (one word), and the second (5 words) subgroups. The ratio in the number of terms in each list remained the same thus demonstrating stability of the ET structure. The most dramatic changes occurred in the inventory of the technological terms' subgroup.

Technologies in Education

This investigation also allowed us to define different technologies used in education (based on Ed-Media 99 papers): Academic, adaptive, agent, architecture, ASP, automation, cable broadband, CD-ROM, classroom, CMC, collaborative, communication(s), computer, computer-based learning, computing, conferencing, course, database, digital, domestic, education, educational, educational communications, engineering, graphical, high, hyperlearning, hypermedia, imaging, human interface, information, instructional, instructional performance, instructional systems, integrated, interactive, interactive digital, Internet, Internet audio, Internet voice, learning, media, METNET, multidimensional analysis, multimedia, multimedia communications, network, new media, NCATE, optical fiber, participatory, projection, push, satellite, social, student-centered, subjacent, SUMMIT, teacher-centered, teaching, telecommunication(s), training, UTP, video, videoconferencing, Virtual Reality, voice, VR, Web, Web-based, Web-related, WMI, WWW - altogether 73.

We can hardly apply the words "academic", "classroom", "course", "social", etc. to a technology - these attributes refer to the area of application, whereas "multidimensional analysis", "collaborative" and "participatory" technologies are, actually, concrete uses of certain technologies. "Learner" or "teacher-centered" technology points out to the approach used in a technologically-based education. The terms "adaptive" and "subjacent" reflect inherent characteristics of the technologies, and "high" demonstrates the level of technology. But we certainly can differentiate between technologies on the basis of certain characteristics that can be utilized for their classification, namely:

Field: communication, information
Area: CMC, telecommunications
Application sphere: education, instructional, learning, engineering
Principle of action: digital (vs. analogue)
Major tool or instrument: computer, satellite
System (organization): network, Internet, Web, WWW
Means of connection: cable broadband, optical fiber
Technique or device: database, projection, CD-ROM
Activity: computing, interactive, videoconferencing
Media: media, multimedia, video, voice, Internet, audio/voice
Structuring: integrated (vs. shared)
Combined: educational communications, instructional systems.
There can certainly be other approaches to classifying technologies.

All ET terms can be subdivided into four major groups: General Education, Computer Technology, Telecommunications Technology terms and terms belonging to other technologies (audio, video and projection). The ratio between the number of terms in each group is 40:24:29:7. This means that besides general terms related to education, the largest group of terms represents Telecommunications Technology.

It was curious to find quite a few neologisms the majority of which is based on the most popular roots *net*, *tech*, *tele* and *web*: Inet, technofatigue, teleinstructor, telepresence, webagogy, webber, webbook, etc. We noticed also a growing tendency to spell the composite terms without a dash, e.g. telelearning vs. tele-learning, website vs. web-site, etc.

Conclusions

Technology of a specialty field can be regarded as a system of units and laws that, on the one hand, describes the field reflecting its structure and processes occurring there over time, and regulates the correct use of the terms belonging to this field in the text, on the other. Investigation of the ET terminology using various methods gives us better understanding of the field organization and its functioning. The next stage of this study will be focused on identifying the changes that have taken place in ET in the last 10 years of the 20^{th} century - this will help us discover and describe the trends in the historical development of ET and thus prepare for the future.

References

1. Ed-Media 1999. *World Conference on Educational Media, Multimedia, Hypermedia & Telecommunications. Electronic versions of papers presented at Ed-Media Conferences 1996-1999.* AACE.
2. Serdiukov, P. (1999) Educational Technology: Definitions, Areas and Terminology. *Proceedings of EdMedia 99 World Conference on Educational Media, Multimedia, Hypermedia & Telecommunications.* Seattle, WA, USA, 1582-1583.
3. Serdiukov, P. (2000) Terminology of Educational Technology: A Quantitative Study Based on SITE Conference Proceedings. *SITE 2000 11th International Conference Proceedings.* San Diego, CA, 1624 - 1629.

MULTIFUNCTIONALITY OF EDUCATIONAL TECHNOLOGY APPLICATIONS

Peter Serdiukov
School of Education
University of Utah
U.S.A.
serdiu_p@gse.utah.edu

Abstract: In order to make a technology-based education cost-effective, we need to find ways to intensify the use of Educational Technology tools in various teaching/learning applications. One of the ways to do so is to utilize the multifunctional potential of the technological tools that allows to use one and the same tool for various educational goals. A new approach to classifying Educational Technology is also proposed that allows to find different applications for the existing tools.

Introduction

A remarkable growth of Educational Technology's (ET) applications in all forms of education and training is often undermined by the limited utilization of its potential: few educators fully exploit versatile capabilities of ET. This leads to its inefficient use in teaching and learning, lesser effect on the students, inadequate distribution of educational resources and extra expenses. However, practically each tool can be used to attain more than one goal in teaching and learning that can make ET-based education more cost-effective. Thus, we come to the idea of multifunctionality of ET according to which one and the same tool can effectively serve a variety of purposes. This idea is the opposite of the idea of integrated use of technologies that advocates building up a mix of various technological tools in one educational environment - integration is certainly very important but we suggest as well to find ways of intensive utilization of each ET tool for different applications in teaching and learning to maximize its effectiveness.

Theoretical Considerations

It is interesting to follow the development of this idea over the last 20-25 years. At first, teachers tried to find all possible uses for each new tool that appeared in schools and universities. For example, a slide projector was first used in foreign language teaching for the semantization of new words - by showing on the screen the objects these words denoted to the students (in this way, teachers avoided the need for translating these words into the students' native language). Then it began to be employed to develop verbal skills: the pictures served as objects for oral or written narration. Later, the pictures on the slides were found to stimulate communication in the target language by creating a communicative situation. Similarly, a tape recorder was used firstly to train the students to pronounce foreign sounds, then - to understand words and phrases, after - to develop listening skills; finally - to develop communicative competence.

Later, there was an attempt to integrate several different tools in one classroom and in one lecture or laboratory work, when the teachers as well as the learners began to realize that they needed a number of ET capabilities to assist them in the teaching/learning process. Thus, integral use of ET began to spread in 1980-ies that invited sequential or simultaneous use of several ET tools in one lesson. The idea of integral use of ET was grounded both on the necessity to use various media in information (text, sound and picture) presentation - simultaneous use of a slide projector that produced static images with or without a written text and a tape recorder with an audio text and/or music is an example, and also on the desire to intensify the impact of the teacher's pedagogical actions and in this way to increase students' perception, cognition and learning outcomes on the whole. This approach was based on peculiarities of a person's perception supported by the data given by E. Dale: we learn 11% of information through hearing and 83 through sight. People remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they see and hear, 70% of what they say during communication, and 90% of what they say in the process of some activity (cit. by K. Spencer 1991, 116). It has been proved that education and training based on the integral approach to information presentation and its use in learning activities could improve students' cognition and provide efficient knowledge construction (Dovgiallo 1990, Spencer 1991, et al.).

Due to the versatility of contemporary ET tools, primarily a computer, the idea of multifunctionality revived again and replaced with the time the idea of integral ET application, at least partially, though later it underwent modification and now can be viewed from a different angle: PC capabilities today are extended with a number of peripheral devices - printer, scanner, LCD plate, modem, video camera, loudspeakers etc. that serve as its extenders and provide the multifunctionality of its application.

The use of technological tools for different educational goals is based on the tools' technical capabilities, on the one hand, and on the principle of multifunctionality, on the other. This principle first formulated in 1984 (Serdiukov 1984) and further developed in our later works (1990, 1997) states that one and the same tool can and should be used for various educational purposes. Implementation of this principle results in greater effectiveness of teaching, training and learning, and in savings on technology expenses.

Still, it is quite obvious that each tool is intended for one major purpose (selective application), so in a systemic approach to the ET application (see Serdiukov 1997, 410-419) one tool may not be sufficient to solve a particular educational problem. Then we have to look for other tools that can supplement the primary one. This approach is used in integrated systems. Supplementing one tool with other tools allows designers of educational software and practicing teachers to find the best solution to instructional problems.

Principles of ET Application

Multifunctionality of ET tools application is a complicated domain, and it should be appropriately structured. We suggest that the use of ET tools in education and training be based on the following three principles: selectivity, multifunctionality and suppletivity.

Selectivity: Application of each ET tool for specific educational goals is regulated by its technical and pedagogical capabilities.

Multifunctionality: Practically any ET tool can be used for a variety of educational goals; these applications are allowed by the tool's technical and pedagogical capabilities.

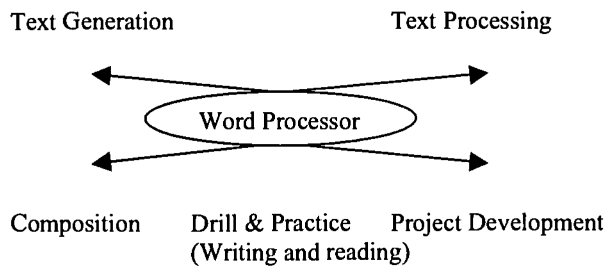
Suppletivity: If a given ET tool utilized for a particular application cannot offer the best performance, another tool with a better capability for this application can be used together with the first one, supplement or even replace it so as to increase its efficiency and achieve the desired goals.

Multifunctional Use of ET Tools

There are many instances of the multifunctionality of ET tools. Let's consider a few examples.

Word processor' s main use is, clearly, text generation and processing; however, it also finds use as an educational tool for writing instruction, composition skills formation, and project development (Scrimshaw 1993). Along with developing writing skills, it indirectly helps to develop reading skills as well (Serdiukov 1997). Work with the text in a word processor also stimulates thinking (Marcus 1993).

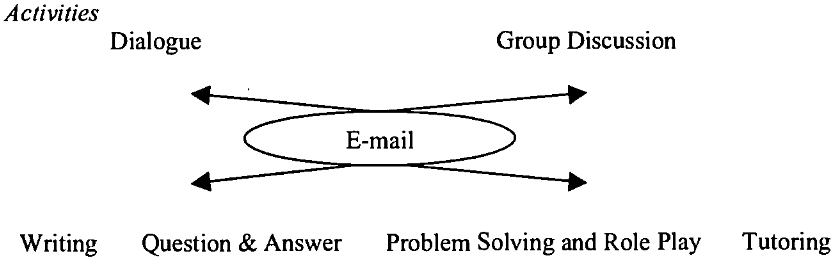
Textual Activities



Learning Activities

E-mail is used predominantly as a communication tool, but, at the same time, it is a great instrument for writing instruction, individual and group tutoring and consultations, question and answer exercises, problem solving and role play (Warschauer 1995):

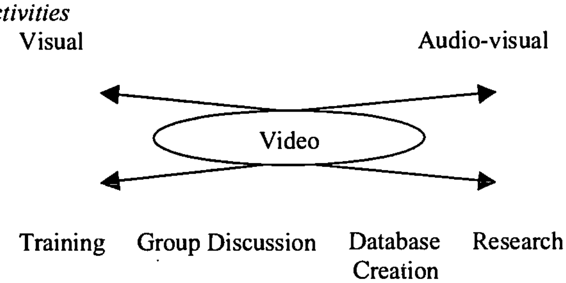
Communication Activities



Learning activities

Video can be used not only for the teaching material presentation (both visual and audio-visual), but also for training (problem solving, role-play, and simulations), for group discussions, and for information database creation and research. The Group Discussion application is particularly important for professional training when a videotaped real-life situation is used for group analysis and discussion (Payr 1999). It can also be used as an assessment instrument when the student's real activity in a predesigned situation is filmed and later used in the class collaborative work and group communication (both face-to face and virtual/electronic) for analysis, discussion and evaluation (Serdiukov et al. 2000):

Material Presentation Activities



Learning Activities

ET applications cannot be limited only to the delivery or presentation of information, or to the development of certain skills, they also affect emotional state and cognitive processes of the learner. Thus, pictures, colored and moving, are able to grasp our attention far better that a plain text - hence a dramatic spread of videos and video games and the ensuing tragic decline in reading among school age children and many adults. Music is not just an acoustic accompaniment of still images or video: it can influence the learners' mood and stimulate cognition - we found these effects in our research and practice of intensive foreign language training (Serdiukov 1984).

Multimedia with its unlimited capabilities is certainly the best example of multifunctionality of a computer: student's interaction with multimedia programs takes place at various levels of perception and cognition. Hypertext is another example of multifunctionality at a different scale - the scale of information depth: it offers a hierarchical network of information tools and databases that can serve multiple applications in teaching and learning. Hypermedia is a combination of both.

Versatility of the WWW adds up to the ET multifunctionality: videoconferencing, streaming video, multimedia and various communication capabilities (asynchronous and synchronous communication, on-line and off-line dialogues, and group forms of interaction - bulletin/message board, chat, on-line conferences, etc.) that support electronic communication between students and their teachers, among students and with anybody in the world on any topic are another manifestation of multifunctionality of ET tools.

Suppletivity can be illustrated by using information activities as an example. Students have traditionally obtained information for learning primarily from the textbooks. Today they also use computer-based and web-based courses that provide all the necessary information and also support knowledge construction. Besides, now they have access to web-based databases and distributed Internet resources, such as electronic university and web-based libraries, information sites, databanks, journals, etc. Finally, they utilize e-mail for collecting information from other people (fellow students, instructors, experts, etc.). All these sources supplement each other.

Multifunctionality of ET brings us before the problem of choice: what tool and what application is best for any particular teaching/learning case? The right answer depends mainly on educational goals, potential characteristics of the available ET tools, ingenuity of the courseware designer and teacher's pedagogical and technological expertise and skills.

Table of Multifunctional Applications of ET Tools

Before we deal with these concerns, we should rather analyze various applications of ET tools in students' activities (See the Table).

We arranged students' learning activities into six groups and matched them to the existing tools so that we could have an opportunity to see which activity could be performed with which tools. There are the following activities: *information activities*: information search, processing and presentation; *textual activities*: text processing, editing and generation; *learning activities* proper: question-answer, drill and practice, problem solving, role-play and simulation; *research activities*; *communication activities*: dialogue, group discussion and conference, and *assessment activities* (quizzes and tests).

Technologies are divided into two major groups: *computer technology* that offers computer-based courses, automated/computerized tests, word processors, spreadsheets, databases, graphics and presentation software, and *telecommunications technology* that offers distance courses, distributed educational resources, email, videoconferencing, bulletin boards, whiteboards and chat. (We did not include other technologies into our analysis: audio, video, audio-visual, projection and TV, though they play an important part in education.)

As we can see from the Table, practically each tool can be used for multiple purposes. The widest multifunctionality can be attributed to the Computer-Based and Web-Based (Distance) Interactive Multimedia Courses - they must perform various functions in students' learning: from information search and processing to different learning activities and assessment. Telecommunications tools, such as Videoconferencing, Bulletin/Message Board and Whiteboard, are also multifunctional: they can be used for information presentation, several learning activities involving collaboration between students and communication with the instructor as well as within the student group. E-mail can be effective for communication and in supporting group activities, such as question/answer, problem solving, role-play and simulations, and exchange of information. There are two selective, monofunctional tools - presentation software and automated tests, though we are aware that the lesson presentation phase can be easily converted into a learning activity phase by asking questions, posing problems, etc; in the same way many tests can be used for learning purposes and not only for the assessment.

Applications (Students' activities) \ Technologies and Tools	**1.0. Information**	1.1. Search	1.2. Processing	1.3. Presentation	**2.0. Text**	2.1. Processing	2.2. Editing	2.3. Generation	**3.0. Learning**	3.1. Questions & Answer	3.2. Drill & Practice	3.3. Problem Solving	3.4. Role Play	3.5. Simulation	**4.0. Research**	**5.0. Communication**	5.1. Dialogue	5.2. Group Discussion	5.4. Conference	**6.0. Assessment**
A. Computer Technology	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A1. Computer-Based Course	.	+	+	+	.		+	+	.	+	+	+	+	+		.				+
A2. Automated Test	.				.				.							.				+
A3. Word Processor	.		+		.	+	+	+	.		+					.				
A4. Spreadsheet	.			+	.				.			+		+	+	.				+
A5. Database	.	+			.				.	+	+	+		+	+	.				
A6. Graphics Software	.			+	.				.						+	.				
A7. Presentation Software	.			+	.				.							.				
B. Telecom. Technology	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B1. Distance Course	.	+	+	+	.		+	+	.	+	+	+	+	+		.	+	+		+
B2. Distributed Resources	.	+			.				.	+	+	+	+	+	+	.				
B3. E-mail	.	+			.	+	+	+	.	+	+	+	+	+	+	.	+	+		+
B4. Videoconferencing	.			+	.				.	+	+	+	+	+	+	.		+	+	+
B5. Bulletin Board	.	+		+	.			+	.	+	+	+				.		+	+	
B6. Whiteboard	.			+	.				.	+	+	+	+	+	+	.		+	+	
B7. Chat	.			+	.				.	+	+	+	+	+	+	.	+	+	+	

Table. Multifunctional Applications of ET Tools in Students' Learning Activities.

This Table is actually an attempt at classifying contemporary ET. It can be used by teachers and designers of educational software as a guide in the development and application of teaching/learning materials.

Our approach to classifying ET tools has semblance to the chemical elements' valences count: each tool has certain technical and educational capabilities that allow to utilize this tool for particular classroom applications. This approach is different from, for instance, B. Bruce and J. Levin's approach that suggests a four-part taxonomy based on J. Dewey's division: inquiry, communication, construction and expression (Bruce and Levin 1997, 79). We can find similarities between our classification and this taxonomy: information and research activities refer to the inquiry, communication is, clearly, the same, learning and textual activities relate to construction, and information presentation is expression. However, our classification embraces all major up-to-date technologies and more of the current applications of ET than other approaches, including the abovementioned taxonomy.

Conclusions

Multifunctionality is a property inherent in almost any ET tool. The use of ET based on the principle of multifunctionality allows to expand the application sphere of ET tools and brings about greater effectiveness of teaching, training and learning, as well as significant savings on technology expenses that can make technology-based education more practical and cost-effective.

References

Bruce, B.C., Levin, J.A. Educational Technology: Media for Inquiry, Communication, Construction, and Expression. *Journal of Educational Computing Research*, 1997, Vol. 17(1), 79-102.

Dovgiallo, A., Koval, T., Legkiy, M., Serdiukov, P. (1990) (Ed. By Peter Serdiukov) *Foundations of Educational Informatics and Computer Sciences.* A textbook for students of language universities. Kiev: Vystcha Shkola.

Marcus, S. (1993) Multimedia, Hypermedia and Teaching of English. *Computers and Language.* Ed. By M.Monteith. Oxford: Intellect, 21-43.

Payr, S. (1999) Tele-Training on the Job: Experiments and Experiences in Media Education. *Proceedings of ED-MEDIA 99 World Conference on Educational Media, Multimedia, Hypermedia & Telecommunications*. Seattle, WA, USA, 276-81.

Scrimshaw, P. (1993) Cooperative writing with computers. *Language, classroom and computers.* Ed. By P.Scrimshaw. London and New York: Routledge, 100-110.

Serdiukov, P. (1984) *Foundations of Intensive Foreign Language Training.* Kiev: Vystcha Shkola.

Serdiukov, P. (1997) *Theoretical Foundations of Language Instruction in Universities on the Basis of Information Technologies.* Manuscript of Doctorate Dissertation. Kiev State Linguistic University.

Serdiukov, P. Niederhauser, D., Reynolds, R. (2000) Teachers' Professional Development and Support Model. *Proceedings of SITE 2000 11th International Conference.* San Diego, CA, Vol. 1, 469-473.

Spencer, K. (1991) *The Psychology of Educational Technology and Instructional Media.* Liverpool: United Writers Press.

Warschauer, M. (1995) *E-mail for English Teaching. Bringing the Internet and Computer Learning Networks into the Language Classrooms.* Alexandria, VA: Teachers of English to Speakers of Other Languages, Inc.

Student Satisfaction and Perceived Learning in Internet-Based Higher Education

Peter Shea, Educational Theory and Practice, University at Albany, USA, pshea@sln.suny.edu

Eric Fredericksen, The SUNY Learning Network, State University of New York, efrederi@sln.suny.edu

Alexandra Pickett, The SUNY Learning Network, State University of New York, apickett@sln.suny.edu

Abstract: In the fall of 1999 students in the SUNY Learning Network completed surveys regarding their level of satisfaction and perceived learning in an entirely on-line learning environment. The goals of the research were to begin to build a profile of satisfied, successful students studying in this environment and to tie the research to theory. To generate hypotheses social learning theory was used as a conceptual framework. Data were collected from 1584 students, representing the largest study of on-line student attitudes to date. The data was analyzed using univariate analysis. Results indicated that a number of variables were significantly correlated with high levels of satisfaction and perceived learning. These included level of interaction with the instructor and classmates, satisfaction with the Help Desk, and satisfaction with the administration of the SUNY learning network. The report includes an explanation of the results relative to social learning theory.

Introduction

The SUNY Learning Network (SLN) is an Asynchronous Learning Network (ALN) for the 64 colleges and universities and 400,000 students of the State University of New York. All of the activities that occur in a traditional college classroom occur on-line. These include, but are not limited to, lectures, discussions, written assignments, tests, labs, simulations, and opportunities to socialize with classmates. This study presents some of the results of a survey of students including relationships between student demographics and levels of satisfaction and perceived learning in the online environment.

Method

In the fall of 1999 students enrolled in courses in the SUNY Learning Network completed a survey, which asked them to comment about their satisfaction with and learning in this on-line learning environment. The survey consisted of twenty-five multiple-choice questions that utilized a Likert-type scale to assess degrees of satisfaction and learning. Demographic data were collected on variables such as student age, gender, academic level, distance from campus, and previous computer skills. These demographics were analyzed against items that assessed student attitudes about topics such as level of interaction with the instructor and classmates, level of learning compared to the traditional classroom, overall satisfaction with their specific course and with on-line learning in general. The data was analyzed for significant differences using univariate analysis of variance.

Review of Literature

Frequent reports in the popular media decry the lack of hard data on questions surrounding student attitudes about Internet based distance learning. This study was designed to provide such data, to determine how students who studied online felt about their courses and to discover whether the most satisfied students shared any characteristics. These are not new questions and a large body of literature points to similar answers. Most of these studies conclude that, regardless of the technology used, distance-learning courses compare favorably with classroom-based instruction and enjoy high student satisfaction. (Phipps, Merisotis, and O'Brien, 1999): It has been reported however that research in the area of distance learning suffers from several weaknesses. Phipps, Merisotis, and O'Brien (1999) summarize these:

"...the methodology of many of the research designs is weak, with regard to such factors as the populations being compared or otherwise studied; the treatments being given, the statistical techniques being applied, and the validity, reliability, and generalizability of the data on which the conclusions are based." (Phipps, Merisotis, and O'Brien, 1999; p. 28)

Other areas of weakness identified by the authors are

> "A. The research has tended to emphasize student outcomes for individual courses rather than for a total academic program. B. The research does not take into account differences among students. C. The research does not adequately explain why the dropout rates of distance learners are higher. D. The research does not take into consideration how the different learning styles of students relate to the use of particular technologies. E. The research focuses mostly on the impact of individual technologies rather than on the interaction of multiple technologies. F. The research does not include a theoretical or conceptual framework." (Phipps, Merisotis, and O'Brien, 1999; p. 11)

The authors conclude that although a great deal of research supports the notion that distance learning compares favorably to classroom based learning, the research is so weak that no clear conclusions can be made. While these criticisms cannot all be addressed by a single work, this study will attempt to account for as many of these weaknesses as possible. To address Phipps' et.al. first concern (A) this study will emphasize student attitudes not for individual courses but for the entire program represented by the SUNY Learning Network. In all the data used in this study represents more than 250 instructors and courses and over 1500 students. As such the data in this study represents a very large sample without the weaknesses identified by analyses of individual courses. With a sample of this size it can reasonably be expected that a wide variety of students and learning styles will be represented thus accounting for student differences in (B) and (D). Further, this study will look specifically at student differences such as age, gender, academic level etc. in an attempt to sort out how such differences affect student satisfaction and learning. Inasmuch as these courses utilized a wide variety of technologies (computers, audio, video, the Internet) it does not focus on a single technology as in (E). This study will also present a conceptual framework for understanding student satisfaction with online learning, accounting for (F). Unfortunately dropout rates (C) are not addressed by this study.

Conceptual Framework

"Learning, both outside and inside school, advances through collaborative social interaction and the social construction of knowledge" (Brown, Collins & Duguid, 1989).

Learning has been defined very cogently as a social process (Vygotsky, 1962, 1978; Bruner, 1990; Brown, Collins & Duguid, 1989; Lave, 1988, 1990) and any learning environment that is meant to foster understanding must account for the social nature of the endeavor. If an overarching framework for understanding student's feelings about working in the relative isolation of a virtual classroom is to make sense, this framework must account for mechanisms that overcome such isolation. Students learning in a virtual environment can be expected to require several support mechanisms in order to feel satisfied and to learn. These include the support of the faculty, classmates, the administration of the environment, as well as the technology, and content. If faculty are trained to recognize the affordances and constraints of virtual learning environments, if students and instructors are offered a variety of support mechanisms for overcoming social isolation, if courses and course content are designed with an understanding of the requirements of learning at a distance, then it can be predicted that student satisfaction and learning will be relatively high. In the absence of these prerequisites students can be expected to experience confusion, frustration and isolation. For a detailed description of the planning and execution of the overall program of the SUNY Learning Network, which describes the strategies employed to ensure that these prerequisites were met, see Pickett, 1999.

When learning is viewed primarily as a social process a number of predictions can be made about student affect in virtual learning domains. An obvious hypothesis is that interaction between student and teacher and student and student will be of great importance. From this conceptual perspective one would hypothesize significant relationships between students satisfaction with levels of interaction with the instructor and fellow students and their overall satisfaction with the learning experience. A second prediction - in as much as resources such as Helpdesk, technological tools and system administration break down barriers to collaborative social interaction, student satisfaction with these supports will be significantly related to overall satisfaction and learning. These predictions, stemming from a conceptual framework in which online learning is viewed primarily as a social process, are tested in this study.

Results

The results of the survey were quite positive overall. When asked, "How satisfied are you with your course?" the most common response was the highest rating available (very satisfied). Forty nine point seven percent (49.7%) of students gave this response. Another thirty eight point five percent (38.5%) gave the second highest rating (satisfied). Thus, overall, eighty eight point two percent (88.2%) of students were at least satisfied with their online course regardless of their background. Eight point five percent (8.5%) were "not very satisfied" and three point three percent (3.3%) were "not satisfied at all". When asked, "How much did you learn in your online course?" the most common response, once again, was the highest rating (A great deal). Fifty three point nine percent (53.9%) of students gave this response. Another thirty eight point six percent (38.6%) gave the second highest rating (sufficient). Thus, overall ninety-two point four percent (92.4%) of respondents felt that their level of learning was at least sufficient in the online environment, regardless of student background. Six point nine percent (6.9%) felt that their level of learning was "insufficient" and point six percent (.6%) felt that their level of learning was "none".

Among these students certain characteristics are significantly related to satisfaction and reported learning. When asked to rate their level of interaction with the instructor the following results were found. Thirty three percent (33%) of the students rated their level of interaction as "a great deal", the highest rating available. Fifty one percent (51%) felt that their level of interaction was "sufficient". Thus a total of 84% of the respondents felt that their level of interaction was at least sufficient in the online environment. Fourteen point six percent (14.6%) felt that the level of interaction was "insufficient" and one point four percent (1.4%) rated their level of interaction as "none". When the students level of satisfaction and learning are compared to their level of interaction with the instructor we find, as predicted, a significant relationship between these variables. Students who reported the highest levels of interaction with the instructor also reported the highest levels of satisfaction and learning.

Course Satisfaction Level of Learning * Interaction with Instructor

Interaction with Instructor		Course Satisfaction	Level of Learning
A great deal	Mean	1.2529	1.2107
	N	522	522
	Std. Deviation	.4731	.4266
Sufficient	Mean	1.5978	1.5347
	N	808	808
	Std. Deviation	.6240	.5795
Insufficient	Mean	2.6164	2.2328
	N	232	232
	Std. Deviation	.7919	.6691
None	Mean	3.1364	2.5000
	N	22	22
	Std. Deviation	.9409	.8591
Total	Mean	1.6547	1.5436
	N	1584	1584
	Std. Deviation	.7723	.6520

Note: All responses are based on a Likert scale from 1-5. A score of 1 is a high rating; a score of 5 is a low rating.

Table 1: Course Satisfaction and Level of Learning by Level of Interaction with the Instructor

As demonstrated in Table 1, each increase in students' level of interaction with the instructor is related to an increase in both satisfaction with the course and the student's reported level of learning. These increases are significant at the .000 level as demonstrated in Table 2 below:

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Course Satisfaction * Interaction with Instructor	Between	(Combined)	349.760	3	116.587	309.933	.000
	Within Groups		594.345	1580	.376		
	Total		944.105	1583			
Level of Learning * Interaction with Instructor	Between	(Combined)	188.214	3	62.738	204.476	.000
	Within Groups		484.781	1580	.307		
	Total		672.994	1583			

Table 2: Analysis of Variance for Course Satisfaction and Level of Learning by Level of Interaction with the Instructor

Additionally, these differences account a relatively large proportion in the variance between students' ratings of their levels of satisfaction for all the variables examined as seen in the strength of association test in Table 3 below:

Measures of Association

	Eta	Eta Squared
Course Satisfaction * Interaction with Instructor	.609	.370
Level of Learning * Interaction with Instructor	.529	.280

Table 3: ETA Squared Measure of Association for Course Satisfaction and Level of Learning by Level of Interaction with the Instructor

Ratings for interaction with the instructor account for the largest proportion of the variance for students' reports of satisfaction and learning. Additionally, high levels of interaction with classmates and high reports of learning and satisfaction were also significantly related. Students with the highest levels of interaction with classmates were also the most likely to report high levels of learning and to be the most satisfied. Due to space constraints, tabular information for these and other variables cannot be provided here. To see this information go to http://cms.suny.edu/research.htm#Results

Relationship of satisfaction and learning with other variables

As mentioned above, a focus on the social nature of learning leads to several predictions regarding online learning. In addition to the necessity of frequent interaction with the instructor and other students, online learners can also be expected to require other kinds of support in the potential isolation of the virtual learning environment. For example, the technical requirement of participating in such an environment pose a possible barrier to interaction, collaboration and hence the achievement of learning goals and attendant satisfaction. It can, therefore, be predicted that satisfaction with the administration of the environment will be significantly related to satisfaction and learning online inasmuch as the effective administration assists students to overcome these technological barriers to success.

An analysis of these variables does, in fact, show that they are significantly related. Other significant relationships that support the view that design and administration of online instruction should focus on the social aspects of learning include significant relationships between satisfaction with assistance provided by the Help Desk and high reports of student learning and satisfaction. Students who reported the highest levels of satisfaction with the Help Desk also reported the highest levels of learning and satisfaction. Similar relationships were found for students' feelings about technical difficulties. Those that felt that technical difficulties caused problems in the environment were also the most likely to report the lowest levels of learning and satisfaction.

One of the variables that do not appear to inhibit online learning is students' computers skill prior to taking the course. Students who reported low levels of computer skills before taking the course were no less likely to report high levels of learning and satisfaction in the course. As long as students were able to get assistance for overcoming technical difficulties reports of learning and satisfaction did not differ by prior computer skill level. The same can be said of online course experience. Students who had taken multiple courses through SLN were no less likely to report high levels of learning and satisfaction than students who had never taken an online course before. There is no evidence to suggest a "novelty effect" for satisfaction or perceived learning among these online students.

Another variable of interest was gender. Small but reliable differences exist suggesting that, women feel that they participate at higher levels than in the classroom, that they learn more, that technical difficulties are less likely to impede their learning, that they are more likely want to continue taking on -line courses, and finally, that they are more satisfied both with their specific courses at SUNY Learning Network and more satisfied with on-line learning in general than their male classmates. In summary, the on-line classroom appears to be a very female friendly place.

Discussion

The results reported here support the notion that online learning is best viewed through a focus on its social nature. Students who reported the highest levels of learning and satisfaction also reported the highest levels of interaction with the instructor and with other students, i.e. they had the greatest opportunity to collaborate. Students who reported the lowest levels of interaction with the instructor and other students reported the lowest levels of satisfaction and learning, i.e. they had the least opportunity for collaboration. Barriers to participation evidenced by dissatisfaction with the help desk and high levels of technical difficulties are also significantly related to satisfaction and reported learning. Students who reported the lowest levels of satisfaction with the help desk and high levels of technical difficulties also reported the lowest levels of learning and satisfaction. Inasmuch as interaction with the instructor and other students accounts for the most variation between students' ratings of their satisfaction and learning, it can be hypothesized that barriers to this interaction caused by technical difficulties and inability to get help with their resolution can be viewed primarily as barriers to student collaboration with instructors, peers and course content. Administrative process and instructional design in online learning should emphasize lowering barriers to and increasing opportunities for social collaboration and the social construction of knowledge.

References

Brown, J.S., Collins, A. & Duguid, S. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32-42.

Bruner, J. (1990). *Acts of Meaning*. Cambridge, MA: Harvard University Press.

Lave, J. (1988). *Cognition in Practice: Mind, mathematics, and culture in everyday life*. Cambridge, UK: Cambridge University Press.

Lave, J., & Wenger, E. (1990). *Situated Learning: Legitimate Peripheral Participation*. Cambridge, UK: Cambridge University Press.

Pickett, A. (1999). The Faculty Development and Course Design Process at the SUNY Learning Network. *Proceedings of Webnet 99*, Honolulu Hawaii.

Vygotsky, L.S. (1962). *Thought and Language*. Cambridge, MA: MIT Press.

Vygotsky, L.S. (1978). *Mind in Society*. Cambridge, MA: Harvard University Press.

How to Show Web Pages for Learners: Teaching and Learning with Web Recorder.

Toshio Souya
Tokyo Research Laboratory, IBM Research, Japan
souya@trl.ibm.co.jp

Chie Ohtani
Zenjin Education Institute, Tamagawa Gakuen, Japan.
Chie_Ohtani_L@k12.tamagawa.ac.jp

Yoshinori Aoki
Tokyo Research Laboratory, IBM Research, Japan
yoshia@jp.ibm.com

Yoshie Masuda
Personal System Group, IBM Japan Ltd., Japan
yoshie7@jp.ibm.com

Amane Nakajima,
Tokyo Research Laboratory, IBM Research, Japan
amane@jp.ibm.com

Abstract: There are huge numbers of Web pages in the Internet. However, many learners tend to miss useful pages, miss valuable information in a page, or misunderstand the contents because there are huge amount of irrelevant information exist mingled with the useful information. To deal with this problem, we propose a "Web Recorder" system that provides functions for recording and replaying Web browsing operations and annotating pages. Instructors can create a Web browsing "scenario" to show learners Web information that is relevant to the learning objectives. We conducted experiments in real learning and teaching activities. The results indicate that the system made it easier for learners to become aware of and to understand important information dispersed in the pages. Improvements in teaching and learning effectiveness were observed in the course of these experiments.

1. Introduction

The Internet has become a common medium for the provision of information and services. Numerous studies have been done on how to create materials to be delivered via the Internet (e.g. Brooks 1997, McCormack, 1997) and there are projects where the creation of materials is used as a means for education (e.g. Thinkquest 2000). In these kinds of activities, the Internet is considered as a communication channel to deliver materials and to interact without regards to time and distance. On the other hand, the Internet, especially the Web system, can also serve as a huge database system consisting of sites around the world. We believe that the Web can be an ideal learning and teaching resource if the information meets the needs of the learners.

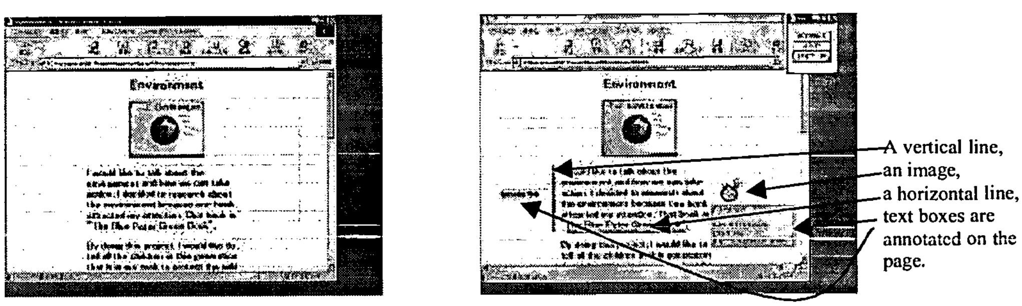
From the viewpoint of learners and instructors, there are several issues in using Web for learning. First, the Web contains a lot of information but not all of it was created for learning or teaching purposes. Even if a topic on a Web page is suitable for a learning activity, the page likely contains some useless information or insufficient information for the whole activity. Second, learners themselves have to decide which pages to browse, even though they may be unsure where to go. Third, it is hard for an instructor to control a learner's browsing operations. A learner in front of a Web browser is likely to click hyperlinks regardless of the instructor's intentions.

All these issues create difficulties during Web-based learning and teaching activities. We the essential problems are that (1) it is hard for learners to extract valuable information from large numbers of Web pages without any help and (2) it is hard for instructors to lead their learners to valuable information on Web pages.

To address these problems, we propose a method for showing Web pages by using the "Web Recorder" system. The Web Recorder enables an instructor to record and play back operations on a Web browser. An instructor can create a series of operations (which we call a "scenario") corresponding to the teaching intention.
This paper describes experiments to investigate how the Web Recorder can improve learning and teaching effectiveness. In the next section, we give an overview of the Web Recorder system, mainly from the functional point of view. In the third section we describe our objectives, plans, and the results of three experiments. After that, we discuss the implications of the results, mainly as regards how the system changes a learner's behavior. Finally, we present our conclusions and outline future work.

2. System Overview

In this section we explain the functions of the Web Recorder.
The Web Recorder is a software system that has functions for both recording and playing back a user's operations on a Web browser. To record operations, the Web Recorder gathers operation events on a Web browser. Each operation is recorded with a time stamp and parameters, and stored in a file as a "scenario." To play back operations, the Web Recorder throws events to a Web browser according to the scenario. The Web browser processes the events in the same way as an actual user's operations. In this way, the Web browser plays back the recorded behavior.
Web browser operations that can be recorded by the system are as follows;
(1) Page loading
(2) Page scrolling
(3) Mouse movement
(4) Text, images, hyperlink, and voice annotation
Page loadings are recorded with related URLs to show the same pages during a playback. Page scrollings are recorded to show the same part of the page. Mouse movements are recorded to show the same mouse pointer movement. The recorded mouse pointer movements can mark the focus on a page. These three operations are available on the usual Web browser and the Web Recorder also enables users to make annotation operations (Figure 1). While recording on a Web browser, an operator (usually an instructor) can add text, images (e.g., illustrations or underlines), hyperlinks, and voice to Web pages without modifying the HTML files of the pages. These annotations are recorded as operations and stored in the scenario file. A graphical user-interface for annotation is included in the Web Recorder system. Thus an operator can add annotations without any special knowledge, such as how to use a page description language.
The Web Recorder was implemented with common Internet programming languages such as Java and JavaScript and runs in a standard Internet environment such as a Web browser. Thus the program and operation scenarios, which are plain text files, can be distributed via the Internet.
The details of the system are described in (Aoki et. al., 1999, and Aoki et. al., 2000).



(a) A page view without The Web Recorder (b) A page view with annotations by the Web Recorder

Figure 1: Page views with and without the Web Recorder

3. Experiments in Class Activities

Two classes at Tamagawa Gakuen secondary school attended experimental lessons, which we organized in cooperation with the school's teaching staff.

3.1 Objectives of Experiments

Our main objective was to examine how the Web Recorder reduced the difficulties of using the Web, and improved learning and teaching effectiveness. We planned and conducted three experiments to examine the following points:

(1) The Web Recorder system as means of showing information.

Showing information is an essential function of scenario playback. It was compared with giving information on a sheet of paper.

(2) A method for improving teaching effectiveness with the Web Recorder.

The system enables teachers to indicate a focus and to show interpretations on parts of page. The effects of these techniques were examined.

(3) A method for organizing learners' net surfing.

The Web Recorder can guide learners around Web pages. We examined how it works in a class activity.

3.2 Experiment 1: Feasibility Study

First, we examined the properties of the system's functions for showing interpretations. The Web Recorder system has a function to show interpretations on the Web pages. The interpretations are presented as textual and/or graphic annotations. It can facilitate learning and teaching activities because the system shows the interpretations near the original information.

3.2.1 Experimental Method

We selected a unit in the English curriculum on understanding different cultures, and gathered various Web pages that were appropriate for the unit except for the difficulty of the English and the number of topics on the pages. We then added abstracts for the pages and notes (The pages were used after receiving the author's permission).

We divided the class into two groups (of 13 and 12 students) and conducted experiments in two sessions. In the first session we gave one group a Web page with annotations made with the Web Recorder. For the purpose of comparison, the other group saw the same Web page with annotations printed on a sheet of paper. In the second session, we prepared another topic. The group, that used the Web Recorder in the previous session, saw the new topic on a Web page with a sheet of paper, while the other group used the Web Recorder.

3.2.2 Results of the Feasibility Study

After each session, we asked the students to answer six questions:

(1) Was the session fun?
(2) Was the topic interesting?
(3) Was there enough time for you?
(4) Is it useful to use Web pages as we did today, in comparison with looking at Web pages by yourself?
(5) Did you understand the topic in the textbook better than usual?
(6) Would you feel more interested in English if we often have sessions like today?

Each question had five possible responses to indicate opinion ranging from the most favorable (e.g., It was really fun, really interesting, and so on) to the most unfavorable answers (e.g., It was not fun at all, etc.).

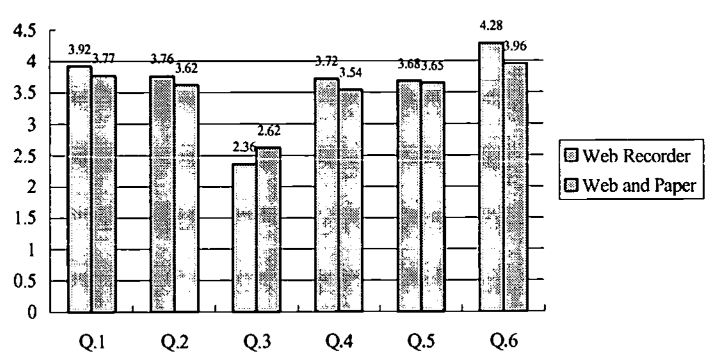


Figure 2: Average Results from Feasibility Study Questionnaire.

We converted the answers into scores ranging from 1 (most unfavorable) to 5 (most favorable) and averaged the results separately according to whether the Web Recorder was used or not. The scores were averaged to cancel the effects of topics and the competence of group members.

Figure 2 shows the averaged scores for each of the questions.

These results indicate that; the scores for recorder users exceeded those for browser and paper users in the results of five questions out of six. For Question 3, the score of the Web Recorder group did not exceed those of the other group. The question was about if the given time had been enough or not (a higher score indicates that they felt enough time was given). There was a system trouble with the Web Recorder that forced students to wait for a long time (it was solved before the second session). It is likely that the trouble caused a negative influence on the Web Recorder users' score for the question.

In evaluating the result, we have to take account of the presentation problems. Thus we believe we can conclude that the Web Recorder had equally good or better characteristics than paper as a medium for showing information.

3.3 Experiment 2: Focusing and Interpretation

In the second experiment, we examined the effect of focusing and interpreting on teaching activity in a classroom. We believe that teacher-led sessions are a common and valuable way of presenting ideas. It is meaningful to try to improve teacher-led sessions not only through the various merits of the Web such as volume, freshness of information and bi-directional communication, but also through the method of the Web Recorder.

3.3.1 Experimental Method

To observe how the system facilitated teaching sessions, we planned a review session after a presentation session in English to a class, which consists of students who have returned to Japan after living abroad. The educational objective was to give the students some ideas on presentation skills and to make them to think about how to improve their presentations. First, we recorded all of their speeches and created Web pages that reproduced their presentations, using conventional Web authoring tools. The pages consisted of their voices and scripts of their presentations. We selected the best two presentations and created the teaching scenario by using the Web Recorder to present these pages with annotations of major points. We also recorded the teaching presentation as an operation sequence.

The experimental session consisted of self-reviewing the pages created for each student, then a lecture on a sample presentation, using the Web Recorder, and a discussion of how they felt about improving their presentations.

We gathered their opinions on their presentations and suggestions to improve them. We asked them to categorize their opinions and suggestions into those concerning presentation technique and those concerning contents. These opinions were compared with the opinions submitted at the end of the presentation session (i.e., before the experimental session). We observed the class session and evaluated how the recorder facilitated it.

3.3.2 Results of the Review Session

Differences were observed between the opinions received before and after the experimental session, in both number and quality. Before the review session, there were only 26 opinions from 15 students. After the review session, the number increased significantly to 63 opinions. The system contributed to the success of the class by focusing on many ideas, although this was not entirely due to the Web Recorder.

As regards the quality of the opinions, these after the review session concerned concrete methods for achieving concrete improvement. On the assumption that the opinions progress from vague impressions to concrete methods, they were categorized into three groups:

(Category 1) Abstract points for improvement

(Category 2) Concrete points for improvement

(Category 3) Concrete methods for achieving improvement

Table 1 shows the results of categorization:

Counts of Opinion	Before the Review	After the Review
Category 1 (Abstract Points)	5	4
Category 2 (Concrete Points)	21	55
Category 3 (Concrete Methods)	0	4
Total	26	63

Table 1: Numbers of opinion in each category before and after the review session.

It is obvious that more opinions appeared in Categories 2 and 3 after the session. The system had succeeded in focusing and strengthening the presentation of the teaching materials, and had contributed to the success of the teaching session.

3.4 Experiment 3: Organizing Web Browsing

Third, we tried to organize class activities in net surfing with the aim of achieving a learning objective set by a teacher. It is hard for students to find and understand descriptions of a topic scattered over several pages. This experiment examined the effects of the Web Recorder system for guiding students to several paragraphs scattered over several Web pages and interpreting understanding them.

3.4.1 Experimental Method

We selected the topic "weddings and marriage" from a learning unit titled "Understanding different cultures." We decided that the educational objective of the teaching was to motivate English study by giving the students the experience of finding an interesting world of different cultures through English and the Internet. First, we searched around the Internet, then chose 13 pages containing descriptions related to the topic. We felt that 13 pages would be enough to simulate Internet surfing because this amount is enough for a one-hour class. We received the authors' permission to use their pages, and created link lists for these pages. We prepared translations for each page, because the English of the pages is too difficult for the students to understand without spending considerable time.

We then chose 8 pages containing descriptions of customs significantly different from those in Japan. From many interesting points in those pages, we selected 10 points for the class, and a teacher created a surfing scenario to see these points scattered among the pages.

In the experimental class hours, each student had a computer and was able to freely browse Web pages from the link list page that we had created. We divided one class of students into three groups, and divided a class hour into three periods. We showed the scenario to each group in a different period; for instance, we showed the scenario to group 1 in period 1, to group 2 in period 2 and to group 3 in period 3. One period was ten minutes, which was not enough to see the whole scenario, and the students could control the Web Recorder to progress to the next point. Each student had a sheet of paper to write down comments about what they found.

3.4.2 Results of Organizing the Web Browsing

Table 2 shows the averaged numbers of comments per person for each group and period.

	Group 1	Group 2	Group 3
Period 1	1.8 (*)	1.5	1.5
Period 2	1.6	2.2 (*)	1.9
Period 3	1.3	2	3.0 (*)

(*) Groups saw the scenario by Web Recorder in this period.

Table 2: The averaged numbers of comments from the organized Web browsing.

Each group saw the scenario recorded by the Web Recorder in the period marked "(*)." Obviously, the members of each group expressed more comments in the period when they saw the scenario than the other groups in the same period, and than during their other two periods. We believe that this result indicates that the Web Recorder organizes the Web surfing to focus on points of the teacher's intention among large amounts of information.

We also noticed a decrease in the number of comments during the period after they saw the scenario even though the average increased. Figure 3 shows the average number of comments from all groups for each period:

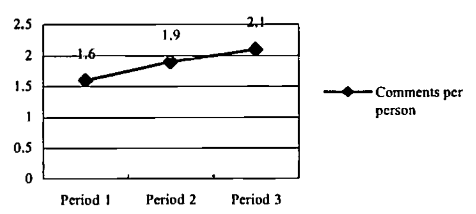


Figure 3: Average number of comments from all groups for each period in the organized Web browsing

We believe this tendency resulted from the students getting the hang of the work. This is why we can see that the overall average increased, despite the previously mentioned decrease after seeing the scenario. We observed the following attitude among some students: "I have seen the contents of the scenario. What should I do now?" even though there were many points they had not focused on. This kind of attitude and the decrease in the number of comments after seeing the scenario shows that the students felt satisfaction and had an illusion that they had seen all the topics.
Figure 4 shows the average number of comments for each group in whole period.

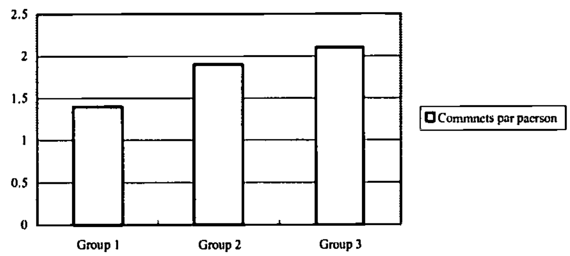


Figure 4: Average number of comments for each group in the organized Web browsing.

The average numbers may have been affected by the period when they saw the scenario. We believe that they were not significantly affected by the ability of each individual group, because we took care to create groups of equal ability. To put it simply, we feel these averages indicate that the scenario should be shown at the end of the class hour. We can conclude that the Web Recorder helps learners to focus on the exact point selected by the educator, but we have to be aware of the feeling of complacency.

4. Discussion

Besides presenting the results, we have to consider some limitations of our research. First, we conducted only one experiment of each type because we had limited time for these experiments in the regular teaching schedule. Second, the numbers of students are too small to prove the effects statistically. Also there should be a measurement method for education results beside the use of questionnaires. In spite of these limitations, we believe that the results indicate the software has some excellent features for education and suggest directions for the next experiments, which will investigate the system while addressing these limitations.

5. Conclusion

The Web Recorder has functions for showing important parts of Web pages without distraction from a huge number of pages or from a large number of topics in a single page. It also has functions for adding annotations to parts of pages to interpret them or provide the contextual knowledge required understanding them. We conducted three types of experiment involving real class activities to examine how these functions affected learning and teaching. The results indicate that the Web Recorder can eliminate some of the difficulties faced by learners because of specific properties of the Internet, such as excessive numbers of pages, excessive number of topics on a page, and lack of necessary background information. The Web Recorder improves learning and teaching effectiveness with Web browsing by improving the method of showing pages.

Reference

David W. Brooks (1997). *Web-Teaching, A Guide to Designing Interactive Teaching for the World Wide Web*, Plenum Publishing Corp.
Colin McCormack (1997). *Building a Web-Based Education System*, John Wiley & Sons.
ThinkQuest Inc. (2000). *Thinkquest*, as http://www.thinkquest.org/, ThinkQuest Inc.
Aoki, Y., and Nakajima, A. (1999) The 8th International Conference on Human Computer Interaction (HCI International '99), *User-Side Web Page Customization*, Vol. 1, pp. 580-584, August 1999.
Aoki, Y., Ando, F., and Nakajima, A. (2000). The 7th International Conference on Parallel and Distributed Systems (ICPADS2000), *Web Operation Recorder and Player*, (will be appeared), July 2000.

Evaluating the Impact of System Dynamics Based Learning Environments

J. Michael Spector
Syracuse University, IDD&E
330 Huntington Hall, Syracuse, New York 13244 USA
Spector@syr.edu

Dean C. Christensen
University of Bergen, EIST
Herman Fossgate 6, 4. Etg.
N 5020 Bergen, NORWAY
Deanc@ifi.uib.no

Dalton McCormack
University of Bergen, IFI
Herman Fossgate 6, 4. Etg.
N 5020 Bergen, NORWAY

Abstract: A promising approach to support learning in and about complex domains involves the use of system dynamics as a methodology since it supports both the modeling of complex systems and interaction with those models (Sterman, 1994). Two central disputes among advocates of system dynamics based learning are: (1) the extent to which collaboration among learners facilitates learning; and, (2) the utility of making underlying models accessible to and modifiable by learners (Davidsen, 1996). Both of these issues concern the degree of learner engagement and appear crucial to overall learning effectiveness. Little empirical evidence has been gathered to explore learning effects of different approaches. This paper describes a methodology for evaluation of learning effectiveness in complex and dynamic domains and reports on its the use in settings that include/exclude opportunities for collaboration, which show/hide the underlying system dynamics model, and which allow/disallow modification of the underlying model.

Introduction

Many excellent uses of system dynamics to support learning in complex domains exist and are available commercially. Learning environments to support learning about complex, dynamic systems include SimCity™ for helping children learn about factors influencing the growth of urban area and Beefeater™ for helping adults learn about factors influencing the growth of a particular business, and a host of other such environments which are now frequently used to support various types of learning activities. Such environments are consistent with a great deal of learning research concerning active learning (Bruner, 1985), cognitive apprenticeship (Collins, 1991), cognitive flexibility (Spiro et al., 1987), and situated learning (Lave, 1988).

However, there is very little evidence to demonstrate the impact of these environments and their overall learning effectiveness. Moreover, there is no established methodology to determine which design approach might be most likely to lead to desired learning outcomes in various situations. Our long term goal is to develop a methodology which can be used to insure consistent success in the effectiveness of system dynamics based learning environments, and to establish reliable measures of effectiveness for such environments. We shall describe an evaluation methodology that is particularly well suited to complex and dynamic domains. We shall then describe how that methodology can be used to evaluate the impact of different key design decisions in constructing such environments, including whether and how to support collaborative learning, whether and when to make the underlying model visible to learners, and whether and how to provide learners with control of the underlying model.

There exists a well-elaborated methodology for analyzing a complex, dynamic domain in terms of system dynamics (Davidsen, 1996; Spector & Davidsen, 1997). That model proceeds on several assumptions. First, the type of complexity involved is characterized by systems which involve nonlinear relationships, delays and internal feedback among several variables, systemic behavior which may change dramatically over time, and systems in which human perceptions and actions based on perception play an active role in determining performance and outcomes. That such systems can be effectively modeled using system dynamics is now quite well established (Forrester, 1961, 1985, 1992; Sterman, 1994). What is not well established is how such models can be optimally used to facilitate learning.

It has been argued that collaboration facilitates learning about new and complex topics (Salomon, 1993; Vygotsky, 1978). This belief in the utility of collaboration in learning, however, has not been demonstrated to be effective in the context of system dynamics based learning environments, although nearly all such environments in some way attempt to integrate collaboration with other learners into various learning activities.

Moreover, there is a clear distinction between a model of reality and the process of modeling reality. Many of those who support the use of system dynamics in learning about complex domains generally support the notion of constructivists that learners construct their own models of reality. Likewise, many who construct system dynamics based learning environments believe that active learner engagement with the underlying models is crucial. This implies that learners should be eventually be provided with access to underlyling models and encouraged to modify and reconstruct those models.

Rouwette and colleagues (in press) further argue that group model building actively contributes to learning outcomes. They have produce some preliminary evidence that both the collaborative and the constructivist aspects of such system dynamics based learning environments contribute to improved learning. However, their research is largely based on data gathered from self-reports of participants and is difficult to independently confirm and validate.

From this brief review of design trends and beliefs with regard to system dynamics based learning environments, it should be obvious that learner engagement is generally viewed as critical to the efficacy of a learning improvement, consistent with the general instructional design and learning effectiveness literature. Moreover, the general belief in the system dynamics learning community is that collaboration with other learners enhances learner engagement as does the ability to manipulate existing and create alternative models. While we share these widely held beliefs, it is our intention to establish a methodology which can be used to determine to what extent these beliefs are true.

The Evaluation Methodology

It is possible to view learning from a number of alternative perspectives. The preferred learning perspective largely determines the appropriate learning effectiveness methodology. Sfard (1998) identifies a participation metaphor and contrasts it with an acquisition metaphor. She argues that both metaphors should be taken into account when considering learning from a larger and longer-term perspective. We agree with this argument. The implications for evaluation are twofold. When learning is viewed as acquisition of expertise, it makes sense to evaluate learning in terms of how learners are performing and thinking in comparison with experts. When learning is viewed as participation in a community of practitioners, it makes sense to evaluate how activities of learners are changing in various learning and working situations. When the domains are dynamic and complex, evaluation is more challenging since experts are likely to exhibit a wider ranges of performances and since activities are much more open-ended than is the case with simpler domains. Nevertheless, a scientific attitude with regard to the design of environments to support learning about complex domains implies the need to collect measures of outcomes in a variety of settings in order to determine what works best, when, and why.

We begin with the learning-as-acquisition-of-expertise perspective (Ericsson & Smith, 1991). With simpler domains, it has been demonstrated that experts do in fact exhibit similarities in their thinking, and, consequently, it is possible to capture initial learner thinking patterns in the form of concept maps, to see how those maps differ from concept maps of experts, and then track changes over time and after instruction and experience performing a variety of tasks (Schvaneveldt et al., 1985). The type of concept maps which have been used to capture learner and expert thinking range from association nets to semantic networks. Surprisingly, simple association nets have proven to be excellent predictors of performance in a variety of domains, including aircraft maintenance as well as formation flying (Schvaneveldt et al., 1985). These domains, however, are not complex and dynamic in the sense described earlier, so we still regard these domains as simple when compared with the domains modeled and supported with system dynamics (e.g., predicting the spread of an epidemic, macro-economic planning, environmental policy formation, etc.).

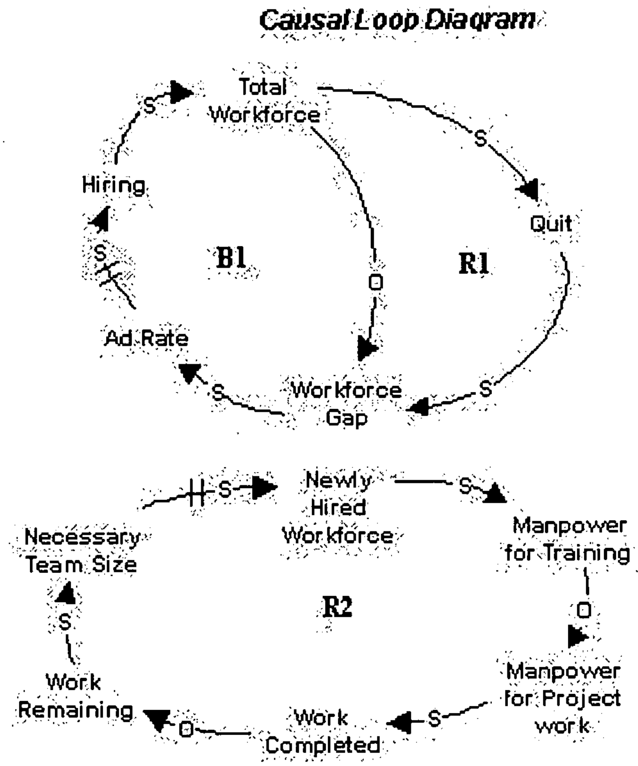


Figure 1. Causal loop diagram for workforce problems.

The type of concept mapping methodology which appears to be the most appropriate for the kinds of complex, dynamic domains which are well supported by system dynamics modeling and simulation techniques is causal loop diagramming. Causal loops are visual representations of the dynamic influences and interrelationships that exist among a collection of variables. Figure 1 depicts a causal loop diagram for typical workforce problems which project managers confront. This diagram consists of a number of key factors which are linked. The arrows and letters 'S' (same) or 'O' (opposite) indicate the direction and nature of causal influence. For example, hiring leads to an increase in the total workforce. An increase in the total workforce leads to a decrease in the workforce gap (those needed to fulfill task requirements). The double slash across a link indicates a delay. Identifying and understanding the nature of delays is especially problematic in complex systems. In this example, there is a delay indicated between the time an advertisement for a job is published and when a person is hired. A second delay is depicted between when an increase in necessary team size is identified and persons hired and placed onto the team.

It should be noted that this causal loop diagram is intended only to represent the general nature of causal loop diagrams. It docs not necessarily represent how experts view a particular workforce problem. Much that is relevant to such problems has been omitted to make the problem and diagram easily accessible. For cxample, there is a significant delay between the time when persons are placed on a project and an improvement in overall project productivity. Often productivity even declines initially when additional persons are added because they are typically less experienced workers, require training and project orientation, and increase the communication overhead associated with an effort. The point here, however, is that it is just such subtle relationships and delays that expert project managers are able to anticipate and integrate into project planning. Moreover, it is precisely such delays and internal feedback that less sophisticated concept mapping tools fail to capture.

Our general hypothesis is that within the context of a problem area in a complex, dynamic system experts will construct similar causal loop diagrams. Furthermore, these diagrams will be noticeably different from those constructed by less experienced persons. As a consequence, the level of fit between a learner's causal loop diagram and that of an expert's will be a reasonable predictor of level of expertise in that problem domain. This particular methodology is partly quantitative and partly qualitative in nature. A measure of fit between a learner's causal loop diagram and an expert's is derived based on similarities in the set of key concepts identified for a particular problem domain, and the types and directions of links. Additionally, subjects are asked to insert open-ended comments about links and key components. Protocol analysis is used to determine whether a subject's comments reflect an expert level of understanding of that problem domain.

When learning is considered as participating in a community of practitioners, a different evaluation methodology appears more appropriate. In this case, patterns of collaboration with peers, places where specific expertise is sought, how proposals are evaluated, interactions with and about various artifacts, and the like are more directly relevant. These data can be collected by interviews and observations and changes noted. The evaluation methodology in this case is primarily qualitative in nature, drawing on the notion of distributed cognition (Salomon, 1993) and the general approach found in activity theory (Nardi, 1996) from a learner-centered, phenomenographic perspective. Specifically, learners and teachers are interviewed prior to exposure to a learning experience with a participatory, system dynamics learning environment. That learning environment will constitute the primary mediating object. Questions are designed to establish current patterns of interactions with other learners and teachers, to determine attitudes about specific technology-based learning capabilities, and to record perceived learning value of those capabilities. During the learning experience and subsequent to the experience with the participatory learning environment, learners and teachers are interviewed and asked similar questions. Changes are analyzed so as to determine whether and how patterns of interaction and attitudes evolve as a result of participation in the continuing construction of a digital database or simulation on the web.

Discussion and Conclusions

The first step in developing the causal loop mapping tool was to determine if it was true that experts did produce similar causal loop diagrams for particular problem domains. Three quite different problems were selected for this purpose: (1) an inventory management problem; (2) an environmental policy formulation problem; and, (3) a problem involving interpersonal relationships. In each domain, five experts and five novices were asked to produce causal loop diagrams on paper representing the concepts, factors, and causal relationships thought to be associated with a short problem description (about two pages each).

Since there were obvious similarities in the set of expert causal loops diagrams, and because newcomers to a complex domain exhibited noticeably different causal loop diagrams, there is the possibility that the nearness of fit to an expert's causal loop diagram would be a predictor of expert understanding in a particular problem domain. Based on this initial confirmation, a tool was built to facilitate the creation of problem scenarios and associated causal loop diagrams. The tool is designed to proceed in two steps, first prompting subjects to create a list of annotated key concepts from the scenario, and then prompting users to create an annotated causal loop diagram based on those key concepts. Subjects are allowed to revise their ideas and all entries are recorded in a user log file.

Automating the process of performing the concept mapping is intended to make it possible to collect and analyze a great deal of relevant data to determine how effective particular learning environments are with regard to promoting understanding in and about complex domains. This approach is basically an extension of the pathfinder technology (Schvaneveldt, 1990) to include complex, dynamic domains and a concept mapping and analysis tool appropriate to such domains.

The qualitative methodology and interview techniques used for the analysis of participation in communities of practice has been used in other domains and independently demonstrated to be robust (see, for example, Nardi, 1996). Our findings from initial pilot tests indicate that both methods tend to produce consistent indications of learning effects. If this finding continues to hold as additional subjects are tested, and if there is independent confirmation that a correlation between these indicators and performance on complex tasks, then the advantage of the causal loop diagramming technique is that it can also support learning about complex domains and not merely evaluation of learning effects.

References

Bruner, J. S. (1985). Models of the learner. *Educational Researcher,* 14(6), 5-8.

Collins, A. (1991). Cognitive apprenticeship and instructional technology. In L. Idol & B. F. Jones (Eds.), *Educational values and cognitive instruction: Implications for reform*. Hillsdale, NJ: Erlbaum.

Davidsen, P. I. (1996). Educational features of the system dynamics approach to modelling and simulation. *Journal of Structured Learning,* 12(4), 269-290.

Forrester, J. W. (1961). *Industrial Dynamics.* Cambridge, MA: MIT Press.1961, 1985, 1992; Sterman, 1994).

Forrester, J. W. (1985). 'The' model versus a modeling 'process'. *System Dynamics Review,* 1(1), 133-134.

Forrester, J. W. (1992). Policies, decision, and information sources for modeling. *European Journal of Operational Research, 59(1), 42-63.*

Lave, J. (1988). *Cognition in practice.* Cambridge, UK: Cambridge University Press.

Nardi, B. (Ed.) (1996). *Context and consciousness: Activity theory and human-computer interaction.* Cambridge, MA: MIT Press.

Piaget (1970). The science of education and the psychology of the child. NY: Grossman.

Rouwette, E. J. A., Vennix, J. A. M., & Thijssen, C. M. (in press). Rouwette, Group model building: A decision room approach. *Simulation and Gaming.*

Salomon, G. (Ed.) (1993). *Distributed cognitions.* New York: Cambridge University Press.

Schvaneveldt, R. W., Durso, F. T., Goldsmith, T. E., Breen, T. J., Cooke, N. M., Tucker, R. G., & DeMaio, J. C. (1985). Measuring the structure of expertise. *International Journal of Man-Machine Studies*, 23, 699-728.

Schvaneveldt, R. W. (Ed.) (1990). *Pathfinder associative networks: Studies in knowledge organization.* Norwood, NJ: Ablex.

Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Research*, *27*(2), 4-12.

Spector, J. M. & Davidsen, P. I. (1997). Creating engaging courseware using system dynamics. *Computers in Human Behavior*, *13*(2), 127-155.

Spiro, R. J., Vispoel, W., Schmitz, J., Samarapungavan, A., & Boerger, A. (1987). Knowledge acquisition for application: Cognitive flexibility and transfer in complex content domains. In B. C. Britton (Ed.), *Executive control processes* (177-200). Hillsdale, NJ: Lawrence Erlbaum Associates.

Sterman, J. D. (1994). Learning in and about complex systems. *System Dynamics Review,* 10(2-3), 291-330.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* (M. cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds. and Trs.). Cambridge, MA: Harvard University Press.

Facilitating Learning via Computer Conferencing: Aspirations, Requirements and Hard Facts.

Dr Stuart D Stein.
University of the West of England
United Kingdom
Stuart.Stein@uwe.ac.uk

Abstract: This paper explores the validity of contentions made in the literature concerning the advantages of computer conferencing in *facilitating* learning. It asserts that much of the supporting research is lacking in conceptual clarity, methodological rigor and systematic analysis. The findings have frequently emerged from studies conducted under conditions removed from everyday instructional contexts. Consequently, these can only be generalised with difficulty to extra-research settings, if at all. The paper includes a report of case studies on the use of computer conferencing in settings that probably approximates more closely the *typical* instructional context in many institutions of higher education. Non-moderated computer conferencing was employed on a number of courses and the results compared to others that employed traditional, non-electronically mediated, pedagogic approaches. The results indicate that in the absence of any moderator input, students can achieve results comparable to those attained by more traditional methods.

Overview

The literature on computer conferencing is already very extensive and has periodically been subjected to extended reviews (e.g. Kaye 91; Mason 91; Paulsen 95; Berge) Although a significant volume of work has been undertaken to establish whether or not the deployment and use of electronic mediating technologies enhances learning outcomes, many findings have been called into question on conceptual, methodological and empirical grounds. (e.g. Schute; Russell; Neal; Cooper and Robinson; Springer, et al.) Moreover, the findings tend to be somewhat inconsistent, as Kaye (1991) has noted. Although there appears to be a broad consensus that computer conferencing can enhance the learning experiences of students, especially as far as distance learning is concerned, not much evidence has been adduced that the learning/pedagogic outcomes are in some sense superior to those attainable via more traditional face-to-face interactive forums.

Much of the literature is comprised of case studies of the ongoing experiences of educators. Generally, this has a tendency to be methodologically unstructured. It is often non-comparative in orientation, does not include adequate control groups, and is rarely enlightened by appropriate statistical analysis. Consequently, many of the findings are essentially anecdotal, being, for the most part, reports from the electronic frontier. Although it may very well turn out in the medium to long term that many of these "common-sense" assertions are borne out by subsequent research, at this juncture many of the claims that have been made appear to be unproven, not a few of which are, in Popperian terms, untestable.

To illustrate with one example, the literature abounds with claims concerning the benefits of computer mediated group work without specifying clearly what the dependent variables are, and what would constitute reasonably adequate confirmation. Thus, Henri (91; see also Kaye 91; Harasim 89) contends that group-work "consistently yields results of a higher calibre than those attained by the average group member. This is due to the greater amount of information available within the group, the greater diversity of interpretations of fact and the opportunity to test individual ideas. ...the combination of social osmosis, the circulation of ideas, and the links established among the participants all contribute to the efficiency of CMC group exchanges." Perhaps, but a very elaborate and problematic research design would be required to provide evidence attesting to this (see Berthold M.R. et al., 97, on mailing list interactivity). At present the most frequently employed *objective* evaluative criterion is grade performance, whilst the *subjective* counterpart is student satisfaction. Detailed qualitative analyses of exchanges are the only means of grappling with such wide reaching claims. The required research designs are intensively resource demanding, and the findings are unlikely to meet requirements of replication and objectivity, however loosely defined. (see Mason, 1991; Berthold et al.,97.; Henri 91; Graham, et al., 99, on the need for qualitative assessments of content)

In these reports there is all too often-insufficient consideration given to the large number of interacting variables plausibly associated with perceived outcomes, learning and other. Some of the most significant relate to characteristics associated with participants in conferencing exchanges. There is no question that until very recently most case studies were based on experiences with distance education students. (e.g., Kaye 91, Mason 91, McConnell 91) A disproportionate number involve students taking information technology related courses, students who can be expected to be more favourably disposed toward pedagogic programs employing electronic platforms (e.g. Hiltz 95). The student subjects in many studies tend to be older than the typical campus-based student, and differ from them in other important respects which probably have a direct bearing on learning related outcomes. Their motivation and commitments, their social relations, the nature of their social networks, their economic situation, and their pedagogic backgrounds and experiences, all potentially relevant to learning outcomes, are probably significantly different from those of the vast majority of students undertaking campus-based higher education courses.

The list of potentially relevant variables is too lengthy to include a detailed exposition on here. They include, but are by no means limited to: (1) the category of student [mature/school graduate; graduate/post-graduate; experienced electronic communication media users/inexperienced electronic communication media users; continuing education/life-long learning]. (2) The conferencing system employed and its organisation, [which relate to ease of use, difficulty of hierarchical inclusion and integration, feedback on activities engaged in by participants, availability of private and public fora, integration with other electronic applications and their transparency/ease of use]; (3) The extent to which the conferencing system is integrated with other electronic applications [e.g. use of the Web, electronic revision/testing applications]; (4) The role of the conferencing component in the overall structure of the delivery of pedagogic materials. (5) The overall pedagogic context and its structure.

Two other clusters of variables that I wish to draw attention to here are the *instructional context* and *instructor moderation*. In the research literature on computer conferencing there is often a failure to emphasise the somewhat *ideal* conditions under which a significant number of these projects have been undertaken. Many studies, as noted earlier, have been carried out on mature and highly motivated students, frequently undertaking courses at a distance. The sample sizes are frequently relatively small (e.g., McConnell 91; Soby 91; Warren and Rada 88; Mason, 91; Heath 98). Many studies have been funded with additional financial resources that have enabled instructors to carry out such projects unburdened by the teaching and administrative constraints that many instructors in higher education institutions have to contend with. The instructional context in which the case studies described below were carried out approximate more closely the conditions described by Hiltz as obtaining at NJIT, namely, "first generation college students", who must work while attending school and who commute rather than live on campus, who are faced with overcrowded classes and lecture halls, and who are tutored by staff who are themselves under severe time constraints.

My use of the terminology *instructional context* subsumes the whole complex of pedagogical related experiences and programmes that the student encounters within the same time frame that includes the research project. The performance of students in a collaborative group environment, whether mediated by electronic platforms or not, is affected by the way in which that experience melds with the pedagogical approaches employed in other courses that they are pursuing. Many of the presumed benefits currently attributed to collaborative conferencing and other work might, in considerable measure, be a consequence of a high novelty factor, something that I would expect to be substantially dissipated if all courses were undertaken employing similar approaches.

As far as computer mediated communications based on conferencing applications are concerned, the role of the moderator has frequently been taken to be of critical importance. (Brochet 89, quoted in Paulsen 95; Paulsen 95; Feenberg 89; Mason 91; Collins and Berge 99; Berge; Kaye91; McConnell 91) Numerous roles are allocated to the moderator in the literature, most of which are deemed to be important to the success of conferencing outcomes. The more effectively implemented, the greater the benefits. Paulsen, who reviews the literature, lists 15. There is no reason to assume that if these roles are effectively adopted and implemented that students will not benefit. However, and related to the point that I made earlier concerning the relationship between the research and typical instructional context, this literature also stresses the amount of time that is required to carry out such roles effectively. Mason (91), in reviewing one such study, carried out under the auspices of the UK Open University, noted that the 300 students had the benefit of the attention of 16 tutors, in addition to a "super-tutor" who moderated and organized the conference, "under whom the other tutors made their own contributions." This ratio of 1 to 18 is somewhat removed from that of 1 to 95-120 that applies with respect to the case studies that I discuss below.

Case Studies

Context:

The empirical study focuses on the analysis of computer conferencing by undergraduate students at the University of the West of England. The students were drawn from two programmes. Those enrolled in the Faculty of Economics and Social Science and undertaking one of the programmes of study in Social Science that it offers, and students who were taking an Inter-Faculty mix of programmes, one of the two strands being a programme offered by the Faculty of Economics and Social Science.

The University of the West of England is one of the newer UK universities. Located in Bristol, in south west England, it currently has an enrolment of some 28,000 students undertaking a wide variety of degrees, diplomas and certificates, ranging form sub-degree vocational courses to PhD programmes. It has a mix of full and part-time students, weighted toward the former.

The students who are the subjects of this study were all undertaking undergraduate programmes, the overwhelming majority of whom were 18 to 19 year-olds who entered university directly after the completion of their secondary education. Hardly any of them had had any prior experience of using a conferencing system. All students undertaking programmes offered by the Faculty of Economics and Social Science are provided with the opportunity to attend IT induction sessions, which include familiarisation with the use of FirstClass conferencing, the majority of whom take this up.

FirstClass conferencing is widely used by staff in the Faculty of Economics and Social Science, principally as a broadcast medium, providing information to students on administrative matters relevant to courses, and as a repository of articles and lecture notes relating to specific modules. Other than in the modules discussed below, FirstClass conferencing in the Faculty of Economics and Social Science is not employed in interactive mode, nor are conferencing contributions used as part of course assessments.

In the Faculty of Economics and Social Science the academic year is divided into three trimesters. In practice only the first two are teaching terms, the summer term being used principally for examinations.

Case Studies Course Modules:

The students whose conferencing work forms the basis of the discussion and analysis below were taking the following course modules. The term *assigned work* below refers to coursework other than tests or examinations.

> **(i) Methods of Analysis**. A 1st year undergraduate module that all students studying Social Science programmes are required to take. Its aim is to provide students with critical appraisal of qualitative and quantitative research methods. The analysis and discussion below is based on work undertaken by students during the first trimester of the 1999/2000 academic year. There were 119 conferences. The total number of students taking this course in the first term of 1999/00 =420. Comparison was made with assigned written, non-conferencing, work carried out by students taking this course in 1998/99, the number of students =290
>
> **(ii) Introduction to Social Psychology.** This is a compulsory module for those majoring in Sociology but optional for all those taking other Social Science programmes. It can be taken by 2nd and 3rd year students. Analysis is based on assigned work undertaken during the first trimester of 1998/1999 N=61, divided into 19 conferences, membership ranging from 3 to 6, 11 of which had 4 members, one with 6. Comparison was made with performance on assigned and examination work on other modules taken by the students, excluding **(iii)** below.
>
> **(iii) The Holocaust and Other Massacres.** This is a compulsory module for those majoring in Sociology but optional for all those taking other Social Science programmes. It can be taken by 2nd and

3rd year students. Analysis based on those taking this course in 1998/99 divided into 22 conferences of between 2 and 6 members in the first trimester with 66 students, and 22 of between 1 and 5 in the second, also with 66 students. There was only one conference with 1 member. Most conferences had a membership of between 3 and 5, relatively evenly distributed in both trimesters. Comparison was made with performance on assigned work and overall results on other modules taken by students, excluding **(ii)** above.

Students were posed essay type questions relating to the subject matter of the courses that they were undertaking and were required to discuss this through the medium of the FirstClass conferencing system. Because of the large numbers of students involved, and student commitments and time constraints, very few of these students met face to face in connection with the fulfilment of conferencing course requirements. Students were allocated to conferences alphabetically, or on the basis of surname after they had chosen an assignment topic. They were assessed on the basis of the quality of the contributions that they made to the conferences, and written work that summarised their own conclusions concerning the essay questions. Students were given detailed information concerning what was expected from them as far as the volume of contributions they should make, when these should be made, the range of issues that should be covered (e.g., methodological issues, relevant theoretical frameworks, status of empirical data), and, in the case of course (i) above, requirements concerning alternating turn-taking in assuming a lead and reactive/interactive contributing role. All students were given the opportunity of having 30 minutes training using the conferencing system.

The overall course grades for (ii) and (iii) above are made on the basis of the assigned work and a final examination, each contributing 50 percent to the total. The assigned work was a mix of conferencing contributions and written work related to the question posed for conferencing contributions. All other modules are also assessed on a combination of written coursework and final examinations, each contributing, with few exceptions, fifty percent of the total. None of these other courses use conferencing for assessment purposes, although instructors on many courses employ the conferencing system as a broadcast medium. Students taking these courses take a total of six courses per year, with the exception of the very few part-time students. The performance of the students on the conferencing courses was compared with their performance on the other courses that they took in the same academic year. The comparison was with the average performance on coursework grades, examination grades, and the overall average of coursework and examination grades on these other courses. In most cases these were averages of performance on five courses. However, in some instances the comparison was confined to a comparison of performance on the conferencing related module with performance on four other courses, as some students opted to study both courses in the same academic year.

As far as the methods course was concerned, (i) above, comparison was made between the assessed work on the conferencing system of students in the first term of the 1999/00 academic year, with that of written coursework undertaken by students taking the same course in the first term of the academic year 1998/99. These latter students did not use the conferencing system for assessed work in any courses during that year.

Although I designed the essay questions, wrote the guidelines relating to conferencing work requirements, and administered the conferencing system, the assessment of conferencing contributions, written, and examination work, was undertaken entirely independently by the course seminar instructors. The methods course had 10 seminar instructors, whereas (ii) and (iii) had one each. None of the conferences were moderated. None of the instructors made any contributions to the conferencing discussions, with a few exceptions when it was necessary to intervene for administrative purposes, for instance, informing students that they were sending the message to the parent conference rather than to the project group conference. Consequently, students undertook all conferencing work independently.

Findings

With respect to modules, (ii) and (iii) student t-Tests, paired two samples for means, were carried out on a number of data series, the Null Hypothesis being that there was no difference between the means attained on conferencing work modules and the averaged performance of students on all other modules. For module (i) the t-Test two sample assuming unequal variance was employed. This was undertaken separately for the assigned coursework and examination grades. No significant difference was found at the .01 level in respect of (iii) for the second term. There was, however, a significant difference for (iii) in the first term, the mean for coursework on the conferencing module being 3% higher than for the average for all other modules. There was a 6.7% difference between the final mark on the conferencing module and the overall final mark, for (iii) in the first term. Significant differences persisted when the tests were carried out separately for males and females. However, for (iii), term two, no significant differences were found respecting any of the data series, although the means for performance on all of the data series relating to the conferencing modules were higher than those with which they were compared. The differences between terms (i) and (ii) could conceivably be interpreted as being a product of the wearing off of the novelty effect, but many other explanations are equally plausible.

For module (ii), the only significant difference was between the means for the overall grade for the module and the average overall grade on other modules, the mean for the former being nearly 6% higher. The means in all other comparison were higher for the conferencing module.

For the methods course, (i) above, the t-Test between the written assignment work for the 1998/99 and the 1999/00 conferencing work was significantly different at the .01 level, the means differing by 4.2%, being higher for the conferencing work. The t-Test between the 1998/99 and the 1999/00 written work was not significantly different at the 0.05 level, the mean for the former being higher.

Case Studies Conclusions

The analysis, along with mixed effects regression and correlation analysis, not reported upon here, indicate that conferencing undertaken without the benefit of moderation is not reflected in poorer performance, as measured by grades in written and examination work, compared with courses using *traditional* higher education instructional modes. In fact, students performed better on average on two of the conferencing modules (ii, iii), than they did on other coursers. There are various reasons that can be advanced for this. As noted earlier, as the pedagogic context is one in which conferencing work is a novelty on the case study courses, this may impact on student interest, perseverance and motivation. Another possible explanation is the impact of what social psychologists refer to as *social facilitation*. It is also possible that the subject matter of the assigned conferencing work is perceived by students to be more interesting than that than which they are required to undertake on other courses. It is also plausible to argue that many of the benefits singled out by other researchers as being associated with collaborative work, are also active in the minimalist intervention computer conferencing contexts that applied in the present case studies.

Summary and Conclusion

Although there is now a substantial body of literature dealing with varied matters relating to the deployment of interactive communication technologies in educational settings, we are still a long way from *knowing* or understanding how to deploy them effectively in order to achieve pedagogic outcomes. This is hardly surprising given that disputes concerning the effectiveness of more traditional pedagogic mediums, such as lectures and seminars, are far from being settled. Some of the reasons are not difficult to track. Much research has been anecdotal, case study oriented, findings being applicable to very specific contexts, and therefore non-replicable. Much research has been carried out under conditions that do not approximate those of *typical* educational settings. Many of the assertions deployed with missionary zeal by educational technology enthusiasts have not been systematically tested. At the same time, it is possible to demonstrate that such technologies might be effectively deployed under less than ideal conditions to achieve modest improvements.

References:

Bart P. B. (1999). Keeping Online Asynchronous Discussions on Topic. *JALN* Volume 3, Issue 2

Brochet, M. G. (1989). Effective moderation of computer conferences: Notes and suggestions. In M. G. Brochet (Ed.), *Moderating Conferences.* Guelph, Ontario: University of Guelph.

Collins, M. P, Berge, Z.L. (1999) *Moderating Online Electronic Discussion Groups.* Online at http://www.gl.umbc.edu/~berge/sur_aera97.html

Cooper, J. &, Robinson, P. *Small-group Instruction in Science, Mathematics, Engineering and Technology (SMET) Disciplines: A Status Report and an Agenda for the Future.* http://www.wcer.wisc.edu/cl1/CL/resource/smallgrp.htm Accessed 29/02/00

Cueso, J. (1992) Cooperative Learning Vs. Small-Group Discussions and Group Projects: The Critical Differences. *Cooperative Learning and College Teaching, 2.3*

Feenberg, A. (1989). The written world:On the theory and practice of Moderating Educational Computer Conferences. In R. Mason, A. Kaye (Eds.). *Mindweave: Communications, Computers, and Distance Education* (pp. 22-39). Oxford: Pergamon Press.

Graham, M &, Scarborough, H., & Goodwin, C.(1999). Implementing Computer Mediated Communication in an Undergraduate Course-A Practical Experience. *JALN* Volume 3, Issue 1

Harasim, L. (1989) Online education as a new domain. In R D Mason, & A. R. Kaye (Eds.) *Mindweave: Communication, Computers and Distance Education.* Oxford: Pergamon Press.

Heath, E.F. (1998) Two Cheers and a Pint of Worry: An On-Line Course in Political and Social Philosophy *JALN,* Vol. 2, Issue 1-March

Henri, F (1991). Computer Conferencing and Content Analysis. In A.R.Kaye (Ed.) *Collaborative Learning Through Computer Conferencing.* Springer-Verlag, Berlin, 1991

Hiltz, S.R. (1995). Impacts of college-level courses via Asynchronous Learning Networks: Focus on Students. *Sloan Conference on Asynchronous Learning Networks,* Philadelphia. Draft.

Kaye, A. R. (1991). Learning Together Apart. In A.R.Kaye (Ed.) *Collaborative Learning Through Computer Conferencing.* Springer-Verlag, Berlin, 1991

Mason, R. (1991) Analysing Computer Conferencing Interactions. *Computers in Adult Education and Training,* Vol. 2, No. 3

McConnell, D. (1991). Computer Mediated Communication for Management Learning. In A.R.Kaye (Ed.) *Collaborative Learning Through Computer Conferencing.* Springer-Verlag, Berlin, 1991

Paulsen, M F. (1995). Moderating Educational Computer Conferences. In Berge, Z. L., & Collins, M. P. (Eds.) *Computer-mediated Communication and the On-line Classroom in Distance Education.* Cresskill, NJ: Hampton Press.

Salmon, G.(1998). Developing Learning Through Effective Online Moderation. *Active Learning,* No.9, December.

Soby, M. (1991). Waiting for Electropolis. In A.R.Kaye (Ed.) *Collaborative Learning Through Computer Conferencing.* Springer-Verlag, Berlin, 1991

Springer, L., &, Stanne M. E., & Donovan S. *Measuring the Success of Small-Group Learning in College-Level SMET Teaching: A Meta-Analysis.* http://www.wcer.wisc.edu/cl1/CL/resource/scismet.htm Accesed 29/02/00

Warren, K.J., & Rada, R. (1988) Sustaining Computer-mediated communication in university courses. *Journal of Computer Assisted Learning.* Vol. 14

Acknowledgement

I am grateful to Dr Wayne Thomas, University of the West of England, for valuable assistance in analysing the statistical data.

Tracking Human Expression Actions in Lectures

Tilmann Steinberg, Li Shen, Ling Cheng, Fillia Makedon
Department of Computer Science, Dartmouth College, Hanover, NH 03755
{tilmann, li, ling, makedon}@cs.dartmouth.edu

Abstract: Recorded multimedia presentations in the form of lectures, conference proceedings, commercial demonstrations or tutorials, are becoming increasingly available in multiple, diverse, and often heterogeneous formats. These materials are stored in databases or digital libraries where the user can search by a variety of mechanisms, ranging from keyword search to content-based queries. Tracking human expression actions is a valuable tool for mining information because it can add significance value to the materials being searched. In this paper, we focus on tracking the presenter's pointing activity during a lecture, and show how this information can be used to provide the user with an improved overview of the lecture to quickly navigate to those points that the user might find the most interesting. The strength of this approach lies in the ability to correlate the pointing actions of the lecturer with other streams of data during the recorded lectures, such as audio amplitude, gesture motion, slide presentation, or text. In the absence of complete transcripts or manually added annotations, which are expensive to generate given the quantity of recorded lectures, the level and type of interaction of the presenter with the material can be analyzed to yield likely points of interest.

1. Introduction

As classrooms are increasingly equipped with presenting and recording technology, more and more recorded lecture material becomes digitally available for both local and remote students. Central repositories of such lectures are valuable assets for online education as students can re-create the environment of the lecture hall wherever, whenever, and however often they need to. Yet as such digital libraries grow in size, the problem of accessing or retrieving relevant information becomes increasingly pronounced. It is helpful to locate individual segments of lectures dealing with a particular aspect of a problem in order to view these segments side by side, rather than reviewing entire lectures sequentially. When reviewing a single lecture, instead of providing uniform access to any point, we focus on providing "relevance" by computing points of interest within a lecture. This is done by tracking lecturer pointing activity, a new data stream that can be combined with other captured streams, such as slides, audio, etc. Using lecturer pointing activity presents a new way for browsing/searching large digital libraries of lectures and for data mining higher level information, such as a lecture's "hot spots".

2. Related Work

In computerized classroom projects (e.g., Classroom 2000 project at the Georgia Institute for Technology (Abowd et al. 1998)), the idea is to capture and re-create the classroom experience. One pitfall is to store information graphically, not symbolically, which makes it very difficult to correlate diverse streams of data occuring during the lecture, and thus to do data mining, and increases the work necessary to analyze the content of lectures to add conceptual structure. Other systems are similarly based on the idea of providing sequential lecture material. Barry Arons from the MIT Media Lab developed SpeechSkimmer (Arons 1997), which tries to find the important parts of speech recordings in order to give quick overviews, saving reviewing time. Arons evaluated attributes in speech patterns that indicate where the speaker is placing emphasis. We translate this idea to the classroom recording: in our case, the protagonist places emphasis by interacting with the presented material, literally pointing out the important parts. At the Dartmouth Experimental Visualization Laboratory (DEVLAB), earlier projects focused on making electronic lectures and conference proceedings more interactive (Ford et al. 1998), and to correlate data streams of different modalities (Owen et al. 1999, Owen 1998). Currently, the DEVLAB is combining this previous work to extend the Authoring on the Fly (AOF) system (Mueller et al. to appear) developed at the University of Freiburg, Germany. Because of its capability to store lecture data streams symbolically, the AOF system is used by six major universities in Germany sharing lectures in real time via the Internet, and the University of Freiburg is creating an online library of these lectures.

2.1 Processing parallel data streams during lectures

In order to extract higher level information about a lecture, it is necessary to correlate multiple data streams such as, speech, video, speaker's facial expression, speaker's head motion, and other data streams. Tracking the correlation between heterogeneous data streams allows us to perform data mining and determine, for example, where the highest pointing activity occurred during a slide presentation. Computing the synchronization between diverse data streams is the work described in the book by Owen and Makedon (Owen et al. 1999). We demonstrate this approach with the AOF (Authoring on the Fly) System (Mueller et al. to appear) which already captures diverse data streams in synchronized mode. The AOF system is used as an intermediate step on which to build the theory of multiple data stream tracking, and has been chosen for two major reasons: (a) it provides a symbolic representation of the data contained within a recorded presentation; and (b) it is easily extensible via helper applications.

The AOF system has a whiteboard (AOFwb) which is the electronic substitute of a blackboard. Lectures are created in two phases: (a) In the *pre-processing phase*, the instructor uses AOFwb to produce slides to present in class. The result of the editing process is a presentation file with a page structure based on SGML. (b) In *the presentation and recording phase*, the presentation file is loaded into AOFwb and used by the instructor to present, annotate, and orally explain the prepared material, i.e. the presentation file together with other material such as animations, simulations, audio or video files, etc. Annotations are made on a transparent overlay on top of the loaded page, using the same graphic and text manipulation tools available during authoring.

While the instructor is presenting the material, the recording facility in AOFwb captures the important data streams generated: the audio stream with the instructor's voice, the graphics stream of time-stamped graphics displayed during the presentation, the external applications stream, any video streams (of the instructor or audience), and any others depending on the presentation. At the end of the presentation, a post-processing step builds a self-contained lecture represented by an HTML overview with links between the presented slides and associated replay locations. The resulting AOF document can be replayed synchronously, i.e. the relation between the various captured data streams is maintained. (See (Mueller et al. to appear) for details.) The most attractive features of the AOF replay component are the random visible scrolling facility and the case with which AOF documents can be integrated into web-based teaching and learning environments.

AOF's random visible scrolling facility permits fast browsing of a recorded lecture, similar to flipping through a book. Apart from this, however, the current AOF system does not have tools for retrieval of lecture content by importance of information or by lecturer activity. In other words, it is not possible for a user to query a database of AOF lectures for, say, all slides where certain phrases appear or where there are "important" parts for a given topic. In this paper we report on ongoing work that aims to enable queries of what is important in a lecture and what is not. We do this by observing that AOF records a great deal of information which is not utilized to its full extent. This information is valuable for supporting the retrieval of what is important content in a lecture and in segmenting the lecture (giving it conceptual structure) into parts of high, average, and low importance.

Using the AOF recording process, the respective data streams have already been aligned (e.g., slide-to-audio, application-to-audio, and video-to-audio alignments). This helps us use text queries to search for lecture parts because, as we showed in earlier work, we can do "cross modal information retrieval," i.e., search for information across modalities. For example, we can find the words spoken when high pointing activity takes place. Since the text and formatting information on all slides is available, and we know exactly when and where each annotation was made by the instructor during the presentation, we can use this information for retrieval either within one document or across many documents. Thus, a large repository of AOF documents becomes accessible via text queries. The HTML document automatically generated is not hierarchically structured but just a flat index. By slightly extending the AOF system in the pre- and the post-processing phase, a better clustering and structuring of information that enhances retrieval is possible. This leads to database and data mining facilities where lecture data streams are segmented and stored accordingly.

3. Tracking Lecture Activity: Why and How

Currently, it is very difficult to search for certain parts of recorded presentations (lectures, conference proceedings, commercial demonstrations or tutorials) that are stored in heterogeneous formats and in distributed databases. Users can apply a variety of tools, ranging from keyword search, to content based queries but this will not give them results to "what is important." We introduce a new "importance mining" framework, which works by tracking and correlating the different data streams generated by a lecturer during a lecture. We focus on a lecturer's pointing activity, such as pointing to items on a slide. Instead of searching by keywords, we introduce the idea of searching a digital library by a certain human activity. This has significant implications in the management of complex knowledge in future large-scale digital libraries of human presentations. For example, one can search for all places where the lecturer exhibited pointing activity over a certain threshold and a certain set of keywords appeared.

Assuming that locations of high interest have high pointing activity, then tracking pointing activity is an effective search "modality stream" in locating complex human information. If the pointing activity stream is the primary search stream, then we have a simple way to derive correlation between lecture structure and content based on the human tracking of the speaker. Here, we employ the built-in synchronization between the audio and the slide-based human actions provided by the AOF system. This is a common-sense mechanism of deriving "hot spots" during a lecture. Our system generates an *activity profile* for a slide, a lecture, or a set of lectures. Visualization graphs are automatically derived, thus providing an intuitive and easy to use interface for the digital library user.

Capturing lectures by merely recording the video and audio streams is sufficient to deliver the information presented, but not for finding higher-level information about the importance of a lecture, especially if one wants an answer in a practical amount of time. Video processing is hindered by limitations in the image resolution and quality: discovering what a lecturer marked or what information was presented on a slide is very difficult and expensive to do by computer. On the other hand, using an authoring/presentation/recording tool such as AOF, one combines preparation of lecture material with the recording facility, thus incorporating "access markers" for finding lecture significance. AOF delivers not just the images of the captured lecture but also stores the lecturer's actions during the presentation. With this information, it is relatively simple to deduce the interaction between lecturer and presented material, and thus to compute "pointing activity" for each segment of the lecture.

3.1 Determining lecture importance

The basic premise is that the level of interaction of the lecturer with the material being presented is an indication as to how relevant the current point in time is within the whole lecture. A lot of interaction means, in all likelihood, that the material is very relevant, as it augments the point that the lecturer is currently trying to convey to the audience. The more often or persistently a given element is, quite literally, pointed out to the audience, the more important this element is for understanding the information. On the other hand, no interaction is likely to indicate that the lecturer is giving secondary information, such as background or related material, that has no direct relation to the current slide, or that the lecturer is merely glossing over the material in order to move on to more important things.

Our approach allows a user to search for interesting points in a lecture or set of lectures because it can combine results from the following: (a) the value of lecturer pointing (pointing activity that a lecturer exerts on a slide or view graph); (b) the value from additional parallel lecturer-generated data streams: voice pitch, frequency, amplitude, head motion, eye direction, etc.; (c) the value derived from applying data mining algorithms. The results can be visualized and build what we call a *lecture architecture*, showing the peaks and valleys of lecturer pointing activity. Once a lecture has been processed, a digital library user may wish to search for all the sorting lecture slides that have high pointing activity and also exhibit audio amplitude within a certain range.

The fact that the system is slide-based is a conscious decision: the use of slides is a natural segmentation of a multimedia information stream (the lecture): it assumes that the material is presented via slides or similar media which contain enough information to automatically structure the lecture. In other words, the slides provide a form of segmented presentation, each being the visual encapsulation of a richer textual, audio or video content. At the lowest level, each new slide indicates a new segment; by adding section numbers to each slide, multiple slides can be grouped into sections or chapters. Using slides as "visual information holders" is not a new idea and is widely used on the web (thumbnails). However, what we propose here is an extension of this idea to include thumbnail hot spots.

The system we are developing does this automatically for AOF, which provides the infrastructure for correlating lecture structure. Most importantly, since the correlation information is stored symbolically, it can be shared over the web and thus the system has particular application to distance learning systems using digital library technologies.

Since the assumption is that intensive pointing indicates important information, we measure various parameters including: duration of pointing, locality (relative location of pointing activity to previous/following pointing activities), repetition, frequency, related text material, and attributes of the corresponding audio. These five parameters are assigned weights and the pointing activity is then ranked and visualized. Another facility may collect statistical data of these actions which are then mined for the benefit of the student.

Slide	Content	% Time	% Activity
1	Presentation Outline	4.7%	0.0%
2	Problem Statement	5.3%	1.6%
3	Some Observations	7.0%	2.0%
4	A Useful Theorem	21.2%	26.7%
5	Next Fit Algorithm	9.4%	7.2%
6		7.4%	4.0%
7	First Fit Algorithm	13.6%	24.7%
8		6.9%	0.8%
9	Best Fit Algorithm	4.4%	4.4%
10	Off-line Algorithms	6.9%	0.0%
11		3.8%	10.0%
12	Conclusions	7.7%	17.1%
13		1.7%	1.6%

Table 1. Slides of the Binpacking presentation.

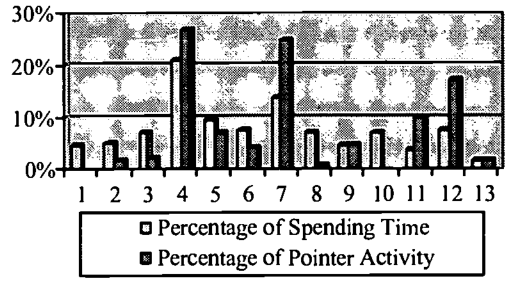


Figure 1. Percentage comparison of spending time and pointer acti among slides in Binpacking presentation. The X-axis shows the sli numbers (cf. Table 1).

4. Pointer Tracking

During a presentation involving slides, the lecturer can focus the attention of the audience to a slide element by placing emphasis on it. In AOF, this is usually done by using a telepointer or by drawing onto the slide, such as underlining a word, connecting items with a stroke, or similar marks. In either case, there is interaction between the lecturer and the presented material, and the more activity the lecturer devotes to a certain element, the more relevant that element becomes within the context of the lecture. To measure the relevance of a slide element, we therefore have to measure the interaction between the lecturer and a given element.

For example, we have done the telepointer tracking to a lecture on Binpacking by Prof. Ottmann. Its length is about 44 minutes. Table 1 shows the titles for the slides in this presentation. Figure 1 shows the comparison result among slides regarding their spending time and telepointer activity. From this result, we can see that slides 4 and 7 contain high levels of interaction. They turn out to be key slides in the presentation. Clearly, the telepointer tracking result can help retrieval system find interesting information.

Depending on the note-taking system, the lecturer can have a variety of tools that can be used to mark slide elements. In the following, we classify these tools by their impact on the presentation. We then describe classes of actions that pointer tools can perform. Next, we view these actions in context to one another, i.e. to distinguish different patterns of actions. Finally, we consider how the slide is structured; interacting with a slide that consists of text needs to be treated differently from interaction with slides consisting of graphics.

4.1 Pointer types

One can assign different weights of significance to different pointing actions during a lecture. We distinguish between the following types of pointers that a lecturer can use during a presentation to indicate areas of interest. These pointers are tools available in AOF but are general enough to apply to similar note-taking systems. The primary classification is by impact on the presentation: the arrow (or telepointer) is a non-intrusive tool, meaning that it leaves no trace on the slide, but also that its action has a time element; whereas the freehand tool leaves a quasi-permanent line on the slide, meaning that the only available time information is the appearing point of the line.

Arrow/Telepointer: a non-intrusive and easily visible pointer that can either indicate a single locationor be used to trace along slide elements, e.g. to underline a word as it is spoken. *Freehand (drawing) tool:* similar to the arrow, but leaving a colored line on the slide for a more permanent effect. The freehand tool can also be used to add information. *Line tool:* usually used to underline or mark slide elements, or to show direct connections between slide elements. *Rectangle tool:* outlines a word or a block of text, such as a definition of a term, or a more general object. *Move tool:* this tool modifies the slide by moving existing slide elements around, either to rearrange the slide (e.g. to simulate animated effects), or to move an indicator, such as a rectangle.

What all these tools have in common is that they are used to direct the attention of the viewer to a particular section of slide in one way or another, which implies that the current point of interest is on the slide. Conversely, by locating a pointer action linked to a specific topic in a presentation, such as a query word, we have found a section of the presentation that is relevant to this topic. Analyzing the pointer action yields an estimate of the relevance of the section: the more the lecturer concentrates on a slide element, the more relevant it becomes. In this context, the type of the pointer bears significance: (a) Using the arrow may indicate a passing reference, as the highlighted element is no longer standing out once the lecturer moves on. Also, repeated highlighting increases relevance (see Pointer actions, below). (b) Drawing and moving tools have a more persisting effect, which translates into a higher relevance. Unlike the arrow, however, it is difficult to measure the amount of time devoted to the highlighted element, meaning that taking successive actions becomes more important. The amount of drawing can also be considered a factor.

4.2 Pointer actions

As described above, segments of a lecture or presentation where the lecturer interacts with the material can be considered more relevant than the segments where there is no such interaction. Rather than simply assigning relevance for segments with interaction, however, we wish to refine the measurement of interaction. We thus classify pointing actions using the following attributes: (1) duration of interaction, (2) repetition of (same or similar) action, (3) location of action, (5) text in vicinity of action, and (5) speech audio levels and speech/facial motion attributes. Some of these attributes are explained in detail below.

Duration of interaction. The relevance of a slide element increases primarily with the time the lecturer spends on this element. The measurement of the time is straightforward in case of the telepointer, as the lecturer has to keep the telepointer activated (e.g. by keeping the mouse button depressed). Depending on whether and how much the pointer is moved during this time, the attribute can be either limited to a single object (on which the lecturer is focussing the whole time), or shared among the objects covered during the action.

The Move tool can be viewed as a hybrid case between the telepointer and a drawing tool: the action is limited by the time the lecturer activates the tool, but its effects are quasi-permanent, similar to the drawing tools. However, the basic usage of the Move tool more closely resembles a drawing tool in that the end result is the desired effect, so evaluation for the Move tool follows that of the drawing tools.

Repetition of actions. As mentioned in the previous section, repeated focus on a single element enlarges that element's significance for the current point in time. In particular, the number of actions associated with one element on a slide can indicate whether it is of central focus or "just" a member of a list of items being presented.

Location of actions. (Rus et al. 1995) uses the structure of a document to classify the type of each component. Thus, a word appearing in the title of a slide has more weight than a word appearing in an indented sentence at regular or reduced size. We invert this indication when it comes to activation, as a targeted element which was in an already elevated position, such as the slide title, is not made much more significant when highlighted.

Neighboring text. As a general rule, words that are pointed out gain more significance if they were equal to their neighbors before. For instance, highlighting a word buried in a paragraph increases its significance; whereas pointing at a single word on a slide does not change the fact that it is already the most significant word on this slide!

Audio. By correlating the pointing action to the audio stream, we can see whether emphasized speech coincides with pointing action, indicating a higher relevance than for regular speech.

4.3 Patterns of actions and data mining

There are two basic kinds of patterns: spatial and chronological. The former include basic movements of the pointing action on slides, e.g. top-to-bottom (indicating a list of items) or a star pattern (central item with secondary items around it). The timing between pointing actions can similarly indicate the relationship between the elements pointed at. One interesting question here is if there are "typical" patterns in presenting that can be used to build up a library of such patterns, either for generic or for lecturer-specific pattern recognition. We can use data mining techniques to find such kinds of patterns. Our objective is to build a model for a classifying attribute, using algorithms like SPRINT (Shafer et al. 1996), to classify interactions, e.g. into spatial or chronological patterns. Besides classification, there are other interesting mining issues (Fayyad et al. 1996) (e.g. associations, sequential patterns) for extracting knowledge for a large digital library of presentations that remain to be explored in depth.

4.4 Slide content: text vs. graphics

In the absence of a transcript or structural information on the lecture or presentation, the evaluation of the presenter's interaction is limited to what elements are contained in each slide. As words can be viewed as forming individual objects, assigning a pointer action to a highlighted word is simpler and more concrete than connecting the action to an element of a graphic. Furthermore, in the case of automated retrieval of lecture material (cf. section 6 below), we need to be able to associate a slide containing only graphics with textual information in order to compare it to the query terms. We plan on developing methods by which we can use the surrounding slides with text to glean what connotation the graphics may have. Even in the absence of text, it is important to give slides with only graphics "credit" for interaction, as graphics are useful or used to illustrate points that the lecturer wants to convey.

5. Representation of Lecture Activity and Retrieval Applications

Traditional video presentation libraries represent a video clip with an icon and a caption for identification. The icon is either a generic video symbol or a representative frame of the video clip, while the caption is usually the filename. When the user selects the video clip, it is played back from beginning to end. To control playback, the user is presented with a generic progress bar or similar timescale, and VCR-like controls. While this model is appropriate for short clips, it is lacking for videos of entire lectures or presentations of comparable length when the user is searching for specific information. A first, simplistic segmentation of a lecture would split it along slide changes: the user can now select a slide and find out whether the requested information is contained on this slide. If it is, the videoclip is started at the corresponding position and the user reviews the lecture from this point on.

An even finer segmentation of the lecture takes into account where the presenter interacted with the presented material, using this as an indication of when main points are discussed. Presenters tend to indicate an element on the slide as they begin talking about it, so by jumping to such a point in the lecture gives users a faster access to the main points. Once such a main point is found, the traditional controls can be used to rewind if necessary; depending on the style of the presenter, the actual beginning of a main point, in relation to the interaction with the slide, can vary significantly, and it is not clearly understood how to universally locate such beginnings. A corresponding user interface can feature either icons along a time scale to indicate overall or individual actions, or a graph-based track in which interaction is quantized, similar to the volume of the audio track.

6. Conclusion

We have presented a framework for improving browsing and querying digital libraries of recorded presentations which are not just audio and video data streams but also capture the interaction with the presented source material. By taking this additional information into account, lectures and presentations are enriched by an evaluation of their relevance at any given point, both in form of a contour spanning the entire document as well as a comparison to other documents within the context of a user query. Since lecturers and presenters have varying styles of presentation and form of interactivity with their material, our approach cannot universally provide good results: a lecturer who in his presentation does not discriminate between important and peripheral material, may even see skewed results as peripheral elements are given undue significance. However, a lecturer who takes care to place emphasis on important elements and, quite literally, points these out, will see more focus on the primary segments, which allows students to be more likely to get to the heart of the matter when reviewing the information.

We plan on using AOF in more realistic environments to learn from other lecturers' styles and incorporate these findings in quantizing different kinds of interaction. One primary concern has to remain the system's low profile during a lecture so that the presenter can concentrate on the material and the reaction of the audience.

References

Arons, B. (1997). SpeechSkimmer: A System for Interactively Skimming Recorded Speech. *ACM Transactions on Computer Human Interaction,* March 1997, Vol 4, No 1, pp 3-38.

Abowd, G., Brotherton, J., & Bhalodia, J. (1998). Classroom 2000: A System for Capturing and Accessing Multimedia Classroom Experiences. *CHI '98 Demonstration Paper,* May, 1998.

Fayyad, U., Piatetsky-Shapiro, G., Smyth, & P., Uthurusamy, R. ed. (1996). *Advances in Knowledge Discovery and Data Mining.* AAAI Press: Menlo Park, CA.

Ford, J., Makedon, F., & Rebelsky, S. A. (1998). Resource-Limited Hyper-Reproductions: Electronically Reproducing and Extending Lectures. *Multimedia Tools and Applications*, Kluwer Academic Publishers.

Mueller, R., & Ottmann Th. (To appear). The "Authoring on the Fly" System for Automated Recording and Replay of (Tele)Presentations. *Special Issue on "Multimedia Authoring and Presentation Techniques" of ACM/Springer Multimedia Systems Journal.*

Owen, C. B., & Makedon, F. (1999). Cross-Modal Information Retrieval. In Borko Furht (ed.), *Handbook of Multimedia Computing.* CRC Press, Boca Raton, pp 403-423.

Owen, C. B., & Makedon, F. (1998). ASML: Automatic Site Markup Language. *Multimedia Tools and Applications*, Kluwer Academic Publishers.

Owen, C. B. (1998). *Multiple Media Correlation: Theory and Applications.* Ph. D. Dissertation, Dartmouth College.

Rus, D., & Summers K. (1995). Using Whitespace for Automated Document Structuring. *Advances in Digital Libraries.* Springer-Verlag, Lecture Notes in Computer Science.

Shafer, J. C., Agrawal, R., Mehta, M. (1996). SPRINT: A Scalable Parallel Classifier for Data Mining. *Proc. of the 22th International Conference on Very Large Databases*, Mumbai (Bombay), India.

Wilcox, L. D., Schilit, B. N., & Sawhney N. (1997). Dynomite: a dynamically organized ink and audio notebook. *Conference proceedings on Human factors in computing systems.* pp 186-193.

oz-TeacherNet: Supporting teacher use of Information and Communications Technologies in the Elementary Curriculum

Jackie Stokes and Jennifer Masters
The Research into Information Technology Education Group
Queensland University of Technology
j.stokes@qut.edu.au j.masters@qut.edu.au

Abstract: This paper looks at two action research projects supported by ozTeacherNet to extend the walls of three Queensland classrooms to the Yasuura education district in Japan. The first project extended a Book Rap to include a cultural comparison of the construct of age. It involved students in all four communicative modes of language and the development of webpages. The second project followed the visit of a Travel Buddy to Japan and back again.

Introduction

The oz-Teachernet is an on-line community facilitated by the Research into Information Technology in Education (RITE) Group at the Queensland University of Technology, Australia. The purpose of oz-Teachernet is to provide an infrastructure for using telecommunications to support teachers with professional development and curriculum activity. Williams (1997) highlights the need for teachers to be "connected" in a society that is increasingly dependent on the Internet for communication. Additionally, she stresses the importance of teacher support organisations in helping teachers learn about and excel in the new professional environments where teachers work. Consequently, the RITE Group offers teachers opportunities to both learn from and contribute to a dynamic virtual community. In doing so the RITE Group hopes to learn more about models of professional development and ways in which teachers can harness telecommunications for powerful learning experiences.

This paper will look at two action research projects which have extended oz-TeacherNet to Japan, meeting, and to a certain extent overcoming, the language (both written and oral) barriers. The first project looks at how the Book Rap project was adapted and extended to develop awareness of different cultural aspects of the regard for the elderly in the International Year of the Older Person. The second project focuses on the Travel Buddy Project and reports on the fostering of rapport between two school communities, one in Japan and the other in Australia through a Travel Buddy icon.

Project one: Investigating the use of Information and Communication Technologies in Languages Other Than English

Within the Queensland curriculum the study of a Language Other Than English (LOTE) is a requirement for upper elementary classes. Schools are able to choose which language they will study but seven languages are currently encouraged: Japanese, Indonesian, Korean, Mandarin, German, French and Italian. The Romance languages show the derivation of the English/Australian language, and the Asian languages, Australia's close proximity and economic interactions with Asia. Despite the concerns of some (Dabblestein, 1997) that a socio-cultural perspective marginalises the primacy of language acquisition as a discipline goal, at the level of elementary schooling this approach introduces students not only to basic language phrases but also to social and cultural aspects whereby Australian and other cultures can be compared.

Following research taken by the Australian Catholic University, Brisbane Catholic Education developed a position paper on Cultural Literacy and Languages (Brisbane Catholic Education, 1997) which identified five key concepts to develop through the teaching of this subject; culture, diversity, interdependence, identity and reconciliation. These five concepts formed the basis of research conducted with a primary school during 1999.

The action research project evolved from a request of a LOTE teacher of Japanese to incorporate Information and Communication Technologies into the upper elementary curriculum. The environmental aspects of the school play an important part in the conduct of the project and thus are elaborated upon at this stage.

The school

The school is situated in a garden suburb, eight kilometres from the centre of Brisbane, Queensland, Australia. It is a systemic Catholic school of 340 students. The predominant cultural derivation of the families is Italian. The school has a well-developed Japanese program, which unlike most schools, involves students from Years 1-7. The school is relatively well resourced with Japanese resources with a LOTE teacher who teaches at the school three days a week, in a specially allocated room. The school has yearly exchanges with a sister school at Yasuura, near Hiroshima, in Japan. These activities are being extended as the previous head-teacher from the Australian school has joined the Education Board in Yasuura.

The project

The action research project was planned in co-operation with the LOTE teacher, the Year 7 teachers, as well as the Library teacher, and the Book Rap co-ordinator from oz-TeacherNet, based at QUT. It extended a Social Justice unit that the Year 7 teachers conducted in first term, that had as one of its resources Wilfrid Gordon McDonald Partridge by Mem Fox (1987). This book is usually used in early childhood classrooms but a Book Rap was developed that allowed older students to reflect on their relationships with their grandparents and other older people that they came in contact with.

The book was seen as a vehicle to explore cultural differences on the way in which Australia and Japan viewed older people. The storyline of the book revolves around a little boy who lives next-door to an old peoples' home, and the friendships that develop between him and some of those who live there. Old peoples' homes (or nursing homes) are familiar in Australia but at present old people are usually looked after within the family home in Japan. Thus it was thought that the cultural differences would be easily noticed in a project that connected a school in Australia with a school in Japan.

Building on students' reflection on their own ideas about older people, students in Australia conducted an interview with an older person that they knew. Most students elected to interview one of their grandparents. They asked them about their hobbies and their favourite television program. They created an image of their 'Golden Oldie's' (GO) hobby and were asked to collect photos of them when they were young and a recent photo. These were to be displayed, with GO permission, on a webpage.

The LOTE teacher required that all four communicative modes were explored in the program. At first, the planned use of written script was a problem, as Japanese word processing applications used Romaji which the teacher did not want the students to use, preferring them to use Hiragana. However, it was decided that students should create a website that included a video clip of them talking about their Golden Oldie. They used Hiragana to write and learn their script. It was also anticipated that they would read Japanese script on the website of the participating Japanese school. In keeping with the philosophy of authentic use of language, the visiting Yasuura students were able to help the students rehearse their scripts before the recording during their visit to the school.

The use of Information and Communications Technology

The project was staged so that students could complete tasks either on the classroom computers or with the aid of the Teacher-Librarian (TL) in the library. The students used Paintbrush to complete the image for their GO's hobby. They scanned the photos with the aid of the TL. A template was set up on a laptop and students wrote in English about their GO on their webpage and were recorded on a video clip using a Sony digital camera speaking in Japanese. The mpg file was linked to their webpage. The site, once complete, was posted on the RITE server.

Five Dimensions of Cultural Literacy

The project to was able to facilitate learning across the five dimensions of the Cultural Literacy curriculum through the use of Information and Communications Technology.

1. *Culture* - use of authentic photos
Students were able to discuss differences and similarities between both the young and old photos of both Japanese and Australian 'Golden Oldies'. The use of authentic photos enabled students to look at changes to other cultural aspects such as transport, clothing, hairstyles.
2. *Diversity* - comparison of graphs
Students were able to see a diversity between people by looking at the hobbies and favourite television programs of the Golden Oldies and comparing them with their own favourites.
3. *Interdependence*- development of web sites
A project such as this enables students to see how it is possible for different groups to co-operate across boundaries to take part in a project.
Students were also able to explore the different relationships that they had with their Golden Oldies.
4. *Identity* - production of graphic for hobby
Students were able to focus on older people as individuals by looking at their hobbies and television programs.
5. *Reconciliation*
The teacher needed to be aware of the possibility that members of the age group of the Golden Oldies, both in Japan and Australia would have memories and may be personal experience of the hostilities between the countries during the Second World War. In only one case was reference made to this.

Summary

The culmination of the event was a Grandparents' day where participating Golden Oldies were invited to morning tea and the website was displayed. The classroom teachers commented on how involved the students became with the project. It strengthened family ties, especially for those grandparents who lived overseas and with whom the students had had minimal contact. It enabled them to see them as a young person and as a person with definite hobbies that the students had previously been unaware of.

The LOTE teacher noted how viewing the students' video clips had enabled her to be much more objective about their spoken language ability. She felt that it would give the host families an indication of the students' skills before they took met the students in the student exchange program. All teachers commented that being in the project had increased their computing skills and had made them aware of how much they could do with their students by using computers with a curriculum focus.

Project two: Establishing real audience and authentic experience

Australia, merely by its physical location, is an isolated environment and population. As a result of this, Australians seem to have developed a strong sense of identity in which we can relate to our unique environment, flora and fauna and lifestyle as Australian cultural identity. Inversely though, because of this isolation, there is a danger that our people can become insulated from the rest of the world and don't develop a sense of a wider community from an international perspective.

As mentioned in the description of the first project in this paper, Languages Other Than English (LOTE) is a defined curriculum area in Australia and is one of eight Key Learning Areas (KLA's) prescribed by Education Queensland (Education Queensland, 1999), the government body for education in this state. While this curriculum area does involve a study of the chosen language, it also involves study of the cultural and physical perspectives of the country or countries in which the language is spoken. The rationale for this is that if children are going to learn a language effectively, there is a need to establish an awareness of the context in which the language is used.

Of course, the best way for a student to immerse in the context of a language is to actually visit the country. This option, ie. a school visit overseas, is becoming more common in Australian schools as the relative cost of airfares has reduced and the notion of travelling abroad is becoming a realistic concept for many. Never the less, the physical location of Australia and therefore the cost of travel is still a major impediment for schools. In cases where the chance to travel to a LOTE country is offered, it is usually every second year on a voluntary basis. It is likely that a student may contemplate an overseas visit once in their school years and then only if their parents can afford to finance the trip. It is obvious that another mechanism that will provide "real experience" is required to supplement this valuable but infrequent (and often inequitable) venture.

The Travel Buddy Project

The Travel Buddies concept is a valid way to meet this need. A Travel Buddy is a soft toy or puppet that travels the world as a representative of a school or class. The buddy may go on a cultural exchange with a single school or travel to many destinations on an itinerary planned by the travel buddy's "family". The buddy becomes a member of the host class and participates in normal activities with the children, both in and out of school. Of course, they need to keep a record of their trip (eg. photos and a diary produced by the children looking after the buddy) and write emails home. At the end of the exchange, the buddy returns home with souvenirs and memories to share with the class.

The oz-Teacher net maintains the Travel Buddy Project through the Travel Buddy forum. The forum is a web/email-based community that provides teachers with an avenue to contact other teachers and establish exchange projects. While the projects that emerge from this program vary considerable as participants negotiate their own terms, the travel buddy character is the common theme of all projects. The role of the oz-Teachernet in this project is as a facilitator.

Keith Koala - A Travel Buddy

The Keith Koala project was designed as a simple action research that would be used to demonstrate the Travel Buddy project to educators around the world. In particular, it was displayed in a poster session at the International Conference for Computers in Education'99 that was held in Chiba, Japan. Additionally, this project was designed to inform future development of the Travel Buddy Project.

The "Keith Koala" puppet spent three weeks with a year six class (11 year olds) in suburban Brisbane, Australia. The brief that the children were given was that they needed to teach Keith about their lives in Australia. The evidence of Keith's experiences was presented in a diary, a collection of souvenirs that were placed in Keith's backpack and a web page about the project. The children also composed a class email to the school in Japan and recorded a digital video-greeting message in Japanese. At the end of the three weeks Keith was taken to Japan and the ICCE'99 conference. After the conference the puppet, along with the memorabilia of his travels was delivered to a parallel class in a Japanese school. The Japanese children in turn wrote in the Keith Diary, collect souvenirs, take photographs and draw pictures to portray their own lives for the Australian children. At the closure of the project, the buddy returned to the Australian class to share stories and presents, just as a real exchange student might.

The Keith Koala project provided some fascinating insights into the role that a travel buddy may take in a classroom community. The Keith travel diary is a rich source of memorable moments that captures the exchange perspective and the experiences that Keith had with the classes. Additionally the Keith Koala web site (http://www.fed.qut.edu.au/masters/koala/menu.htm) provides an engaging and informative record of a "real" adventure.

The Role of Information and Communications Technology

As many of the oz-Teachernet endeavours involve extensive and complex use of technologies, It was initially disappointing when it became apparent that computers and communication technology would play a very small role in this project. The Australian school had one computer in the classroom and an Internet connection in the school library, while the Japanese class had no computer access in their school, their only access being through a laptop and email account belonging to a parent and Internet access at the local community centre. However, as the conceptualisation of the project developed it became obvious that the technologies would actually play a key role in the venture.

The advantage of the travel buddy idea is that it can actually operate successfully with NO use of technology. As such, it provides an excellent mechanism to gradually introduce technology into school environments under real and meaningful context. In this instance, the project gave a great opportunity for the project officer to model and then support valid uses of technology for communication purposes. This included:

- the use of email to negotiate an exchange project
- the use of the classroom computer to prepare text files for later emailing
- using a digital camera to capture aspects of school community
- scanning drawings and photographs for electronic display
- creating a webpage to present the project to a wider audience
- using a digital movie camera to record a video message for a real audience
- using email as a fast communication device from remote locations in the world

Summary

Teachers who have used the Travel Buddy Project with their students often report on the way in which the buddy acts as a catalyst for all types of educational investigation. (Masters, 1999). It seems that the nature of this project is that it offers opportunity for any type of focus a teacher may wish to pursue. While the Keith Koala project was relatively modest in its aspirations, it certainly demonstrated the power of a travel buddy as a metaphor for real travel experiences.

Conclusion

The oz-Teachernet's axiom is "teachers helping teachers". It is through projects such as the two described here that the RITE Group can support teachers to become confident at using Information and Communication Technology for their own curriculum purposes.

References

Brisbane Catholic Education (1997). Position paper on cultural literacy and languages. Brisbane: BCE.

Dabblestein, G. (1997). Word of caution, Modern Language Teachers Association Quarterly, March.

Education Queensland (1999). Languages Other Than English URL:
http://www.qed.qld.gov.au/tal/kla/html/lote/lote.htm

Fox, M. (1987). Wilfrid Gordon McDonald Partridge, Adelaide: Omnibus.
Williams, M. (1998).

Masters, J. (1999). Get the Travel Buddy Bug! Connecting Children through a networked society. Poster presentation at ICCE'99, Chiba, Japan.

A Teachware Management Framework for Multiple Teaching Strategies

Christian Süß, Fakultät für Mathematik u. Informatik (suess@fmi.uni-passau.de)

Rudolf Kammerl, Lehrstuhl für Allgemeine Pädagogik (kammer01@fsuni.rz.uni-passau.de)

Burkhard Freitag, Fakultät für Mathematik u. Informatik (freitag@fmi.uni-passau.de)

Universität Passau,
94030 Passau, Germany

Abstract: In this paper we argue that effective teaching is a multi-method process and propose a teachware management framework flexible enough to support multiple teaching strategies. We model e.g. behaviouristic or constructivistic strategies based on a metamodeling approach to learning material. As the common implementation language we introduce the XML-based Learning Material Structure Markup Language which also facilitates the interchange and portability of learning material. Our teachware management framework has already proved its advantages from both, the author's and the learner's perspective.

1. Introduction

Learning processes depend on the individual properties of learners like age, level of experience, knowledge and interest which usally span a wide range. Thus, there is no best teaching strategy that applies to every learning situation. In fact, even for a single learner the best strategy may change over time. Students taking an introductory course on database theory, for instance, should be guided through the material whereas later on they may want to find out on their own about the SQL query language perhaps coached by a human tutor. As another example, students taking a course on the history of music may at one time wish to learn about operas by following a timeline-based tour through the musical epochs while at another time they may prefer to have more or less unstructured material on composers and their works available and to construct an individual map of the world of opera.

Apparently, teachware management systems or computer managed instruction (CMI) systems should support multiple teaching strategies. Moreover, as the examples above show, they should provide an appropriate data model, suitable abstraction mechanisms, and tools not only to authors but also to learners. It is obvious, that a flexible multi-strategy support and powerful application interface both require system properties that are beyond most traditional hypermedia systems and common techniques and tools for computer based teaching.

In this paper, we show how the required structural properties and multi-strategy support can be largely achieved in the PaKMaS teachware management framework (PaKMaS 2000) which is based on a meta-modeling approach (Süß et al. 1999) providing a flexible and adaptable data model and on the XML-based Learning Material Markup Language (LMML). Some of the key features, of course, are a simple yet powerful component model, repository techniques that exploit the meta-data available, the strict separation of contents from structure as well as the capability of adaptive presentation and navigation.

The rest of the paper is organized as follows: In section 2, we have a look at the three most important learning theories and emphasize the need to apply multiple teaching strategies in teachware managment systems. In section 3, we discuss our meta-modeling approach focussing on the concepts needed for the modeling of learning strategies. We also introduce a sublanguage of LMML, the Learning Material Structure Markup Language (LMSML). The benefits of the teachware management framework based on the meta-modeling approach and the LMML for authoring and application of different strategies are discussed in section 4. A comparison with related work can be found in section 5. The paper is concluded with a summary in section 6.

2. Learning theories and teaching strategies

Due to the heterogeneity of the goals aimed at, practical arrangements for teaching and learning are influenced by various didactical and learn-theoretical considerations. Consequently, teachware appreciating this variety of approaches and thus satisfying the requirements of practical teaching has to account for and give support to different learn-theoretical foundations. The latter can be classified into behaviouristic, cognitivistic and constructivistic theories.

2.1. Behaviourism

The behaviouristic approach is based on the assumption that behaviours can be steered by external stimuli. Certain stimuli (S) cause related behavioural responses (R). Stimulus-response pairs (S-R pairs) can be chained and become habits. Teaching goals are to be achieved by presenting selected information and questions or exercises as stimuli, that are expected to cause a certain behaviour, to the learner. If the learner reacts in the expected way his or her behavioural response will be confirmed. The same principle applies to both simple and complex teaching goals. However, in the case of complex goals the entire process is broken into a collection of simpler steps which are normally ordered sequentially. The behaviouristic learning theory is chiefly materialized as a learning strategy by guided tours or linear presentations using multiple choice questionnaires or drill & practice modules. Teaching machines and the model of programmed instruction are early realizations of behaviourism (Skinner 1958). The basic principle of these approaches is the presentation of information followed by a collection of questions and according feed-back to the learner. Authoring systems (Chambers et al. 1980) support the development of behaviouristic teaching material. The overall teaching goal is the acquisition of factual knowledge.

2.2. Cognitivism

Cognitivism which relates to the theories of Piaget (Piaget 1977) and Bruner (Bruner 1966) considers the learner as an individual that processes external stimuli actively and independently and that can therefore not be steered by external impulses. As opposed to the behaviouristic view, the cognitivists believe that learning is based on cognitive structures. It is assumed that the learner perceives, interprets and processes impressions in a selective way according to his or her level of experience and personal evolution. The latter is characterized by the total of perception, comprehension and processing patterns and schemata that are at the command of the individual and constitute his or her cognitive structure.

Therefore the question what processes underly the interaction of learning material as the external condition of learning on the one hand and cognitive structure as the internal condition of learning on the other hand receives special attention. Within the cognition-theoretical framework there exist various different positions concerning (among others) the question whether the overall goal should be the construction of a knowledge structure or rather the development of a general problem solving ability or intellectual and moral capabilities, the practical means in both cases being hints and problems in simulations or case studies as appropriate to the individual cognitive structure. As another question it has been discussed how the learning material and related information is processed by the human brain and how content can be adapted accordingly, e.g. by relating notions to their conceptual environment or by mixing visual and textual presentations. The cognitivistic learning theory together with behaviouristic ideas has influenced the Instructional Design (Merrill 1991). However, essential aspects received attention only in connection with constructivistic approaches.

2.3. Constructivism

From the perspective of constructivism the potential of teaching media to steer learning processes is considered even lower than from the cognitivistic point of view. The active processing of external impulses is rated even higher. The learner is assumed to construct reality individually based on his or her subjective experience structures (Maturana et al. 1984). Although constructivism is an offspring of cognitivism it refuses the latter's objectivism (Jonasson 1991). Constructivism considers knowledge not as a reflection of an external reality but rather as a function of perceptual processes. From this point of view learning material is to consist just of collections of information units and tools that form the input of the learning processes built by the individual. It is assumed that learning material can neither control the learning processes nor provide any reflection of reality. Every act of perception creates a new world (Maturana et al. 1984). As one possible realization of the constructivistic approach, learning environments can be provided that support the activity-based, explorative interaction with the environment. Three approaches to computerized learning environment are rooted in constructivism:

1. Cognitive tools are a collection of software programs that use the control capabilities of the computer to amplify, extend, or enhance human cognition (Kozma 1987). Cognitive tools support the learner in the formation of his or her own concepts. The learning environment is therefore formed and modeled by the learner.

2. Learning is understood as a communicative activity in knowledge communities. The construction of reality requires the interaction with the social environment, too. Communication, e.g. in networks, should therefore be supported (Brown 1985).
3. Learning is viewed as coaching based on a master-apprentice relationship (cognitive apprenticeship). The master offers advice but gives the apprentice more and more independence when he or she makes progress (Collins et al. 1989)

2.4. Multiple teaching strategies

Courses and seminars normally contain components belonging to different learn-theoretical positions. We are convinced that all three approaches sketched above should be taken into consideration. However, which learning theory is best suited to support learning processes depends on the teaching goals and the individual properties of the learner, i.e. level of experience and education, age, learning habits. To teach freshmen the foundations of database systems, for instance, could possibly be accomplished best by a guided tour, whereas more experienced students may be better served with an interface to a real database system together with hints, comments, documentation, and a facility to contact the responsible coach, e.g. by email. Consequently, a teachware management system should have the capability to support different teaching strategies. These can be materialized in the form of behaviouristic components like guided tours with multiple-choice questions. Likewise, a constructivistic strategy could be provided by a collection of informative components and tools that allow the learner to construct or change the learning environment, in a certain way being an author him- or herself. Besides, a coaching support and facilities for human communication should be provided. Most CMI systems implement only one single teaching strategy. To overcome this restriction a suitable modeling and implementation of multiple strategies are needed as well as an appropriate toolkit for authors and learners. Of course, a CMI system can provide means to develop and use teaching material. However, its success is largely determined by the knowledge and competence of the author.

3. A teachware management framework

3.1 A metamodeling approach to hypermedia teachware

We have developed a meta-modeling approach to hypermedia teachware (Süß et al. 1999), which is flexible enough to let the teachware management system PaKMaS support multiple teaching strategies (see section 2.4.). The bottom layer of our meta-modeling architecture consists of the subjects to be taught or learned. One layer up, hypermedia learning material are describing the given domain of application, e.g. database theory or the world of opera. They use domain-specific means, which are specified in domain-specific models and describe the conceptual content as well as the modular structure of learning material and different teaching strategies of a given domain of application. Finally, the common abstract meta-model specifies learning material in an abstract way. This includes aspects also of teaching strategy by specifying how both, authors and learners, can form learning material in general. Learning material consists of learning *modules* that are either *basic modules* or *structure modules* containing other modules. The former are the terminal nodes of a polyhierarchical hypermedia structure similar to directories or books, but allowing *modules* to belong to more than one super module. Indeed, each module has to be contained in at least one structure module. By composition, they dynamically adapt learning material to the needs of different groups of learners at the content level and realize the different teaching strategies of section 2 using appropriate meta-data. Basic modules, however, are the smallest self-contained units or building blocks of the modular structure of learning material. Representing conceptual units, they contain various content objects, which can be behaviouristic, e.g. drill & practice instructions and multiple choice questions, or constructivistic, e.g. coaching remarks, simulations or interfaces to real world systems.

3.2. Learning Material Markup Language

To represent learning material incorporating different teaching strategies, we need a data format, which is suitable for storing the content and structure of the material and which allows to access the stored modules or data, very much like objects in a database system. Moreover also the authors and learners should find it easy to read and use the information stored in the modules. As described in (Süß et al. 1999) we have developed a XML representation for course content and structure representation and interchange: the Learning Material Markup Language (LMML). It comprises two sublanguages, the Learning Material Content Markup Language, which is a syntactical representation of the conceptual content and the Learning Material Structure Markup Language, which represents the modular structure model. To implement multiple teaching strategies, it uses special elements, e.g. *guidedTour* or *collection*, which are declared in the Document Type Definition (DTD) (PaKMaS 2000) and which have strategy attributes with possible constant values *beh* (behaviouristic) or *con* (constructivistic) respectively. On the one hand, the use of the XML-based LMML faciliates the interchange and portability of learning material (Süß et al. 1999). On the other hand, using metadata like those mentionend above, a teachware management system like PaKMaS supports authors wanting to create learning material using multiple teaching strategies as well as learners using the presented material.

4. Supporting multiple strategies

4.1. Behaviouristic strategies

Within our framework, teaching material can be presented hierarchically using a book metapher with chapters and sections as *structure modules*. They can also be presented sequentially starting at a first *basic module* using a guided tour metapher (Fig. 3). Both represent behaviouristic strategies where the author explicitly plots the route through the given learning material.

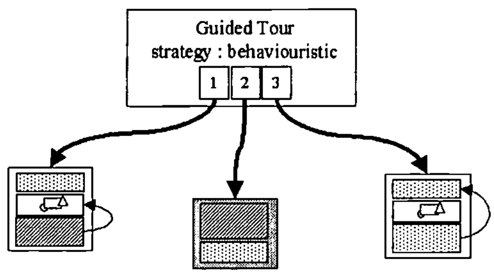


Figure 3: Behaviouristic strategy using a guided tour

If an author, for example, wants to create a section of a booklike course or a guided tour, she can create new behaviouristic *basic modules* using *course units* defined in LMCML which can be extended e.g. by *question* elements from the Tutorial Modelling Language (TML) (Brickley 1999). She also can query the systems repository for suitable basic modules, i.e. for modules with *strategy* attribute (see section 3.2.) set to *beh* (behaviouristic). PaKMaS uses these meta-data to answer questions like "Which basic units about the SELECT statement are appropriate to be used in a guided tour on SQL?". For the *modules* found, the system can suggest a linear ordering or check the consistency of a sequence created by an author using the modules *prerequesite* and *objectives* attributes. As guided tours and sections or chapters are *structure modules* which impose a linear ordering to the children modules a teachware managment system can offer navigation facilities with which the learner can sequentially walk step-by-step through the given *basic modules*.

4.2. Constructivistic strategies

Our framework is flexible enough to support constructivistic strategies, too. It provides *structure modules* like *indexes*, *glossaries*, *time lines* or even just unordered *collections* (see Fig. 4) of learning material.

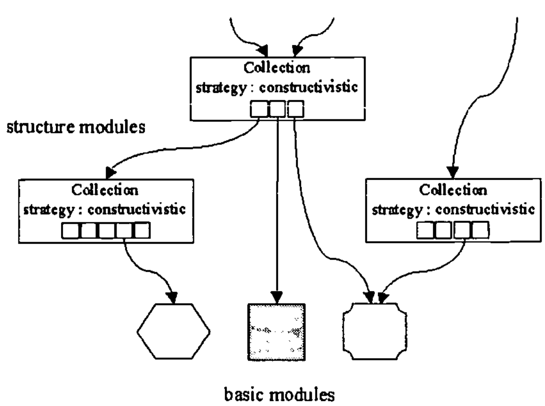


Figure 4: Constructivistiv strategy using collections

They all allow direct, non-hierarchical access. Special *basic modules* representing *coaching units* give some hints to the learner on the appropriate usage of the available material. PaKMaS supports cognitive apprenticeship (see section 2.3.3) using these modules and offering easy to use communication facilities with human coaches. Furthermore communication via email and chat with other users of PaKMaS as well as posting to appropriate newsgroups managed by PaKMaS support the creation of knowledge communities (see section 2.3.2.). A learner, for example, can freely browse through *basic modules* on composers or operas in any order, e.g. alphabetical or by date of birth. If provided by the author, she can use coaching remarks or hints in a coaching unit. Furthermore, she can communicate with coaches or with other learners in this domain of application.
Our framework allows the wrapping of simulations or real life systems into basic modules using LMCML. This way a learner, for example, in a database course can find out about SQL by herself using an interface to a real world database (Fig. 5). As another example, she can learn about harmony in a music course using a composing system thus acquiring complex knowledge by herself. It should be noted that we do not address the support for creation of constructivistic programs like simulations etc.

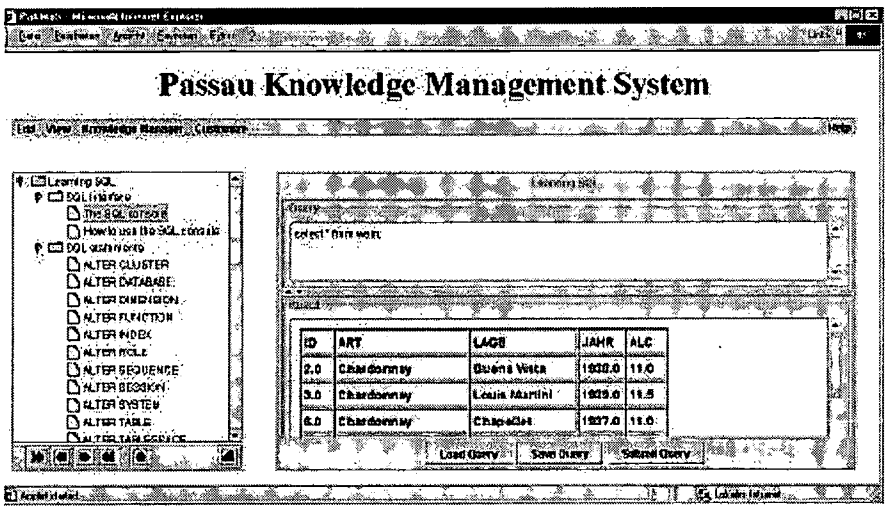


Figure 5: Collections with coaching unit, SQL interface and descriptions of SQL statements

In addition to the simple possibility to annotate learning material with individual notes, PaKMaS provides cognitive tools which are most important for the application of constructivistic strategies (see section 2.3.1). With these tools, learners can structure and form their learning environment with respect to the meta-model. For example, they can use existing *structure modules* to form own *collections* and to create own *guided tours*. Note that although the latter represents a behaviouristic strategy, creating a *guided tour* is a constructivistic learning step. To model their own learning material, learners can use existing content objects like *definitions* or *examples*. Beyond that learners can create new types of structure modules like *slide show* or new types of conceptual units like *slides*. Thereby learners can continuously form their learning environment with respect to the metamodel. Students in a music course, for example, can construct their own "map" of the world of opera using own concepts.

5. Related work

The Instructional Material Structure Description Language (IMSDL) allows to specify instructional models (Silberhorn et al. 1999). In contrast to IMSDL, we differentiate between different types of *conceptual units* or different types of *content objects*. Thus, we have the concepts and syntactical representations of *coaching units* or *coaching remarks* which are necessary in constructivistic strategies. We also differentiate between different types of *structure modules* to realize structures like *books* or *collections*. Finally, using a meta-modeling approach, we distinguish different domains of application and their specific needs with respect to teaching strategies. (IEEE P1484 1999) proposes a text-based programming language to describe courses which consist of blocks and assignable units. The former are the largest structural elements in a course and are comparable to *structure modules*, wheras the latter are programs or whole lessons launched by a CIM system. In contrast to our work, the order in which a student may go through a course is only implicitly given by the order of the blocks and assignable units or their prerequisites data. In the XML-based TeachML (Wehner et al. 1999), a course is the container of learn blocks, which contain any number of didactical paths. The latter contain at least one and at most four facts and one optional exercise. They seem implicitly to specify behaviouristic *guided tours*. In our approach, teaching strategies are explicitly specified allowing the use of learning strategies different from behaviouristic *guided tours*, too. Finally, (Teege 1999) also proposes a XML-based TeachML. Here, the author recursively composes learning material from more or less large modules using XSLT. The resulting hierarchical structures implicitly realize behaviouristic strategies.

6. Conclusion

In this paper we argued that effective teaching requires the use of multiple teaching strategies. The meta-modeling approach to hypermedia teachware which we have proposed allows the domain-specific modeling necessary for the authoring and application of different teaching strategies by providing appropriate structure modules, conceptual units, content objects and meta-data. We discussed how these concepts can be implementcd using the XML-based LMML. On the one hand the Learning Material Content Markup sub-Language of LMML syntactically represents different conceptual units like coaching units or drill & practice units and different content objects like coaching remarks or instructions. The sublanguage Learning Material Structure Markup sub-Language on the other hand implements behaviouristic strategies using guided tours or books as well as cognitivistic or constructivistic strategies. Furthermore, appropriate meta-data are used by a teachware management system like PaKMaS to support authoring as well as usage. Finally, relying on the properties of XML, LMML can facilitate the portability and exchange of learning material.

References

Brickley, Dan (1999). *Tutorial Modelling Language* (TML 5.0), http://www.ilrt.bris.ac.uk/netquest/about/lang/

Brown, J. S. (1985). Process versus Product: A Perspective on Tools for Communal and Informal Elctronic Learning. *Journal of Educational Computing Research* 2 1.

Bruner, J.S. (1966). *Toward a theory of instruction*. Cambridge, Massachusetts: The Belknap Press of Harvard University Press.

Chambers, J. A. , & Sprecher, J. W. (1980) *Computer Aided Instrcution: Current Trends and Critical Issues.* Communications of the ACM 6 23.

Collins, A., & Brown, J. S., & Newman, S. E. (1989): Cognitive Apprenticeship: Teaching the Crafts of Reading, Writing and Mathematics. Resnick, L. B. (ed): *Knowing, Learning and Instruction*. Hillsdale, NJ.

Goldfarb, C.F., & Prescod, P. (1998): *The XML Handbook*. Prentice Hall.

IEEE P1484 (1999). *Learning Technology Standards Committee (LTSC), CBT Interchange Language Working Group*, http://ltsc.ieee.org/doc/wg11/CMI-Sem1.doc

Jonasson, D. H. (1991). Objectivism versus Constructivism: Do we need a new philosophical paradigm? *Educational Technology: Research & Development* 39 (3).

Kozma, R. B. (1987). The Implications of Cognitive Psychology für Computer-Based Learning Tools. *Educational Technology* 11 27.

Maturana, H.R. & Varela, F. J. (1984). *The Tree of Knowledge*. Boston, MA: New Science Library.

Merrill, M. D. (1991). Constructivism and Instructional Design. *Educational Technology* 5 31.

PaKMaS (2000). *Passau Knowledge Management System*, http://daisy.fmi.uni-passau.de/pakmas/

Piaget, J. (1977). *Epistemology and psychology of functions*. Dordrecht.

Silberhorn, H., & Gaede, B. (1999). *IMSDL: Instructional Material Structure Description Language*, 7th BOBCATSSS Symposium on Learning Society, Learning Organisation, Lifelong Learning, Bratislava.

Skinner, B.F. (1958). Teaching Machines, *Science* 128.

Süß, Ch., & Freitag, B., & Brössler, P. (1999): Metamodeling for Web-Based Teachware Management. *Advances in Conceptual Modeling*. ER'99 Workshop on the World-Wide Web and Conceptual Modeling, Paris, France, Nov. 1999, Proceedings, Springer LNCS 1727.

Teege, G. (1999). *Targeted Reuse and Generation of TEAching Materials*, http://www11.informatik.tu-muenchen.de/proj/targeteam/

Wehner, F. & Meißner, K. (1999): Ein Dokumentmodell für Kursdokumente in Webbasierten Virtuellen Lernumgebungen, *Proceedings of "GeNeMe99"*, Dresden, Germany.

Technology Integration and Professional Development: A Mentoring Model

Karen Swan, Aliya Holmes & Juan D. Vargas
University at Albany
ED 114A
Albany, NY 12222
swan@cnsvax.albany.edu; ah5555@cnsvax.albany.edu; jv0536@cnsvax.albany.edu

Sybillyn Jennings
Sage College
Author Address
Troy, NY
jennis@rpi.edu

Abstract: This paper describes the development and exploration of a model for professional development concerned with the integration of computing technologies into classroom teaching and learning. Grounded in situative theories of knowledge and learning, the model adopts a mentoring approach that places technology experts in schools to work with teachers to create technology supported lessons that meet the teachers' curricular needs.

Theoretical Perspectives

Recent large scale studies of computer usage in schools (Becker, 1994; Panel on Educational Technology, 1997; Educational Testing Service, 1998) have precipitated public debate concerning the efficacy of using computers to support instruction, and highlighted the need for professional development in this area. While highlighting such need and pointing to the relationship between professional development and more sophisticated uses of technology in schools, these and other studies have contributed little to our understanding of how professional development impacts technology integration, especially in terms of how it affects teaching, learning, and technology integration at the classroom level.

Indeed, teacher lore suggests that traditional inservice teacher education has little impact on teaching practices in general. Smylie (1989), for example, found that teachers ranked inservice training last out of fourteen possible opportunities for learning. What teachers ranked as most important was direct classroom experience. Other researchers report similar findings (Little, 1994), leading scholars in the field to develop lists of the features common to effective staff development activities (Little, 1988; Abdal-Haqq, 1995; Ball, 1996; Wilson & Berne, 1999). Putnam and Borko (1997), for example, reduce the essential features of effective teacher education to four:

- Teachers should be treated as active learners who construct their own understanding.
- Teachers should be empowered and treated as professionals.
- Teacher education should be situated in classroom practice.
- Teacher educators should treat teachers as they expect teachers to treat students.

In a more recent article, Putnam and Borko (2000) relate recent trends in research on professional development to new understandings of the nature of learning and knowing that have beencollectively labeled "situative" (Greeno, 1997). They identify three conceptual themes central to situative perspectives – that cognition is situated in particular physical and social contexts, that it is social in nature, and that cognition is distributed across the individual, others, and tools (p. 4) – which they believe have important implications for professional development. Putnam and Borko argue that how teachers learn new methods of teaching is no different from any learning. If knowledge and learning are indeed situative, then the most effective inservice education will be situated in authentic classroom practice and constructivist in focus. The situative perspective thus gives a theoretical rationale for previous findings concerning effective inservice activities.

To our knowledge, such perspective has not been used to frame either the development of, or research on, professional development programs aimed at technology integration, although a situative perspective is widespread in research and development of technology-based educational programs. Indeed, the Report to the President on the Use of Technology to Strengthen K-12 Education in the United States (Panel on Educational Technology, 1997) consciously grounds its recommendations concerning technology integration, professional development, and educational technology research within a constructivist and situative theoretical framework. The Panel's argument for these later approaches is analogous to Putnam and Borko's (1997) finding that teacher educators should treat teachers as they expect teachers to treat students; it only makes sense to model best technology integration practices when attempting to get teachers to use them.

It only makes sense, and yet most professional development programs aimed at technology integration are instructionist, application-driven, after-school workshops or summer "institutes" well removed from classroom practice. Some have argued (Wilson & Berne, 1999) that while not optimal, such approaches are often the only practical solutions to meeting large-scale professional development needs with limited resources. There has been very little investigation of the effects of these traditional professional development activities, however, on technology integration at the classroom level. In fact, what little research there is suggests such activities have little impact on the day-to-day integration of computing technologies into classroom teaching and learning (Becker, 1994; Panel on Educational Technology, 1997; Educational Testing Service, 1998).

It is hard to see how approaches that consistently have little or no effect on classroom-based technology integration can bee deemed "practical," thus we decided to try an "impractical" approach. In the remainder of this paper, we describe a professional development program which has adopted an approach to technology education that is situates professional development in day-to-day classroom practice.

The CATIE Program

The Capital Area Technology and Inquiry in Education (CATIE) program was established through the Institute for Pre-College Initiatives at Rennselaer Polytechnic Institute (RPI) as an innovative means for addressing technology-based, constructivist-oriented staff development in elementary schools in the greater Albany (NY) area. This unique program places technology experts in school buildings where they serve as mentors to teachers interested in integrating the use of technology into their day-to-day classroom activities. The school-based mentors provide training to teachers on technology utilization, but, more importantly, do so in the context of jointly designing computer-supported lessons that incorporate technology into existing classroom curricula. Teacher learning about technology integration is thus situated in authentic technology integration activities.

Typically, the mentors first meet with teachers, both individually and in groups, to discuss how technology might be used to enhance learning in planned units on particular topics. Mentors try to avoid planning that is either artificial or focused on specific software applications. They then work with teachers to design computer-supported lessons that are integral parts of larger, classroom-based learning units. They encourage inquiry-based, student-centered, constructivist uses of computing technologies, but do not insist on them. Often, mentors model best practices in computer-based teaching and learning by taking the lead in implementing jointly created lessons. They then guide teachers in designing and implementing their own computer-based lessons, finally fading their support as teachers become more confident in the use of computer technologies.

Mentor support, however, does not just disappear. Each mentor structures his or her schedule according to their school's individual needs, but is generally available two or three days each week for a period of two years or more to work with teachers and their students on a continuing, as-needed basis. Many teachers, having mastered a particular technology tool, return to their mentor for help in utilizing other applications in their teaching. Some teachers just come to share with their mentors the ways in which they are using technology on their own, and some mentors meet regularly with groups of teachers to discuss technology integration. As mentors become a part of the culture of the school, formal and informal conversations of this sort become more common and ongoing, and a discourse community grows up around technology integration.

The major goals of the CATIE program are to foster individual teacher and student development of technological skills, to assist teachers' with the infusion of technology into existing curricula, to broaden the use of computing technologies within the elementary school setting, and to foster constructivist teaching and learning around electronic technologies. It is an ongoing program and has grown from a single mentor in one school to more than ten mentors working in fourteen elementary schools in four school districts. Indeed, the model is currently being institutionalized in at least one of these districts as the preferred means of technology training.

Research Methodologies

In keeping with its constructivist goals, research on the CATIE program is being conducted using an action research approach. Mentors work with the researchers to set an evolving research agenda, collecting data and sharing it in weekly meetings with the researchers and each other. Of course, as with mentors work in the schools, constructivist approaches can be slow going, and this process has taken time. Data being collected to date centers on narratives structured to tell the stories of the mentors' experiences and the themes that emerge from them. Other data being regularly collected include: time spent on particular mentoring activities, teachers worked with, lessons planned, subject areas and learning standards addressed, technologies used, and grading rubrics. The mentors have also been collecting student work, and project researchers are conducting observations in representative classrooms. In addition, outside evaluators have conducted interviews with each of the mentors and a sample of participating teachers.

Data analyses for the first year of CATIE's operation concentrated on four objectives:

- documenting how mentor services were utilized
- identifying best practices in mentoring
- assessing stakeholder perceptions of the CATIE program
- identifying areas in need of change or additional resources.

Data analyses for this, the second year of CATIE's operation will focus on:

- evidence of teacher change
- student learning
- mentoring themes
- categories of technology integration

Findings

Clearly, the CATIE program exhibits the features Putnam and Borko (1997) identify as essential to effective teacher education:

- Teachers involved in the CATIE program are treated as active learners who construct their own learning to meet their own specific professional needs. CATIE mentors serve as facilitators for that learning but follow and respect the directions it takes.
- Thus, teachers in the CATIE program are empowered to use technology in their teaching (through the on-site support of the mentors) and treated as the professionals they are.
- In the CATIE program, teacher learning about technology integration is situated in classroom practice.
- CATIE mentors model constructivist, student-centered teaching with technology in their work with both students and teachers. Mentors thus treat teachers the way they would have them treat students.

Most mentors spend the majority of their time working with teachers and students in the computer labs of their participating schools, although they also assisted some classes within their own classrooms. The latter is the goal of the program and something to work towards in the future. A related goal is to encourage teachers to look beyond their current uses of technology. This seems to be happening with the more technology-experienced participating teachers, and with teachers involved in their second year with the program. The CATIE program has also made significant gains in helping teachers less familiar with educational technology become comfortable in its use.

Flexibility and adaptability were found to be central to best practices in mentoring. Mentors' ability to work with variations in teacher learning styles, pedagogical approaches, and prior experiences, as well as with existing school technology resources were found to significantly influence technology integration in schools and classrooms.

Teacher perceptions of the CATIE program were overwhelmingly positive. Teachers uniformly reported increased knowledge of computing technologies, greater confidence in using them, and more creative teaching with computers. Positive outcomes for students, including greater independence, heightened self-efficacy, and increased motivation, were also noted by participating teachers. In addition, the CATIE program has been a positive experience for mentors as well, giving them the opportunity to become part of school communities while learning more about technology infusion therein.

Finally, additional resources needed to improve the mentoring program included:

- Time -- More time is needed for teachers to work with the mentors and experiment with the technologies. Teachers would also like mentors to be available more times in the schools. Mentors would like more time to meet together to share strategies and projects.
- Technology Resources – Many schools and/or classrooms had outdated hardware and software; access to better technology resources would make it easier to implement best practices.
- Administrative Support – Administrative support can lead to changes in the culture of a school such that it supports technology integration. Administrative practices identified identified as most supportive of technology integration included: defining mentors roles early in the school year, discussing technology integration with teachers, frequent visits to the computer labs, spotlighting teachers' technology-based projects and other systems of rewards for technology using teachers, and support for technology needs.
- Additional Opportunities for Teacher Learning – Additional opportunities for teacher learning requested included: summer technology workshops, planning meetings with mentors before the beginning of school, and more one-on-one learning opportunities during the school year.

Educational Significance

Although early on in its development, the CATIE program seems to be positively affecting technology integration in the schools in which it is operating. Indeed, in this its second year of operation, its effects are becoming clearer. Perhaps the best measure of its success is that one of the districts in which it has been implementing is adopting mentoring as the preferred means of technology training. Common sense indicates that the CATIE program is successful because it is reaching out to teachers in the physical and social context of their practice, because it provides ongoing, long-term support for technology integration, and because of the personal relationships mentors are forging with participating teachers and within the culture of the schools in which they work. Its success thus supports a situative perspective on teacher learning, especially teacher learning about technology and technology integration.

References

Abdal-Haqq, I (1995) Making time for teacher professional development (Digest 95-4). Washington, DC: ERIC Clearinghouse on Teaching and Teacher Education.

Ball, D. L. (1996) Teacher learning and the mathematics reforms: What do we think we know and what do we need to learn? Phi Delta Kappan, 77, 500-508.

Becker, H. J. (1994) Analysis and Trends of School Use of New Information Technologies. Washington, DC: US Congress Office of Technology Assessment. http://www.gse.uci.edu/EdTechUse/c-tblcnt.htm

Educational Testing Service (1998) Does it Compute? Princeton, NJ: Education Week. http://www.edweek.org/sreports/tc98.html

Greeno, J. G. (1997) On claims that answer the wrong questions. Educational Researcher, 26 (1), 5-17.

Little, J. W. (1988) District policy choices and teachers' professional development opportunities. Educational Evaluation and Policy Analysis, 11, 165-179.

Little, J. W. (1994) Teachers' professional development in a climate of cducational reform. Educational Evaluation and Policy Analysis, 15, 129-151.

Panel on Educational Technology. (1997) Report to the President on the Use of Technology to Strengthen K-12 Education in the United States. Washington, DC: President's Committee of Advisors on Science and Technology. http://www.whitehouse.gov/WH/EOP/OSTP/NSTC/PCAST/k-12ed.html

Putnam, R. T. & Borko, H. (1997) Teacher learning: Implications of the new view of cognition. In Bidle, B. J., Good, T. L. & Goodson, I. F. (Eds.) The International Handbook of Teachers and Teaching. Dordrecht. Netherlands: Kluwer.

Putnam, R. T. & Borko, H. (2000) What do new views of knowledge and thinking have to say about research on teacher learning? Educational Researcher, 29 (1), 4-15.

Smylie, M. A. (1989) Teachers' views of the effectiveness of sources of learning to teach. Elementary School Journal, 84, 543-558.

Wilson, S. M. & Berne, J. (1999) Teacher learning and the acquistion of professional knowledge: An examination of research on contemporary professional development. In Iran-Nejad, A. & Pearson, P. D. (Eds.) Review of Research in Education, 24. Washington, DC: American Educational Research Association, 173-209.

Electronic Literacy Standards for the 21st Century

Karen Swan
University at Albany
ED 114A
Albany, NY 12222
swan@cnsvax.albany.edu

Abstract: This paper explores the notion that the desired outcome of current technology initiatives is technology integration across the curriculum. It argues that technology integration across the curriculum can best be understood in terms of an expanded notion of literacy; that technology integration across subject areas and grade levels can best be guided and assessed in terms of the critical and creative uses made of nonprint media and computing and communications technologies. To such ends, it presents a possible set of performance-based, nonprint media and technology literacy standards for guiding and assessing technology integration across the K-12 curriculum.

Perspectives

For the past several centuries, the dominance of print over other forms of communication media has been overwhelming and largely unchallenged. Recent decades, however, have witnessed rapid changes in how we communicate with one another, entertain ourselves, conduct business, get information, create knowledge, and generally make sense of the larger world. Electronic texts are everywhere replacing printed ones as the media of choice in a wide range of human endeavors. Our notions of what it means to be literate are correspondingly expanding.

For example, the National Council of Teachers of English (NCTE) and the International Reading Association (IRA) state in their summary of the national Standards for the English Language Arts,

> *". . . being literate in contemporary society means being active, critical, and creative users of print and spoken language, as well as the visual language of film and television, commercial and political advertising, and more. It also means being able to use an array of technologies to gather information and communicate with others."* (NCTE/IRA, 1996a, p. 2).

Renee Hobbs (1988) similarly argues for a new definition of literacy. *"Literacy,"* she writes (p. 7), *"is the ability to access, analyze, evaluate, and communicate messages in a variety of forms."*

Indeed, as we find ourselves on the eve of a new millenium, the question is no longer whether or not we should be using new media technologies in our nation's classrooms but how we can best integrate their use across the curriculum (Panel on Educational Technology, 1997, p. 90). The Panel on Technology (1997), for example, notes that the use of computers in American schools mostly focuses on either learning *about* technology or drill and practice in basic skills. Other national studies have reported similar findings (Becker, 1994; Educational Testing Service, 1998).

Researchers agree that the biggest reason for such under-utilization is lack of understanding. Our own research (Swan, et. al., 1997) suggests that teachers just don't know how to make nonprint media and/or computers and communication technologies an integral part of day to day learning in their classrooms. Teachers need to learn to treat computing technologies and other nonprint media in the same ways they treat technologies of print. In the rest of this paper, I describe a set of nonprint media and technology literacy standards for guiding and assessing technology integration across the K-12 curriculum which, I believe, at least begins a discussion that accepts the use of such media as literate behaviors.

Methodology

Diane Ravitch writes, " . . . *those who develop standards should recognize their role is to discover and explain the very best existing standards, not to invent new and untried ones*" (1995, xxvi). In the case of nonprint literacies, three more than adequate sets of national standards collectively identify the competencies in the use of nonprint media and communications technologies experts and practitioners believe students should have by the completion of elementary, middle, and high school. These are:

- National Educational Technology Standards for Students (International Society for Technology in Education, 1998),
- Information Literacy Standards for Student Learning (American Association of School Librarians, 1998)
- Standards for the English Language Arts (National Council of Teachers of English/International Reading Association, 1996b).

These three sets of standards were chosen because they are national in scope, because they are constructivist in approach (Panel on Educational Technology, 1997), and because they all address media and technological competencies as part of a larger notion of literacy. The three sets taken together address technological literacy, information literacy, and literacy in general. All three sets of standards were developed by the leading professional organizations in their specific areas of interest, and revised through extended, open processes of review and revision that included a variety of stakeholders as well as educational technology experts.

The nonprint media and technology competencies found in these three sets of standards were reworked to a list of simple performances identifying the competencies students should have at the completion of elementary, middle, and high school, and redundancies among them were eliminated. The resulting performance standards were then sorted into three categories – basic skills, critical literacies, and construction skills -- to highlight the kinds of competencies many experts believe students should be developing around nonprint media and computing technologies (Panel on Educational Technology, 1997).

According to Tyner (1998), two kinds of literacy are taught in schools. *Tool* literacies focus more on simple meanings and basic functionality – what Hobbs (1998) calls "access". In our list, these fall in the basic skills category. Literacies of *representation*, on the other hand, stress the need to analyze information and understand how meaning is created. Traditional (print-based) literacy addresses both. Too often nonprint media and technological competencies are only addressed at the tool level. We therefore have highlighted literacies of representation in the critical literacies and construction skills categories.

Results

Basic skills, critical literacies, and construction skills are described in the sections that follow, and specific competencies for each category are given at the elementary, middle, and high school levels. The lists of standards should be understood as tentative. It should also be kept in mind that the standards lists were derived from existing national standards, and were not constructed by us. Thus, while we agree with most of the individual competencies, we do not necessarily agree with all of them. We think there may be competencies missing that represent literate behaviors which are unique to electronic media. We feel confident in arguing, however, that these lists provide a good starting point for discussing nonprint literacy and for guiding and assessing technology integration in our schools. In particular, the sorting of the standards into basic, critical, and construction skills suggests more sophisticated and literate ways of understanding nonprint media and technology literacy and provides a way of assessing not just the extent but the quality of technology integration efforts.

Basic skills are competencies involving the use and simple manipulation of nonprint media and the recognition of common conventions used by them. They include competencies related to accessing, decoding, encoding, locating, etc. In the list which follows, the basic skills students should have by completion of elementary, middle, and high school are given, in that order. These skills should be understood as cumulative; that is, by the completion of high school, students should have acquired all of them.

elementary

- Use a mouse to successfully operate a computer
- Use a keyboard to successfully operate a computer

- Use a computer monitor
- Use a computer printer
- Use a scanner
- Use a digital camera
- Operate a VCR
- Operate an audio tape player
- Use interactive books
- Use developmentally appropriate multimedia encyclopedias
- Use content specific educational software to support learning
- Use a variety of nonprint media resources for directed & independent learning activities
- Use a word processor
- Use computers to compose texts
- Use computers to compose graphical representations
- Use multimedia authoring tools
- Use computers to search a variety of databases
- Use data collection probes
- Use calculators
- Use email
- Participate in online discussions
- Use a browser to navigate the WWW
- Use search engines to locate & access remote information
- Use productivity tools & peripherals to support personal productivity
- Communicate about technology using accurate terminology
- Demonstrate knowledge of video conventions
- Demonstrate knowledge of computing conventions
- Give examples of situations where more information is needed to solve a problem
- List ideas for identifying & finding needed information
- Describe several ways to organize information
- Name a variety of formats for presenting different kinds of information
- Practice responsible use of technology systems & software
- Work cooperatively using technology

middle school

- *Use content specific computer simulations to support learning*
- *Use exploratory environments to support learning*
- *Use graphing calculators*
- *Use computers to search the Internet*
- *Use communications & computing technologies to locate information efficiently*
- *Brainstorm a range of information sources to meet a specific information need*
- *Use productivity tools & peripherals to support group collaboration*

high school

- Take notes & gather data from nonprint sources
- Use online information resources for research
- Use technology tools Y resources for managing personal/professional information
- Use technology tools & resources for communicating personal/professional information
- Use online resources to enhance personal/professional productivity
- Discuss real world applications of expert systems
- Discuss real world applications of intelligent agents
- Discuss real world applications of simulations
- Explore a range of sources to find information of personal/professional interest
- Use & cite others' work appropriately & correctly

Critical literacies are competencies concerned with the ability to interpret, critique, and evaluate nonprint texts, to synthesize information found within them, and to apply them in solving problems and increasing personal understandings. They include such abilities as making sense, analyzing, evaluating, applying, etc. The cumulative critical literacies students should have by completion of elementary, middle, and high school are listed below.

elementary

- Make sense of a variety of graphical representations

- Demonstrate listening skills
- Make sense of films & videos
- Make sense of simple computer programs
- Make sense of WWW pages
- Use computer-based puzzles & logical thinking software to support problem solving activities
- Use a variety of graphical representation to acquire information
- Use audio presentations to acquire information
- Use films & videos to acquire information
- Use a variety of computer-based resources to acquire information
- Discuss & critique audio presentations
- Discuss & critique films & videos
- Discuss & critique computer programs
- Discuss & critique WWW sites
- Use a variety of nonprint media to build self-knowledge
- Use a variety of nonprint media to understand cultures
- Distinguish between accurate & inaccurate, complete & incomplete information
- Define &/or give examples of accuracy, relevance, comprehensiveness, appropriateness & bias in non-print media and/or electronic resources
- Distinguish between fact, opinion & point of view in a variety non-print media and/or electronic resources
- Evaluate the accuracy, relevance, appropriateness & bias of a variety of nonprint resources
- Recognize & make sense of new information in nonprint sources
- Define &/or give examples of equity in access to information resources & technologies
- Define &/or give examples of intellectual freedom
- Define &/or give examples of respecting intellectual property rights
- State the main points of school policy concerning computing & communications technologies
- Discuss basic issues related to the responsible use of technologies
- Demonstrate positive social & ethical behaviors when using technology
- Discuss the advantages & disadvantages of common uses of technologies
- Select and use appropriate technology tools to complete a variety of tasks

middle school

- *Analyze & explain graphical representations*
- *Analyze & explain audio presentations*
- *Analyze & explain films & videos*
- *Distinguish the uses of graphical representations*
- *Distinguish the uses of audio presentations*
- *Distinguish the uses of films & videos*
- *Distinguish the uses of WWW sites*
- *Evaluate nonprint media*
- *Synthesize information from nonprint media*
- *Select & use appropriate technology tools & resources to complete a variety of tasks*
- *Explain how inaccurate or incomplete information can lead to faulty conclusions*
- *Compare & contrast nonprint information sources for accuracy, relevancy, comprehensiveness & bias*
- *Create a plan to access information that meets a particular need*
- *Analyze information from a variety of sources to determine its applicability to a specific problem*
- *Assess both the process & the product of a specific information search*
- *Use multiple & diverse information sources to answer questions or resolve problems*
- *Demonstrate positive ethical & legal behaviors when using information & technology resources*
- *Demonstrate knowledge of current information technologies*
- *Demonstrate an understanding of the effects technological changes have on society & the workplace*
- *Discuss the consequences of the misuse of information &/or technologies*
- *Demonstrate an understanding of the concepts underlying hardware, software & connectivity tools*
- *Apply strategies for identifying & solving routine hardware & software problems*

high school

- Choose the most appropriate formats for presenting a range of information
- Critique & evaluate advertising campaigns for a variety of products
- Recognize & compare different media genres
- Evaluate the strengths & weaknesses of various creative presentations
- Judge the quality of one's own information products & solutions
- Judge the accuracy & completeness of information & support those conclusions
- Appropriately distinguish between fact, opinion & point of view in one's own nonprint work

- Evaluate the electronic information seeking process as it evolves & make appropriate adjustments
- Discuss & evaluate technology-based options for lifelong learning
- Identify capabilities & limitations of current & emerging technologies
- Assess the potential of current & emerging technologies to address personal & workplace needs
- Make informed choices among technology systems, resources & services
- Analyze the advantages & disadvantages of the widespread use of technology in society
- Advocate for ethical & legal behaviors when using information technology

Construction skills are competencies involving the creation and use of nonprint texts for developing ideas and opinions, for communicating and collaborating with others, and for enhancing problem solving and personal fulfillment. Construction skills focus on capabilities for composing, developing, integrating, presenting, etc. The construction skills students should have by completion of elementary, middle, and high school are presented in the list which follows. The skills should be understood as cumulative.

elementary

- Use computer-based writing tools to communicate thoughts, ideas & stories
- Use computer-based drawing tools to illustrate thoughts, ideas & stories
- Use digital cameras to illustrate thoughts, ideas & stories
- Use multimedia authoring tools in the creation of knowledge products
- Use presentation software in the creation of knowledge products
- Use WWW authoring tools in the creation of knowledge products
- Use audio tapes for self-directed &/or extended learning
- Use videos for self-directed &/or extended learning
- Use technology resources for self-directed &/or extended learning
- Use technology resources for problem solving
- Create nonprint media for personal fulfillment
- Explain basic strategies for revising, improving & updating nonprint media
- Use telecommunications technologies to participate in collaborative projects
- Work collaboratively to seek &/or communicate information in nonprint formats
- Work collaboratively to create simple nonprint information products

middle school

- *Use nonprint media to create knowledge*
- *Use nonprint media to communicate*
- *Differentially organize information according to differing problems*
- *Choose appropriate media formats for presenting a variety of information*
- *Use nonprint media to create information products related to topics of personal interest*
- *Express information & ideas creatively in nonprint formats*
- *Design, develop & present videotapes that communicate curriculum concepts*
- *Use telecommunications & collaborative tools to collaborate with peers, experts & others on curriculum related problems*
- *Work collaboratively over distance to create & evaluate complex information*
- *Select & apply appropriate strategies for revising, improving & updating work*

high school

- Use technology to collaborate with others to contribute to a content-related data base
- Select & apply technology tools to support research in content learning
- Select & apply technology tools for decision making in content learning
- Select & apply technology tools for problem solving
- Select & apply technology tools for information analysis
- Differentially organize information so that it is effectively presented in a single nonprint product
- Express ideas creatively &/or uniquely in integrative nonprint formats
- Collaboratively create complex information over distance
- Collaboratively evaluate complex information over distance
- Devise creative ways to use information to resolve problems &/or answer questions

Educational Significance

To reiterate, the above lists of nonprint media and technology literacy competencies are offered as a starting point. We hope they will begin a discussion of what one should know and what one should be able to do to be considered literate in the 21st century. Thus, they are also intended to precipitate discussions of how we should be teaching and learning about literacy in our schools today.

Most importantly, we hope the lists will encourage educators to extend traditional notions of literacy to include critical and creative uses of images, video, and electronic texts of all sorts. We hope they will encourage educators to stop treating technology as a separate subject to be taught, often as a "pull-out," and to start treating the use of electronic media as a form of literacy to be integrated across the curriculum. In particular, we hope that educators will take special note of the critical literacies and construction skills categories and make mindful efforts to include these whenever they incorporate technology usage in teaching and learning.

Changes in communications technologies over the past century have created a world culture that has extended and reshaped our symbolic environment. Today, most Americans receive the majority of their news, information, and entertainment through electronic sources. It only makes sense that we should teach our children to use those sources well, and that we make the use of electronic media an integral part of the daily activities in every classroom in this country. The nonprint media and technology literacy standards herein presented offer a starting point for discussion towards such ends.

References

American Association of School Librarians (1998) Information Literacy Standards for Student Learning. Chicago: American Library Association. http://www.ala.org/aasl/ip_nine.html

Becker, H. J. (1994) Analysis and Trends of School Use of New Information Technologies. Washington, DC: US Congress Office of Technology Assessment. http://www.gse.uci.edu/EdTechUse/c-tblcnt.htm

Educational Testing Service (1998) Does it Compute? Princeton, NJ: Education Week. http://www.edweek.org/sreports/tc98.html

Hobbs, R. (1998) Literacy in the information Age. In Flood, J. Lapp, D. & Heath, S. B. (Eds.), Handbook of Research on Teaching Literacy Through the Communicative and Visual Arts. International Reading Association. New York: Macmillan, 7-14. http://interact.uoregon.edu/MediaLit/FA/mlhobbs/infoage.html

International Society for Technology in Education (1998) National Educational Technology Standards for Students. Eugene, OR: International Society for Technology in Education. http://cnets.iste.org/overview.html

National Council of Teachers of English / International Reading Association. (1996a) Professional Summary; Standards for the English Language Arts. http://www.ncte.org/standards/profsum.html

National Council of Teachers of English / International Reading Association. (1996b) Standards for the English Language Arts. Urbana, IL: National Council of Teachers of English.

Panel on Educational Technology. (1997) Report to the President on the Use of Technology to Strengthen K-12 Education in the United States. Washington, DC: President's Committee of Advisors on Science and Technology. http://www.whitehouse.gov/WH/EOP/OSTP/NSTC/PCAST/k-12ed.html

Ravitch, D. (1995) National Standards in American Education: A Citizen's Guide. Washington, DC: Brookings Institution Press.

Swan, K., Meskill, C., Bowman, J., Mossup, J., Holmes, A.., Mann, S., Cardillo, D. and Kenyon, K. (1997) Redefining literacy for the Information Age. Brockport, NY: CIT '97: Learning With Technologies, 114-115.

Tyner, K. (1998) Literacy in a Digital World: Teaching and Learning in the Age of Information. Mahwah, NJ: Lawrence Erlbaum.

The Effects of Activity Structure and Learner Characteristics on Acceptance of Control Opportunities in Hypermedia Environments: A Report of Quantitative Findings

Denise Tolhurst
School of Information Systems, Technology and Management
The University of New South Wales
Australia
d.tolhurst@unsw.edu.au

Raymond L. Debus
School of Educational Psychology, Literacies and Learning
The University of Sydney
Australia
r.debus@edfac.usyd.edu.au

Abstract: This paper presents the quantitative results of a study that examined the effects of the structure of learning activities and the learner characteristics of prior knowledge, ability and attitudes on students' acceptance of control opportunities while using hypermedia software and consequent learning outcomes. Participants in the study were 101 year 8 students in two Australian schools. A confirmatory factor analysis of a model that theorized the relationships between the variables did not fit the data well, but careful substantively based amendment of the model saw the introduction of a new factor that resulted in an improved fit. The new factor was that of the school which students attended, a factor that proved to have greater influence than the hypothesized variables. This paper is supported by a related article which reports the results of qualitative data collected for the same study.

Introduction

Catering for the needs of individual students by offering some control over learning is a commendable ideal that has been seen by many as offering opportunities to help students reach their potential. Although research in the area of learner control has often been surrounded by a great deal of enthusiasm, the reality of the situation is that research findings in learner control are mixed and inconclusive. There are those who claim that there are no positive findings to support the enthusiasm (Nienmiec, Sikorski & Walberg, 1996; Reeves, 1993; Snow, 1980) and others who suggest the benefits are limited by contexts in which control is offered and by the characteristics of learners (Dillon and Gabbard, 1998).

One of the main problems in the area of learner control is the complexity of interactions that exist between individual learners' characteristics and the environments in which learning takes place. The number of learner characteristics is substantial, as is the variety of learning environments created. Many studies have been undertaken, but they are difficult to compare because they use different combinations of variables. For this reason alone it is not surprising that results are mixed, inconclusive and contradictory.

There are individual characteristics that have been studied to a greater degree than others that do offer some more consistent, positive findings and which suggest promising trends or directions for classroom practitioners to cater for needs of individual learners. Some studies have found that learners with varied abilities (Gray, 1987; Hooper, Temiyakarn & Williams, 1993; Kinzie et al., 1988; Singhanayok & Hooper, 1998), learning styles (Ferguson, 1988; Klein & Keller, 1990; Santiago & Okey, 1992), preferences (Carrier & Williams, 1988; Hannafin & Sullivan, 1995; Hannafin & Sullivan, 1996; Hicken, Sullivan & Klein, 1992) and levels of prior knowledge((Gay, 1986; Gay, Trumbull & Mazur, 1991; Kinzie & Sullivan, 1989; Ross, Morrison & O'Dell, 1989; Shin, Schallert & Savenye, 1994; Stephenson, 1992) differently accept levels of control.

The importance of learner control research is amplified by technological developments allowing the creation of interactive learning environments that are being adopted rapidly and enthusiastically, with considerable investment of financial resources and practitioner time and effort. Hypertext, hypermedia and multimedia environments offer masses of information that can be navigated according to the interests and needs of users. Multiple links and reference points provide a network of possible paths for investigation. The problem associated with the use of these systems is that although learners are provided a high degree of control, they can become overwhelmed with the number and scope of choices available to them. Rather than accepting the myriad of opportunities offered by hypermedia learners may utilize only a small number of the choices available to them, failing to make effective use of the software. It is apparent that if we are to continue to adopt the use of hypertext, hypermedia and multimedia products in education then there is a need to identify how we might support students' use of the software and encourage them to make effective, productive and independent use of such systems.

One approach to supporting students is to attend to the design of the user-interface of software packages, finding ways to provide help for students within the software. This may be done by developing adaptive systems that respond to user input, limiting available options by providing a smaller number of options to novices and increasing available navigational choices as expertise and learning in a domain develop. Another approach to support student use of complex software packages effectively is to consider the learning environment in which the software is used and identify classroom practices and develop support materials that will encourage and support effective learning. Rather than developing software that attempts to cater for the needs of all students, it would be better to utilize the talents of teachers in catering for individual needs while making powerful resources available to them and their students. The main aim of the research presented in this article is to utilize existing hypermedia products available on the educational software market and find procedures and strategies that can be used in the classroom that will encourage students to make effective, productive and independent use of such systems.

Research Model and Study Description

There are a number of studies that have produced some arguably consistent findings regarding particular variables concerned with provision of learner control. These include the amount of control afforded to learners, the level of prior domain knowledge and prior system knowledge, ability, locus-of-control, and students' learning goals or task orientation. The findings for these variables have been reported in terms of achievement outcomes, motivational and attitudinal outcomes and learning efficiency. As it is not possible to effectively address all of the above mentioned variables in a single study, a subset of variables form the focus of this research. Those examined were selected because they have a history of research findings that provide a sound theoretical base.

A theoretical model based on the variables of interest and their hypothesized effects on each other can be expressed in the form of a covariance structure model. Such a model is presented in Figure 1. The model illustrates the theory that prior domain knowledge, learning activity structure, ability and attitude causally affect the acquisition of knowledge and students' post attitudes indirectly through a learner's acceptance of control opportunities. Also, prior domain knowledge directly affects acquisition of task-specific and non-task-specific domain knowledge and software structure knowledge; ability directly affects the acquisition of task-specific and non-task-specific domain knowledge and acquisition of knowledge of software structure; and, prior attitude directly affects post attitude. While it was expected that the weights of the direct effects would be fairly strong, for example prior attitude would have a strong effect on post attitude, it was also predicted that the weights of the indirect effects mediated by acceptance of control opportunity would not be insubstantial.

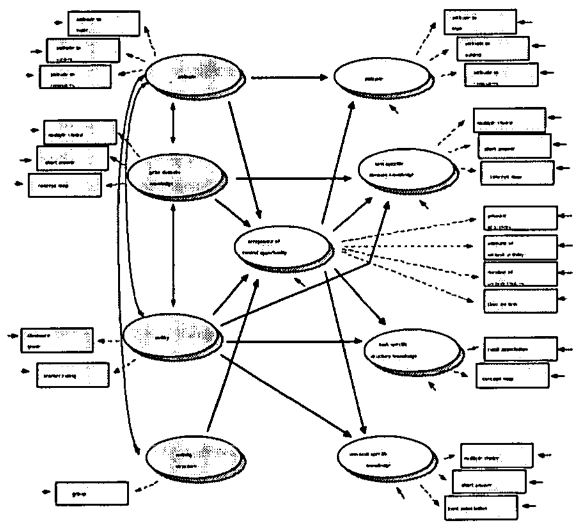


Figure 1: Covariance structure model for the effects of attitudes, prior knowledge, ability and experimental grouping on acceptance of control opportunity, attitudes and acquisition of three types of knowledge

To investigate the variables of interest identified by the research questions and hypotheses, a 3x2 factorial design with three levels of structure (worksheets of high, medium and low structure) and two levels of prior knowledge (high and low) was utilized. So that an authentic educational situation could be the focus of research intact classes were used for grouping. In addition, as the research literature indicates that boys tend to dominate activity in coeducational computer-based activities (Culley, 1990; Fatouros, Downes & Blackwell, 1994; Hattie & Fitzgerald, 1987), single gender schools were used so as to remove the effects of gender interaction and increase the generalizability of the findings. Rather than fully replicating the study with six groups in both boys' and girls' schools, the strategy of *fractional replication* was employed in this design. This was done to remove the effects of gender interactions as an uncontrolled variable, while allowing the practicalities of conducting the study for each gender to be met. Participants in the study were 101 year 8 students in two Australian schools who examined software on the topic of the Australian federal parliament.

Measures for quantitative data are shown in the rectangles in (Fig.1). Data were collected by asking students to complete questionnaires for attitude measures and written tests of knowledge to help determine levels of domain specific, non-domain-specific and software-structure knowledge. In addition student interactions were recorded by the software in the form of audit-trails that stored information about every active choice made in the software during five 40 minute lessons. To supplement the quantitative data that aimed to identify 'what' students did, qualitative data in the forms of student interviews and analyses of navigational choices aimed to identify 'why' students made particular choices and adopted particular navigational strategies. Qualitative results are discussed in a related article.

Results

Quantitative

A confirmatory factor analysis of the covariance structure model shown in (Fig.1) produced goodness-of-fit indices that were very good for the left-hand side measurement model (Goodness of Fit (GFI)=.96, Comparative Fit Index (CFI)=1.0, Standardized Root Mean-square Residual (SRMR)=.051), but not acceptable for the right-hand side measurement model (GFI=.85, CFI=.91, SRMR=.099). With the poor fit of the right-hand side measurement model it was not surprising that the structural model, whose analysis is based on the two measurement models was less than ideal (GFI=.72, CFI=.74, SRMR=.12).

Careful, substantively based post-hoc analysis resulted in the identification of a modified model that produced a better fit than the originally proposed model (GFI=87, CFI=.91, SRMR=.071), and which could be described as a marginally good fit. This alternative model is shown in (Fig. 2), including the standardized parameter estimates and error terms. The most important feature of the alternative model produced was that a new factor was introduced, and that this factor produced the highest parameter estimate between an exogenous variable and acceptance of control opportunity (.62, $p<.001$). This variable was introduced due to observed differences between the navigational approaches of students at the two schools when the study was being undertaken, supported by statistically significant differences on the measures of acceptance of control opportunity between the two school groups. The implications of this introduced factor are addressed in the later discussion.

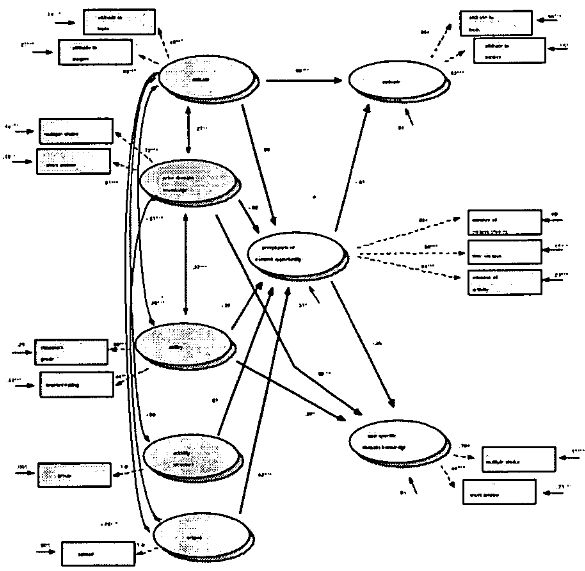


Figure 2: Alternative model showing completely standardized parameter estimates and error terms.
Note: # indicates the y-value for each factor that was set to 1.0 to establish the scale of each factor resulting in no test of statistical significance calculated by LISREL. * $p<.05$, ** $p<.01$, *** $p<.001$

Qualitative

While the quantitative results identified that the school students attended was an important factor influencing choices made in the use of the software, this methodology can not identify *why* this may have been the case. An analysis of the qualitative data for this same study identified three possible factors that may have influenced the strength of the school factor: specifically these were, the gender differences of students at the two schools, the epistemological beliefs of students and the different cultures and learning environments that existed at the two schools. A more comprehensive report of the qualitative findings is presented and discussed in detail in the supportive short paper 'The Emergence of 'School' as a Factor Influencing Patterns of Navigational Choices in Hypermedia' in this ED-Media 2000 conference proceedings.

Discussion

The research reported in this article identifies an unexpected factor, that of the school which students attend, as having a greater influence on students' software use than those identified in the literature as being potentially influential. Unfortunately the adoption of a fractional replication in the 3x2 factorial design, based on the gender of students, did not allow the identification of specific variables that may have caused the strength of the factor. Fractional replication was used in this study to remove the effects of gender domination in software-use, but in-fact caused complications in the light of the unexpected outcomes.

The unanticipated finding that the school which students attend can have an effect on navigational choices in software does have important implications however. The identification of this variable as being potentially influential on students' software choices is important in the design of any learning environment and to the policy decisions made about education and technology. The obvious question that arises is that of '... what are the important factors in the schools that influenced students use of software?' The qualitative results from this study suggest three possible contributing factors, specifically those of the genders of the students, the epistemological beliefs of the students and the learning environments created by the cultures of the schools. These potentially contributing factors are discussed in greatcr detail in the supportive article reporting the qualitative results of this study, and are also worthy of further attention in subsequent research studies.

References

Carrier, C. A., & Williams, M. D. (1988). A test of one learner-control strategy with students of differing levels of task persistence. *American Educational Research Journal*, 25, 285-306.

Culley, L. (1990). Girls, boys and computers. In O. Boyd-Barrett & E. Scanlon (Eds.), *Computers and Learning*, (First ed., pp. 81-87). Wokingham, England: Addison-Wesley Publishing Company.

Dillon, A. and Gabbard, R. (1998) Hypermedia as an educational technology: A review of the quantitative research literature on learner comprehension, control and style, *Review of Educational Research,* 68, 322-349.

Fatouros, C., Downes, T., & Blackwell, S. (1994). *In Control: Young Children Learning with Computers*. (First ed.). Wentworth Falls, Australia: Social Science Press.

Ferguson, H. L. (1988). The effect of locus-of-control on achievement and preference in CAI tutorial systems which vary in terms of system control, learner control with coaching and learner control with no coaching. *Dissertation Abstracts International* (CD-ROM for 1988-Dec 1992), DAI-A 50/01, p120, Jul 1989.

Gay, G. (1986). Interaction of learner control and prior understanding in computer-assisted video instruction. *Journal of Educational Psychology,* 78, 225-227.

Gay, G., Trumbull, D., & Mazur, J. (1991). Designing and testing navigational strategies and guidance tools for a hypermedia program. *Journal of Educational Computing Research*, 7(2), 189-202.

Gray, S. H. (1987). The effect of sequence control on computer assisted learning. *Journal of Computer-Based Instruction*, 14(2), 54-56.

Hannafin, R. D., & Sullivan, H. J. (1995). Learner control in full and lean CAI programs. *Educational Technology Research and Development*, 43(1), 19-30.

Hannafin, R. D., & Sullivan, H. J. (1996). Preference and learner control over amount of instruction. *Journal of Educational Psychology*, 88, 162-173.

Hattie, J., & Fitzgerald, D. (1987). Sex differences in attitudes, achievement and use of computers. *Australian Journal of Education*, 31, 3-26.

Hicken, S., Sullivan, H., & Klein, J. (1992). Learner control modes and incentive variations in computer-delivered instruction. *Educational Technology Research and Development*, 40(4), 15-26.

Hooper, S., Temiyakarn, C., & Williams, M. D. (1993). The effects of cooperative learning and learner control on high- and average-ability students. *Educational Technology Research and Development*, 41(2), 5-18.

Kinzie, M. B., & Sullivan, H. J. (1989). Continuing motivation, learner control, and CAI. *Educational Technology Research and Development*, 37(2), 5-14.

Kinzie, M. B., Sullivan, H. J., & Berdel, R. L. (1988). Learner control and achievement in science computer-assisted instruction. *Journal of Educational Psychology*, 80, 299-303.

Klein, J. D., & Keller, J. M. (1990). Influence of student ability, locus of control, and type of instructional control on performance and confidence. *Journal of Educational Research*, 83(3), 140-146.

Nienmiec, R. P., Sikorski, C., & Walberg, H. J. (1996). Learner-control effects: a review of reviews and a meta-analysis. *Journal of Educational Computing Research*, 15, 157-174.

Reeves, T. C. (1993). Pseudoscience in computer-based instruction: the case of learner control research. *Journal of Computer-Based Instruction*, 20(2), 39-46.

Ross, S.M., Morrison, G.R., & O'Dell, J.K. (1989). Uses & effects of learner control of context and instruction support in computer-based instruction. *Educational Technology Research and Development*, 37(4), 29-39.

Santiago, R. S., & Okey, J. R. (1992). The effects of advisement and locus of control on achievement in learner-controlled instruction. *Journal of Computer-Based Instruction*, 19(2), 47-53.

Shin, E. C., Schallert, D. L., & Savenye, W. C. (1994). Effects of learner control, advisement, and prior knowledge on young students' learning in a hypertext environment. *Educational Technology Research and Development*, 42(1), 33-46.

Singhanayok, C., & Hooper, S. (1998). The effects of cooperative learning and learner control on students' achievement, option selections, and attitudes. *Educational Technology Research and Development*, 46(2), 17-33.

Snow, R. (1980). Aptitude, learner control and adaptive instruction. *Educational Psychologist*, 15(3), 151-158.

Acknowledgements

Many thanks to Mike Bailey and Bob Baker for their support of this work in the form of encouragement, advice on research design and invaluable comments on previous versions of this work. Their time, effort, input and willing help is greatly appreciated! This paper contains work undertaken for a doctoral thesis at the University of Sydney, Australia.

A Linguistic Approach to Use Cultural Web Pages in a Classroom

Yutaka Tsutsumi
Department of Business Administration
Kumamoto Gakuen University, Japan
yutaka@kyu-teikyo.ac.jp

Ryoji Matsuno
Department of Administration
Prefectural University of Kumamoto, Japan
matsuno@pu-kumamoto.ac.jp

Kazuo Ushijima
Graduate School of Information Science and Electrical Engineering
Kyushu University, Japan
ushijima@csce.kyushu-u.ac.jp

Abstract: Using Web Pages for supplemental materials in the classroom is very popular. However, some Web Pages are not suitable for educational use as their stuffy description. Our research aims at translating these formal web pages into plainer Japanese sentences. We provide the system as a proxy program running on UNIX workstation. The main part of this system consists of three phases – morphological analysis, transformation, and mark-up. It is expected that students can read web pages easily by using our system. At the beginning of this paper, we describe the overview of our proxy program and implementation of it. Then we explain many functions of our proxy program. The functions are divided into two categories – "linguistic functions" and "multimedia and appearance functions." At last, a brief experiment result is also mentioned.

Introduction

As the Internet has come into wide use, the WWW is rapidly becoming a great knowledge resource in the educational domain. Many teachers use a variety of web pages in their classroom. There are many culturally oriented web pages, for instance, those pages produced by museums, galleries, libraries, etc. They are suitable for supplemental materials in the classroom. However, the purpose of these pages is not always for educational use only. Often, an overly formal or "stuffy" language-style is used in conveying information. Students sometimes hesitate to read these formal language descriptions. Our research aims at translating these formal web pages into plainer language in order to better suit students' abilities and understanding.

We have implemented this translation program as a proxy program on our proxy server. The reason is that we do not have to distribute our program nor install it on students' PCs. Another merit of this implementation is that we can administer our proxy program.

The following sections in this article, we will discuss many Japanese-specific problems, as our target language is Japanese and we assume the input of our proxy program is the web pages created by Japanese cultural sites and the output web pages would be read by Japanese students. However, we also explain the language-independent functions of our proxy program, such as appearance functions.

In the following sections, we explain our proxy program overview, functions, a brief experiment and its result. Then we discuss the merits and the demerits of our proxy program in the considerations section. Finally, we describe our future plans in the conclusions section.

A Proxy Program Overview

Figure 1 shows the overall system of our proxy program. When students access any web pages that they have difficulty with, they can use our proxy server to translate the web pages into plainer language. Once they have set the proxy server to the URL of our site in their web browser setting, they don't have to be conscious of our proxy program.

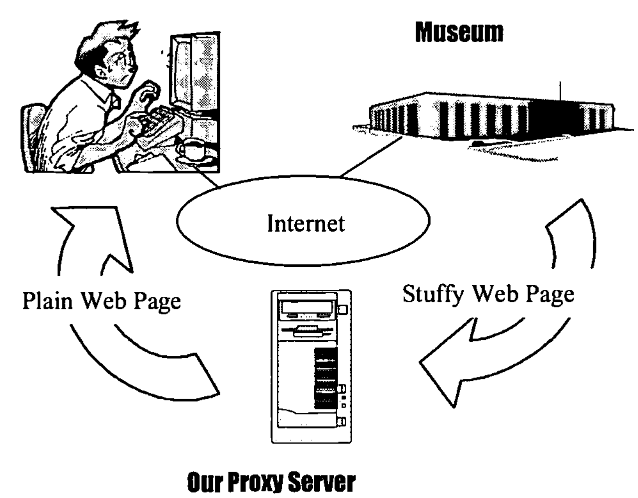


Fig. 1:Overall System

Figure 2 shows the flowchart of our proxy program. As shown, the program consists of following three phases.

(1) Sentence resolution
This phase resolves an input HTML document into sentences and HTML tags.

(2) Translation
This phase is composed of "linguistic translation" and "multimedia and appearance functions." We will describe these functions in the following sections.

(3) Document reconstruction
In this phase, translated sentences and translated HTML tags are reconstructed as original documents.

Linguistic Translation

Linguistic translation process is composed of following three steps.

(1) Morphological analysis:
In Japanese sentences, we can determine the part-of-speech of each word by morphological analysis.

(2) Transformation:
This is the main step of the linguistic translation process. The syntax of the input sentence will be changed according to transformation rules (described in the next section).

(3) Mark-up:
There are many technical terms in web pages. Our approach is to mark-up difficult terms with HTML tags. The user can then open a link to yahoo.com, or an on-line dictionary, by clicking on these terms. Optionally, we can replace difficult terms with easier expressions. However, these expressions may contain the main theme of the web page. Also, too much added description may cause the reader to become frustrated. Utilizing our proxy system, users can specify the difficulty-level for the program to automatically mark up text, thus giving the user a number of options to selectively control the proxy program's functioning. Currently, we have catalogued approximately 6,000 Kanji characters, divided into various levels of difficulty, in order to create optional levels of automatic selection and descriptive narration for the user.

Transformation rules

(1) Compound noun phrase transformation

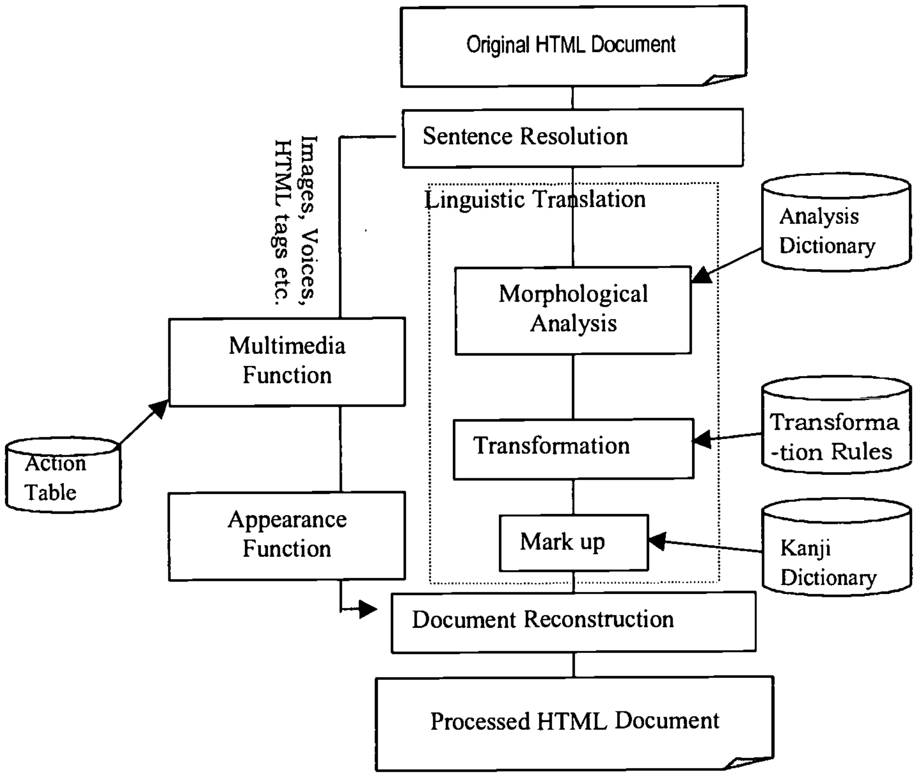


Fig. 2: Program Flowchart

Similar to English, Japanese sometimes uses long compound noun phrases. Long noun phrases give readers serious and formal impression. This category of rules inserts "no" (similar to "of" in English) at appropriate positions in order to make a phrase easier to read. The search algorithm for the appropriate position is based on [Tsutsumi 89]. Figure 3(a) shows an example of compound noun phrase transformation.

(2)□Formal expression replacement

There are several formal expressions in Japanese sentences. "Formal expression replacement" replaces those expressions which contain adverbs and auxiliary words, as they are function words. Function words create a "stuffier" sentence than content words do. This rule replaces the formal syntax, which is determined by adverbs and auxiliary words, with a plainer syntax.

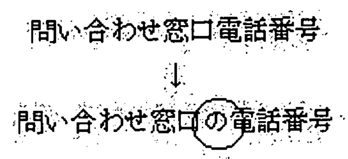
(3)□Sentence length adjustment

If a sentence has more than ten phrases, the sentence will be divided at a conjunctive auxiliary into two sentences. This rule will supply a conjunction between the sentences.□Figure 3(b) shows an example of sentence length adjustment.

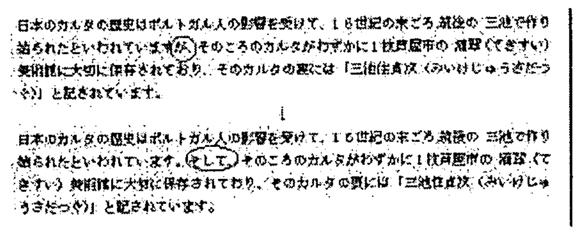
Multimedia and appearance functions

(1) Iconization of hidden image

Web pages have many links to image with "here" or "this." For example, "You can see the castle by clicking HERE." This type of web pages is often dull. Therefore, we replace "HERE" with "FIG. 1" and place the iconized

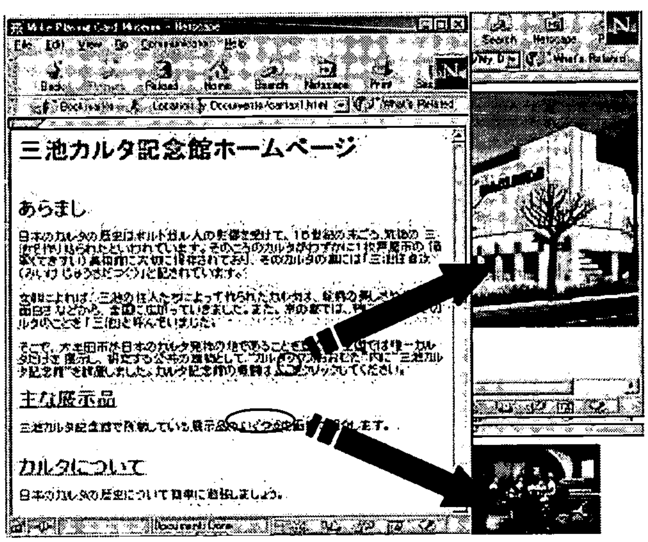


(a) Compound noun phrase transformation

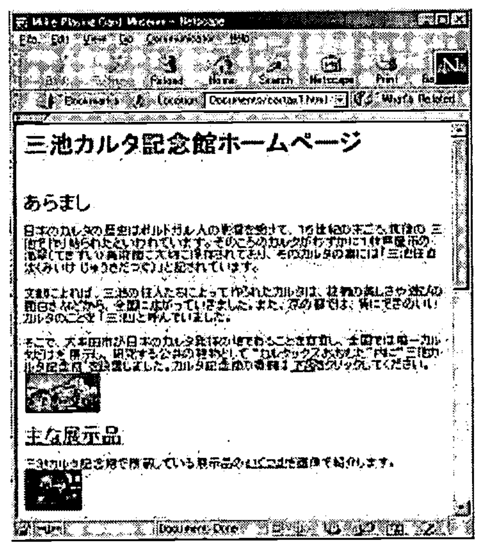


(b) Sentence length adjustment

Fig. 3 Examples of linguistic functions



(a) Original web page(s)



(b) Result web page

Fig. 4 An example of appearance functions

image of linked one. Students will be interested in the graphical pages. Figure 4 illustrates an example of iconization of hidden image. If the classroom computers are connected to the Internet via low speed line, loading the graphical pages needs students' patience. We provide an option for this problem. After students choose this option, hidden image iconization function will not be effective.

(2) Font size replacement

We often use small font in order to show much information in one page. However, too small fonts make readers be tired of.

(3) Reformation of list-items
Students must push a scroll button many times, if there are too many items in a web page. This function divides list-items into several pages, and students can get next items by clicking "forward button" created by this function.

Pedagogical Evaluation

We have tested our proxy program briefly. The examinees are five junior college students. We first showed them translated web pages and asked whether the web pages are easy to read or not. Then we showed them the original web pages and got their impressions.

Table 1
"The translated web pages are easier to read."

	Agree	*Disagree*	*Not answered*
Web Page A	3	1	1
Web Page B	4	1	0
Web Page C	5	0	0
Web Page D	3	2	0

Some of the impressions are:
"It is clear to read."
"Iconized images are good. If a web page is full of characters, I would hesitate to read it."
"Too much HIRAGANA characters are messy to read."

Considerations

In this section, we discuss the advantages and aspects of our approach.

(1) Usage
Students can easily use our program because our program is developed as a proxy program. Once students have specified our server as a proxy server, they will get translated web pages without any operation. This is very important in elementary school students. Most of them do not have computer operation skill yet.

If the classroom PCs are protected by a firewall and they must use the proxy server inside the organization, a way to use our proxy program is the proxy chain from the proxy server inside the firewall to our proxy server. However, you have to ask your system administrator to fix it.

(2) Performance
Our proxy program's process is light because we only use morphological analysis. Unlike semantic analysis or syntax analysis, the morphological analysis is very fast and reliable. As our program is running on our server, we do not need high-speed client PCs. On the other hand, when many students use our proxy program at the same time, the turn-around-time would be very long.

(3) Transformation Rules
We have defined several transformation rules. However, we have to add some rules in order to improve the readability of the translated web pages.

(4) Dictionaries
We provide three dictionaries, analysis dictionary, Chinese character dictionary and Japanese-language dictionary. The analysis dictionary cannot be viewed from students. It is used for morphological analysis. Other dictionaries can be accessed via WWW. Chinese character dictionary is also used for translation level setting.

(5) Adaptability to the multimedia technology progress

The multimedia technology has been rapidly progressing these days. We have incorporated an adaptive mechanism for future changes in multimedia technologies into our proxy program. To be concrete, our proxy program has an action table in which each file type is registered as an index of table with a program name. When the proxy program detects any file type in the table, a corresponding program will be activated. When your web browser cannot handle Quicktime movies, you can see the movies in MPEG format, if you have a format conversion program.

(6) Mark-up

To mark up difficult words is for searching for words in a dictionary or searching for related items in web pages. It is necessary to build a web-based dictionary for users of this system in order to use this easily.

Conclusions

In this paper, we have described our proxy program to translate web pages into plainer language. Our program is designed to help students utilize cyberspace as an educational tool for sourcing out information related to classroom presentations and learning. Using our proxy program, students will not have to hesitate at formal language, as words that are difficult to understand are each marked-up to search for in a dictionary, or selectively replaced with a plainer syntax. Also our program rebuilds messy web pages to tidy web pages. These translations allow young students to start to read the web pages. We believe that our proxy program can be an effective tool for learners of Japanese as well as for young Japanese students.

Since our target language is Japanese, we have discussed some Japanese specific problems. For example, difficult-to-read characters are rarely appeared in English sentences. However, some functions of our program are language independent, such as multimedia and appearance functions.

Our future plans include further experiment and evaluation of our program in the classroom. We also plan to apply our proxy program to other languages.

References

[Shimozono et al. 98] Shimozono, K., Tsutsumi, Y. and Matsuno, R.: "Developing a Proxy Server to Translate Japanese Web Pages into Plainer Japanese Sentences," *Proc. of WebNet '98*, No. 107, 1998.

[Tsutsumi 89] Tsutsumi, Y.: "A Simple Noun Phrase Translation Component of SHALT – English-to-Japanese Machine Translation System", *IBM TRL Report*, RT0011, pp.1—20, 1989 (In Japanese).

Electronics Education System

María D. Valdés, José A. Tarrío, María J. Moure, Enrique Mandado
Institute of Applied Electronics. Department of Electronic Technology. University of Vigo. Spain
mvaldes@uvigo.es jatarrio@uvigo.es mjmoure@uvigo.es emandado@uvigo.es

Julio González
Department of Electrical Engineering. University of New York at New Paltz. U.S.A.
gonzalj@engr.newpaltz.edu

Abstract: This paper analyses traditional methods of teaching Electronics to non-electronic engineers and proposes an alternative educational system involving theoretical and practical learning. The proposed system is divided into hardware and software resources. Hardware resources comprise a PC and external circuits corresponding to representative electronic systems. Software resources provides students with a unique environment containing hypermedia theoretical lessons, simulation tools and virtual instrumentation. Through theoretical lessons students access to simulation and practical exercises where they verify the behaviour of a real circuits using virtual instrumentation.

Introduction

Continuous training of engineers and technicians is one of the most urgent tasks of modern industry. This is mainly due to the vertiginous evolution of technology imposing very demanding competitive levels. That is the reason why both companies and governmental institutions promote applied research projects developing new teaching methods, contents and resources.

At present our research group is working on a project whose objective is the development of a system for non-electronic engineers training about the fundamentals and applications of Electronics. Even though the project contents are focused on a specific technological area (Electronics) the methods we propose can be extended to other educational levels and technology fields.

This project is a joint venture between the Institute of Applied Electronics "Pedro Barrié de la Maza" of the University of Vigo and TEFASA S.L.[1], and is co-financed by the European Regional Development Fund (ERDF).

Background

Traditionally Electronics education of non-electronics engineers has been carried out combining theoretical education with the assembly of circuits using specific measurement instruments like power supplies, voltmeters, oscilloscopes, and signal generators (LAGO 93)(MIRI 93). But this method is very costly and it is not really useful for non-electronics engineers.

An alternative method is the system analysis using kits (COEL 96)(MICR 97)(SALE 96). The kits advantages are the low cost and the possibility of implementing them when and where convenient favouring the independent learning. Nevertheless from an educational point of view the role of the kits is very limited because they are only designed to show specific systems running and not to carry out measurements nor explain the concepts of system functionality.

The previously mentioned disadvantages can be overcome using computer assisted learning (CAL) methods. The potentiality of computer hypermedia resources, and the low cost and widespread diffusion of computers, convert CAL into an essential teaching tool. In the case of Electronics the computer can be used as support both for theoretical and practical teaching. In this sense three kinds of applications can be pointed out:

- Tutorial systems: Mainly oriented toward the explanation of theoretical concepts and self-evaluation allowing individual and non-presential learning (CUET 94).

[1] Spanish company dedicated to the development and marketing of didactic systems.

- Simulation programs: Oriented toward the analysis of circuits operation modes and fundamentals avoiding their practical implementation. Using simulation programs system design and faults detection is carried out before its implementation (MICR 96)(RASH 90).

- Virtual Instrumentation systems (VIS): Made up of a data acquisition board connected to the computer and a program controlling the data acquisition and the information processing. The results are shown on the computer screen using a format that resembles traditional measurement instruments (oscilloscopes, voltmeters, signal generators, etc.). From an economic perspective VIS represent a very appealing alternative in the cases where bandwidth and precision are not very important constraints. From a teaching/learning point of view VIS are low cost laboratories affordable to small and medium sized enterprises or to engineers interested in a continuous training at home (KEIT 97)(LABW 94).

CAL tools can be used for courseware development. Courseware combines computers with real circuit modules where students are able to measure some parameters without modifying their design or structure. These systems are principally based on methods based on proposing questions and analysing several solutions. In most cases they consist of lessons guiding the analysis of a specific circuit. These lessons are tutorials linked to simulation programs or virtual instrumentation systems to carry out measures on pre-established test points of the analysed circuit to verify its behaviour when some variations or faults are introduced (ALEC 95)(EURO 94).

Nevertheless, many research works point out that the methods based on problems solution and practical experimentation are the most adequate approach for teaching technologies like Electronics (BARK 95)(KLEE 94)(VIAU 94). From this perspective we considered the development of a new product oriented not only to the analysis of basic circuits as an introduction to Electronics (What they are and how they work?), but also showing different electronic systems applications.

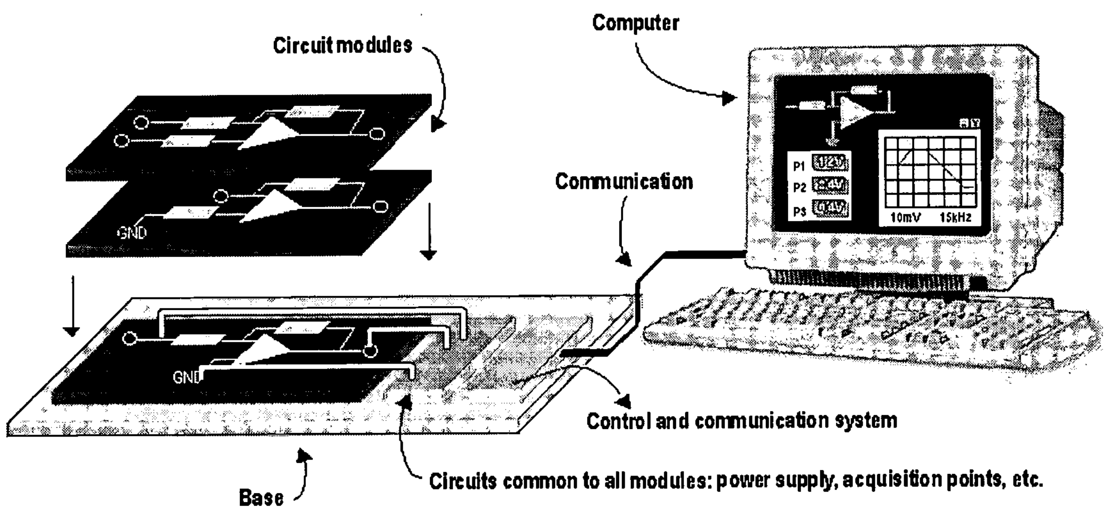


Figure 1: A general view of the proposed system.

The proposed system

The features of a system oriented to the education of non-electronic engineers of small and medium sized enterprises must take the following aspects into account:
- Consistent theoretical contents allowing progressive and individual learning.
- Availability of resources for simulation and analysis of real circuits, including faults detection and changes.
- Possibility of individual (at home) or co-operative learning.
- Low cost.
- Portability.

To meet these requirements we developed a CAL system combining theoretical lessons with simulation and experiments using adequately chosen electronic modules. The objective of our system is to achieve a consistent base of basic knowledge making the comprehension of present and futures technologies easier as well as the development of skills for the verification and maintenance of electronic equipment. From the point of view of the system structure, it can be divided into a hardware system and a software one.

Hardware system

The hardware system consists of three basic elements (see Figure 1):
- A set of real circuit modules related to each lesson.
- A base to support the modules.
- A personal computer.

The modules are circuits oriented to the introduction of simple electronic devices or systems that can be interconnected to obtain more complex ones. Our proposal envisages the possibility that some modules be closed systems oriented to the analysis of circuits where modifications cannot be carried out. Other modules are open systems oriented to the design of simple circuits that engineers themselves can connect and modify if applicable.

The base to support the modules is the equipment where the circuit modules related to each lesson are connected. They are made up of:
a) A control system that establishes the communication protocol with the computer, acquires data when a test must be carried out, or induces faults in specifics points of the analysed circuits.
b) Power supplies and common circuits (signal conditioning circuits, protective circuits, etc.) are placed.

The personal computer sends information to the control system for generating test signals or inducing faults. It also receives information from selected test points.

Software system

The software system is made up of:
a) A hypermedia application[2] oriented toward the presentation and evaluation of contents.
b) Simulation tools to facilitate the analysis of circuits.
c) Virtual instrumentation (oscilloscope, logic analyser, voltmeter and functions generator) for data acquisition from different test points.

Access to these resources is carried out from a main program (user interface) that resembles a Windows browser. In this way the user is provided with a familiar environment avoiding additional learning. Besides, a multiplatform system (Java interface) is used to guaranty its diffusion and the implementation of new functions not foreseeable in the first phase of the project, such as the use of networks like Internet.

Hypermedia application is the core of the system. It is made up of theoretical lessons complemented with simulation exercises and experiments. Each lesson has hyperlinks permitting access to other lessons, to the simulator or to the virtual instrumentation system.

At present the contents of the system are oriented toward the following areas of Electronics:
- Basic electronic devices and circuits.
- Analog circuits and systems and their applications.
- Digital circuits and systems and their applications.
- Introduction to embedded electronic systems: Principles and applications of microcontrollers.

Future versions will extend the system to other Electronic fields.

To guarantee progressive learning information is structured from general to more specific concepts using an original method for complex technologies education (VALD 97)(VALD 99). Users can navigate through the application linking related information which broadens their previous knowledge. Figure 2 shows some screens of the application that illustrate this methodology.

The first screen defines Electronics using a pyramidal structure with four levels corresponding to the main topics of the application: solid state electric phenomena, electronic components, electronic circuits and electronic systems. Each part of the pyramid is an active zone permitting access to the corresponded topic. For example clicking on "Electronic components" the second screen appears.

---

[2] The information in a hypermedia application is structured in nodes containing different concepts. Links can be established between related nodes (related information) providing users with different paths to analyse and understand a concept. Each user looks up the application in an intuitive way, pathing through those nodes that allow him/her to extend the information or introduce himself/herself in a new concept (LESK 91)(RAMI 97)(SHNE 89)(TERR 94). Besides, hypermedia applications include audio-visual resources (texts, images, animations, videos, etc.) especially useful to present many concepts which are very difficult to explain by means of words.

The second screen is the first one of the topic "Electronic components" and classifies them into linear, non-linear, passive, active and integrated circuits. This screen links with others where concepts related with each classification are explained. Navigating through the link "passive" of this screen users can arrive to the third screen of Figure 2 where the electrical characteristics and a typical application of a photodiode are presented as an example of a passive device.

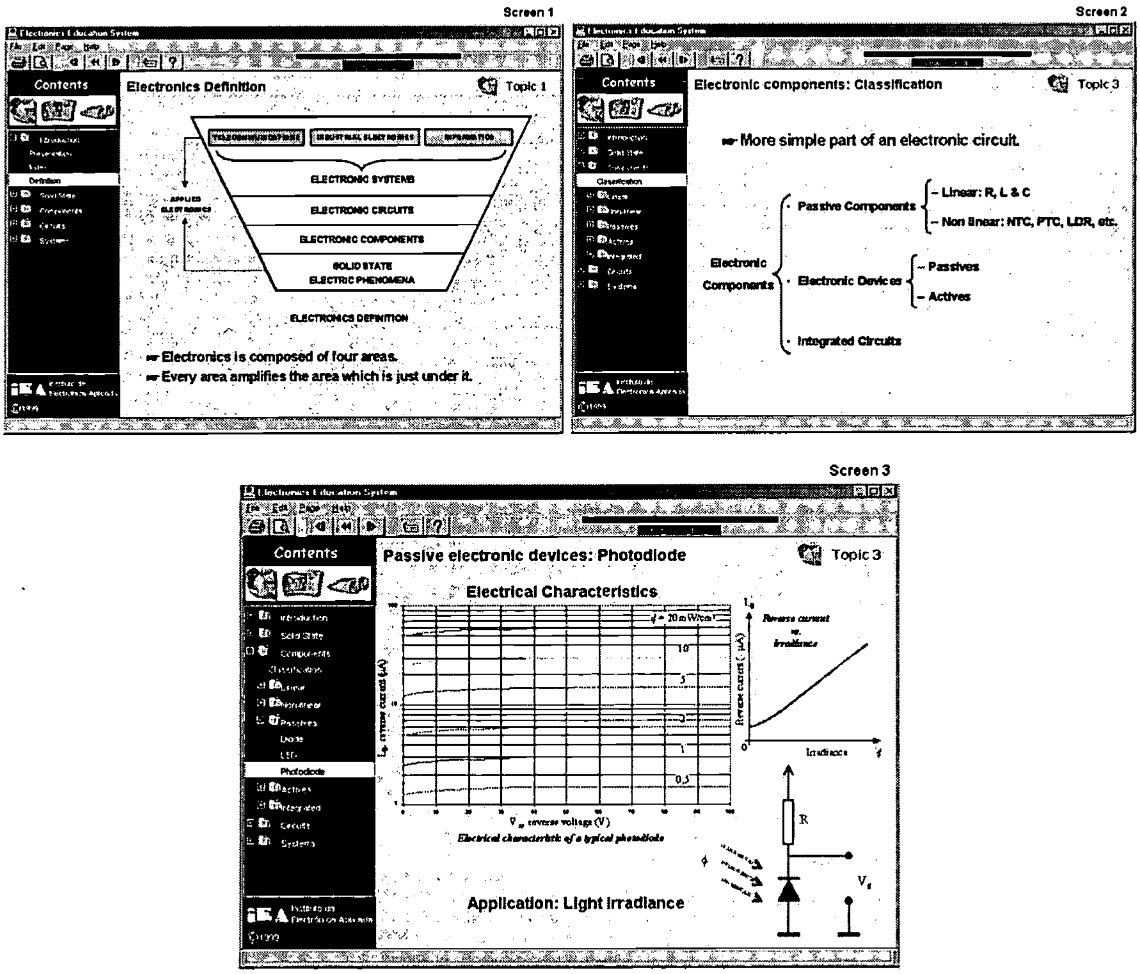


Figure 2: The hypermedia application.

Conclusions

The system being developed is based on the new information technologies to achieve non-electronic engineers education about the analysis of basic circuits as well as electronic systems. To carry out the educational training a computer is used as theoretical and practical instruction tool (using hypermedia techniques and virtual instrumentation systems). As a result we develop a training system including the following features:

- Guided instruction using hypermedia applications.
- Circuits analysis using simulation programs.
- Testing of real systems by means of virtual instrumentation.
- Individual or co-operative learning.
- Self-evaluation.
- Possibility of expansion (contents and functions).
- Competitive cost.

References

ALECOP (1995) Catálogo de Productos, Alecop, Spain.

Barker D. (1995) "Seven New Ways to Learn", Byte, March.

COELMA (1996) "Catálogo KEMO", Componentes Electrónicos Madrid S.L., Madrid, Spain.

Cuetkovic S., Seebold R., Bateson K., Okretic U. K. (1994) "CAL Programs developed in advanced programming environments for teaching electrical engineering", IEEE Transaction on Education, vol. 37, Nº2, May.

Eurociencia (1994) "Sistema Digiac", EUROCIENCIA, Madrid, Spain.

KEITHLEY (1997) "TestPoint. Keithley Data Acquisition Software", Keithley Instruments GmbH, Germany.

Klee H., Dumas J. (1994) "Theory, Simulation, Experimentation: An Integrated Approach to Teaching Digital Control Systems", IEEE Transaction on Education, vol. 37, Nº1, pp. 57-62, February.

"LabWindows/CVI The programmer's choice for instrumentation", (1994) National Instruments Corporation.

Lago A., Rodríguez F. (1993) Manual de Prácticas de Electrónica General y Analógica, (eds.) Tórculo Ediciones.

Lesk, M. *et al* (1991) "Hypertext for the Electronic Library? CORE Sample results", P.D. Stotts and R.K Furuta(eds), Hypertext'91 Proceedings, San Antonio, Association for Computing Machinery.

"MicroSim Applications Notes" (1996) MicroSim Corporation, U.S.A.

MICRONAND (1997) "NAND-001/N. Users Manual", Aplicaciones digitales MICRONAND®, Badalona, Spain.

Miri S. Y Fu R. (1993) "A Hands-On Practical Approach to Teaching Engineering Design", IEEE Transaction on Education, vol. 36, Nº1, pp. 131-136, February.

Ramírez A. (1997) "The design of a cognitive flexible hypertext learning aid to teach a structural model of implementation", Proceedings of ED-MEDIA/ ED-TELECOM 97, Canada.

Rashid M.H. (1990) "Spice for Circuits and Electronics using Pspice", (eds.) Prentice-Hall.

SALES.KIT (1996) "Catálogo General. Ed.C.17", Kadex S.A., Barcelona, Spain.

Shneiderman, B., Kearsley G. (1989) Hypertext Hands-On!: An Introduction to a New Way of Organising and Accessing Information, Addison Wesley.

Terry, J. (1994) "The 'M-World': Multimedia interfaces and their role in interactive learning systems", D.N. Edwards and S. Holland (eds), Multimedia Interface Design in Education, Berlin, Springer-Verlag.

Valdés M.D. (1997) Métodos de enseñanza y de diseño de sistemas basados en Conjuntos Configurables de Puertas, Doctoral Thesis, Department of Electronics Technology, University of Vigo.

Valdés M.D., Moure M.J., Mandado E. (1999) "Using Hypermedia for Complex Technologies Education", IEEE Transaction on Education (USA), Vol. 42, No. 4, November.

Viau E. (1994) "The Mind as a Channel: A Paradigm for the Information Age", Educational Technology Review, Autumn/Winter.

A Patient Simulation System for Nursing Education

Johan C. van Rooyen
Department of Computer Science and Informatics
University of the Orange Free State
South Africa
Johan@wwg3.uovs.ac.za

C. Janse Tolmie
Department of Computer Science and Informatics
University of the Orange Free State
South Africa
Janse@wwg3.uovs.ac.za

Abstract: Changes in the educational methods of nursing students created great possibilities for the use of computer technologies. With the help of computer-based multimedia technologies we can build libraries of simulated clinical problems (patients encounters) that can serve to fill some of the gaps in the current educational systems. This paper covers the structure of a patient simulation system in the early stages of development, called CompuPatient. Feedback from a questionnaire sent out to collaborators on the project is being used as a foundation for the design of a system customized to fit the requirements of the collaborators. The outcome of the questionnaire will be discussed. This will be followed by a discussion on the users involved in a patient simulation system. The final section and also the focus of the paper is the basic structure of CompuPatient covering the primary modules involved and communication between them.

Introduction

The traditional way of teaching nursing and medical students using lectures can be enhanced by a more active and enjoyable approach, namely Problem-based Learning (PBL). According to Albanese and Michell (1993) as quoted by Finucance et al. (1998) PBL is "an educational method characterized by the use of patient problems as a context for students to learn problem-solving skills and acquire knowledge about the basic and clinical sciences". It seems that more and more nursing and medical educational institutions are integrating this approach in their curriculums (Finucance et al. 1998).

One way of presenting PBL to the students is by using sessions. A session, usually two to three times a week, will start with a presentation of a clinical problem in a small group setting. The group discusses possible causes and develops hypotheses and strategies to test these hypotheses. They are then presented with further information. Some information is omitted for self-study between sessions. The information gathered from self-study as well as the information presented to them is used to refine their hypotheses, and to finally reach a conclusion. A facilitator guides the students in this group-learning process. The student and facilitator evaluate the session at the end (Finucance et al. 1998).

A further possibility when using PBL is the use of a standardized patient, which is an actor that plays the role of the patient in the clinical setting or an actual patient. The students can interact with this patient. The use of standardized patients can enhance the presentation of the clinical problem.

Although PBL is widely used by educational institutions, disadvantages do exist. These disadvantages include a greater demand for teacher time, stress experienced by students and teachers, less knowledge acquired of basic sciences, the difficulty in implementing PBL with large class sizes, and finally the costs involved (Finucance et al. 1998). Standardized patients augment this list of disadvantages with the lack of appropriate patients, difficulty in scheduling a standardized patient for a PBL session and the inconvenience of using the same patients over and over again (Roberts et al. 1995). When using an actor as a standardized patient another problem becomes apparent: an actor cannot have all the attributes of an actual patient.

Personal computers with multimedia support is more accessible than in the past making it feasible to implement PBL on them. The computer can simulate the clinical problem or patient, allowing interaction between the users (e.g. students) and the simulated patient. The user can ask the patient questions, examine the patient, request laboratory tests, etc. These systems are called patient simulation systems.

Patient simulation systems used to enhance or replace PBL sessions have some advantages over paper-based presentations and standardized patients. In the next paragraph these advantages are listed.

The faculty should see a reduction in labor cost from both teachers and facilitators (Gleydura et al. 1995). Patient simulation systems let the students analyze a clinical problem at their own pace, in their own way. Because the computer is consistent there is no fear that some group of students might receive better help from their facilitators than others. This is a potential problem when using 'human' facilitators (Vincelette et al. 1997). It is also much easier for the teacher to monitor progress of an individual student and groups of students. Students can receive detailed self-evaluation feedback on their abilities and mistakes made by the student can be simulated on the patient.

This paper covers the structure of a patient simulation system, called CompuPatient, in the early stages of development. We are working in collaboration with six Nursing Departments at South African Universities. A questionnaire consisting of nine categories covering over 125 features of patient simulation systems was sent out to the collaborators. These categories are applicability and scope, computing environment, human-computer interaction, simulation enhancement, patient-nurse encounter, additional assistance available to student, student assessment, feedback and the facilities provided to the teacher. The feedback from this questionnaire is being used as a foundation for the design of a system customized to fit the requirements of the collaborators. The outcome of the questionnaire will be discussed in the next section. Not all but some of the more important features affecting the basic structure of the system will be covered. The users involved in a patient simulation system were identified using the feedback from the questionnaire and used to refine the design of the system. They will be discussed in section 3. The focus of the paper is the basic structure of CompuPatient covering the primary modules involved and communication between them. The structure is discussed in section 4. Although the structure was thoroughly thought through, it is possible that the first prototype might have an influence on the structure.

Outcome of Questionnaire

The collaborators rated more than 125 features, indicating how important the inclusion of these features are to them. Although the questionnaire is being used as a foundation for the structure, the system developer could decide not to include certain features because of their complexity and present non-viability. In the following paragraphs the outcome of the questionnaire is discussed and the influence it has on the structure of CompuPatient.

When looking at the scope of the system it should not only support the training of nurses but also the training of medical doctors. The focus of the system should not be on certain areas in the medical field but accommodate a wide area of disciplines. It is important that the system is customized for healthcare in South Africa. These features will not influence the basic structure of the system.

A student could use the system in a laboratory environment and should be able to access the system over a local area network and from home using the Internet. Both of these are addressed in the design by creating a module responsible for network communication. The other modules do not have to know how communication take place over the network but only know how to communicate with this module. The system should run on a personal computer using Microsoft's Windows operating system. A decision was made to support Windows 95 or later, with the possibility of supporting other platforms using Java.

When looking at the interaction by the student with the system it seems that the collaborators were in favor of direct manipulation for patient examination and interaction with instruments. Natural language was the preferred choice for the implementation of other interaction options, followed by predefined menu choices. Because of complexity of natural language it was ruled out for CompuPatient, however the design of the structure gives the possibility of accommodating this in the future. Predefined menu choices can be accommodated by the structure of the system.

The simulation should and will support the use of text, graphics, animation, audio and video. Although audio and video were seen as essential by some collaborators support for it over an Internet connection might not be viable at the present time because of bandwidth constrains. Some collaborators prefer virtual reality to simulate a patient or environment. Virtual reality simulations can have a great influence on the structure of the patient simulation system because of the tight integration of the student interface and the simulator itself and will not be supported in CompuPatient.

The system should monitor and give intelligent hints to the student. Additional assistance should also be available that can be activated by the student that could give background information concerning the patient's symptoms, information concerning the physical examination, information concerning the interpretation of the physical examination and pointers to resources (e.g. Internet references, books, etc.). A module responsible for help and hints will do this. Although electronic communication with fellow students and the teacher was rated as unimportant by some, provision was made for this in the structure because of the additional benefits it could have. This feature can easily be integrated into the system and be disabled when not used.

Evaluation of the student during the simulation of a problem, also called the case, is important and a "goodness measure" should be assigned to the outcome of the session. The teacher should also be able to specify the particulars of the scheme used to determine the "goodness measure" of an outcome. He should also decide if the evaluation result should be available to the student (e.g. after the simulation). An assessment module is responsible for the evaluation in the structure.

When looking at the facilities provided to the teacher it is clear that the system should analyze the evaluation results discussed in the previous paragraph giving suggestions on improvement of the students. An essential feature is support for the teacher to develop new cases and share cases with other institutions. Some collaborators need access management facilities while others do not. This facility can easily be disabled when not used and therefore included in the structure of CompuPatient.

Users of a Patient Simulation System

In this section the users identified from the questionnaire and the facilities that should be available to them are discussed. There are two primary users of the system, the student and the teacher. Two secondary users were identified, the administrator and the case developer. The teacher can also function as the administrator and case developer depending on the set up at the education institution.

Student

The first and most important user of the patient simulation system will be the student. According to Thomas (1997) the objectives of PBL are to "motivate learning; developing effective clinical reasoning; structuring knowledge in clinical contexts; and developing self-learning skills". These objectives are all focused around the student. She will interact with the simulated patient that responds to the requests and reacts on changes in the simulated environment (e.g. time). Actions available to the student might include reviewing the patient history, interviewing the patient, doing a physical examination, requesting laboratory tests, making a diagnosis and when necessary referring the patient to a specialist or other professional. The system might give intelligent hints when she seems stuck. Help should be available to the student that provides a connection or reference to related material that she can consult when more information is needed. Assessment of the student should be done by the system using an assessment technique defined by the system developer that uses case specific detail supplied by the case developer. The result of the assessment or evaluation should be available to the student after the session depending on the preferences of the teacher. The student could communicate with fellow students using a discussion group or with the teacher using private messages.

Teacher

Another user of a patient simulation system will be the teacher. The teacher's task in the patient simulation system will be to monitor and oversee the learning progress of an individual student or group of students. One of the benefits of computers is the large amount of detailed information that can be collected by the computer on a given student or group. This information could be analyzed by the computer and reports could be generated that can help the teacher to concentrate on problem areas in the field of study.

Administrator

The administrator will be another user of a patient simulation system. He will be responsible for administrating access to students and other users for particular cases and information. A typical patient simulation system will consist of more than one case or clinical problem. Depending on the current progress of the student the student has access to certain cases. The access restrictions can be automated to a certain degree, for example when the student finished case A successfully, access is automatically granted for case B. Another administrator task will be the management of student groups. It could be easier to grant access to certain cases by selecting a student group (e.g. first year students) than to select each student individually. The necessity of groups also becomes apparent when working with discussion groups where students can only communicate with other students within their group.

Case Developer

The final user of a patient simulation system will be the case developer. The case developer's main purpose will be to develop new clinical problems or patients for the patient simulation system. It is important to remember that case developers should decide which variables should be included and which variables should be purposefully excluded, and how those included should be presented to the student. The case developer will also be responsible for specifying any help and hints as well as reference material available to the student for a particular case. He should also define case specific assessment variables used for evaluating the students' performance for a particular case.

A Patient Simulation System Structure

Using the users and feedback of the questionnaire as a foundation, a structure for CompuPatient was designed. In this section the primary and sub-modules of this structure and the communication between them are discussed.

Modules

Five primary modules were identified (Fig. 1). The first module is the student's environment module. The purpose of this module is to provide an environment for the student to interact with the simulated clinical problem and consists of six sub-modules. The first sub-module is the student interface that defines the information presentation and is customizable to suit the preferences of the student. The case simulator is the second sub-module and is responsible for the simulation of the clinical problem. The case simulator is an essential part of the patient simulation system. This module takes interaction commands from the student interface and reacts on them by changing the presentation of the simulated patient. When using natural language another sub-module can fit between the case simulator and the student interface. It translates the natural language into a format understandable by the case simulator. The monitor module keeps a log of data received from the case simulator relating to the state of the simulation as well as interaction commands received from the student. The results are stored for analysis by the teacher's environment. The assessment module uses the data of the monitor to evaluate the student's progress during the session using case specific assessment detail defined by the case developer. The evaluation is available to the student after the session if enabled by the case developer. The intelligent help and hints module gives help and hints to the student, customized to suit the current progress of the student by analyzing the log from the monitor. The help and hints can consist of additional material or references to additional material available to the student. The final sub-module of the student's environment module is the communication interface. The communication interface is responsible for the communication between the student's environment and the other primary modules. Although the primary modules can be on the same machine it is possible that they can be distributed over several machines connected to a network.

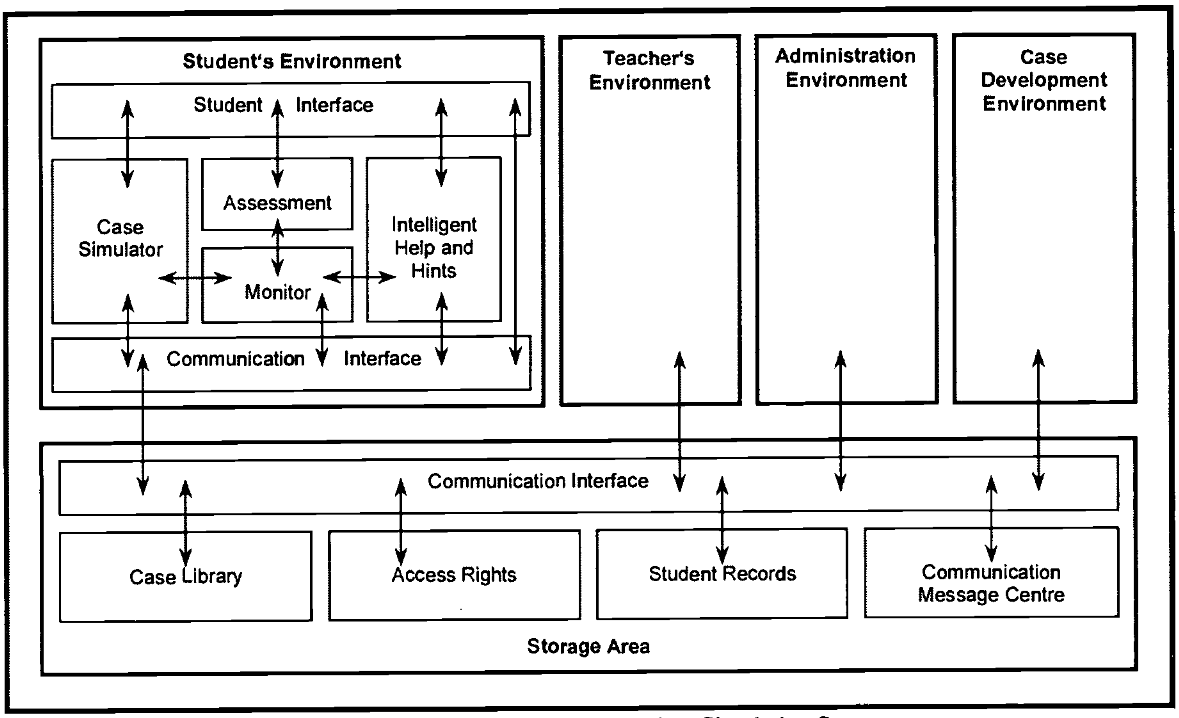


Figure 1: Primary Modules of a Patient Simulation System

The second primary module is the storage area and stores all data used by the other primary modules lasting more than one session with a user. This module is split into five sub-modules. The first sub-module called the case library stores all data of the cases available to the system. This data includes multimedia used to simulate the case, reference material, help and hints, as well as case specific variables used by the case simulator and assessment module. Maintenance of the users involved in the system and the cases and information they have access to are done by the access rights module. The next sub-module called the student records module maintains information about the student's case log received from the monitor and evaluation results received from the assessment module and is available to the teacher's environment for analysis. The communication message centre deals with the storage and distribution of messages sent between the teacher and students or between the students in a group. The final sub-module is the communication interface and is responsible for the communication between the storage area and the other primary modules.

The next primary module is the administration environment module that provides an environment for the administrator to add and remove users, maintain student groups and also grant and restrict access to cases and other information (e.g. student records).

The teacher's environment module is the next primary module in the system. The purpose of this module is to provide an environment for the teacher to retrieve and analyze student records. The teacher can view an individual student or group of students' records, view information about their evaluation, as well as problem areas identified by the system. This makes it possible for the teacher to concentrate on these problem areas in class or when developing new patients for the system.

The final primary module of the system is the case development environment that presents the case developer with an environment to develop new cases, alter old cases and import and export cases from and to other similar systems.

Communication between Modules

Communication between all the primary modules go through the storage area using a client-server approach. The storage area operates as the server and the other primary modules as the clients. An advantage of this approach is that the system can be updated to work not only on the local machine but also over a local area network or even the Internet without changing the structure of the modules. Only the communication interface of all the primary modules will change to accommodate the new communication protocol.

When the student signs on for a session with the system, communication is established by the student's environment with the storage area. The rights of that particular student for the case are verified with the access rights module in the storage area. If access is granted to the student, the contents in the case library for the selected case are transferred to the case simulator, not necessary all at once but can also be transferred on demand. This data includes the case specific variables and multimedia. The reference material, help and hints are transferred from the case library to the intelligent help and hints module. The monitor loads case specific assessment detail into the assessment module from the case library. The monitor queries the student record to see if the student previously suspended the selected case. If she did, the simulation starts with the state of the simulation just before the suspension. Otherwise it starts at the beginning of the case. Interaction between the student and case simulator is sent to the monitor by the case simulator. The monitor keeps a log of all interactions. The assessment and intelligent help and hints modules can use the log of interaction to make an evaluation or giving hints to the student. If the session is suspended or terminated the data in the monitor is stored in the student record. Communication messages sent by the student to the teacher or other students are sent by the student's environment to the communication message centre. The storage area keeps record of all open sessions and if a message arrives for a student currently using the system, the system sends the message through to the student's environment of that particular student.

This paper will not include a discussion on the communication of the case development environment, administration environment and the teacher's environment because of the similarities in communication with the other modules already discussed.

Conclusion

At the time of writing, CompuPatient was still in the phase leading to the implementation of the first prototype. When looking at the transition of education towards distant learning the possibilities of patient simulations are endless. Patient simulation might in the future revolutionize the nursing and medical education process.

References

Albanese, M.A., & Mitchell, S. (1993). Problem-based learning: a review of literature on its outcomes and implementation issues. *Academic Medicine*, 68, 52-81.

Finucance, P.M., & Johnson, S.M., & Prideaux, D.J. (1998). Problem-based learning: its rationale and efficacy. *The Medical Journal of Australia*, 168, 445-448.

Gleydura, A.J., & Michelman, J.E., & Wilson, C.N. (1995). Multimedia Training in Nursing Education. *Computers in Nursing*, 13, 169-175.

Roberts, J.D., & While, A.E., & Fitzpatrick, J.M. (1995). Clinical problem-solving using video simulation: an investigation. *Medical Education*, 29, 347-354.

Thomas, R.E. (1997). Problem-based learning: measurable outcomes. *Medical Education*, 31, 320-329.

Vincelette, J., & Lalande, R., & Delorme, P., & Goudreau, J., & Lalonde, V., & Jean, P. (1997). A Pilot Course as a Model for Implementing a PBL Curriculum. *Academic Medicine*, 72, 698-701.

A Synchronized Multimedia Integration Language (SMIL) Presentation Generator

Joaquin Vila, Ph.D.
Applied Computer Science
Illinois State University, USA
e-mail: javila@ilstu.edu

Barbara Beccue, Ph.D.
Applied Computer Science
Illinois State University, USA
e-mail: bbeccue@ilstu.edu

Abstract: *Synchronized Multimedia Integration Language* (SMIL) enables web developers to create multimedia content for efficient delivery over the Internet. The objective of the SMIL Presentation Generator that this paper discusses is to make the capabilities and advantages of SMIL available to non-technical users. The SMIL Presentation Generator provides templates for the generation of RealText, RealPix and SMIL files. This enables non-technical users to create RealText and streaming media files which they can then synchronize using the SMIL generator templates for the creation of a web-based multimedia applications.

Introduction

Synchronized Multimedia Integration Language (SMIL) is based on the eXtensible Markup Language (XML). SMIL was developed by the World Wide Web Consortium (W3C) and enables Web developers to create multimedia content for delivery over the Internet. SMIL components consist of files and streams of audio, video, text, or image content. These components are transmitted separately over the Internet thus providing more economical and efficient use of resources. However, the components are then displayed together as if they were a single multimedia stream. This gives a more reasonable download time as compared to that required by traditional monolithic multimedia files.

The SMIL specification consists of XML tags that allow the definition of windows, multimedia elements, and their synchronization in time when displayed in a SMIL capable browser. In order to use SMIL for creating presentations, the developer must devote the time to learn the language. In addition, the developer must understand and be able to encode specifications regarding specific details about size, placement and structure of the windows and the placement of the multimedia elements in time for proper synchronization. This detail work is very exacting and time-consuming for the developer. Thus it is difficult for the non-technical user to take advantage of the capabilities provided by SMIL.

In order to make the advantages of SMIL available to potential non-technical users such as educators, tools with enabling interfaces are needed. The objective of the SMIL Presentation Generator that this paper discusses is to make the capabilities and advantages gained by using SMIL available to non-technical users. SMIL files incorporate RealText, RealPix, real audio and real video files. The SMIL Presentation Generator consists of editors for RealText, RealPix and SMIL. Many faculty are attempting to improve the instruction content of course material through the use of multimedia and also improve the availability of the material by deploying it on the Internet. The intent in developing this tool was to provide a user friendly front-end with general templates that could be used for the generation of SMIL web-based multimedia instructional modules. Through the use of templates that guide the developer in creating the files necessary for a SMIL presentation, more faculty members would have the ability to create their own SMIL presentations.

Use of SMIL Presentation Generator

The SMIL Presentation Generator provides an interface that enables a non-technical user with an understanding of the terminology and limited knowledge of the technical aspects of SMIL to generate files in RealText, RealPix and SMIL.

The interface for the RealText Generator looks like a usual HTML editor. The interface is divided into 3 major sections (See Figure 1). One section allows the user to select the window type from a list of possible types that s/he wants to include in the presentation. Another section allows the user to set the specific window properties of the type of window that the user has selected. For example, for a Ticker Tape window type, the properties are duration, width and loop. The working section allows the user to type the contents that are to be included in the RealText file or preview either the RealText file generated or the code. Icon buttons open dialog boxes for the user to do other tasks such as set the time for the display of the text, link to a player or to a browser, select font style and size, and specify background color.

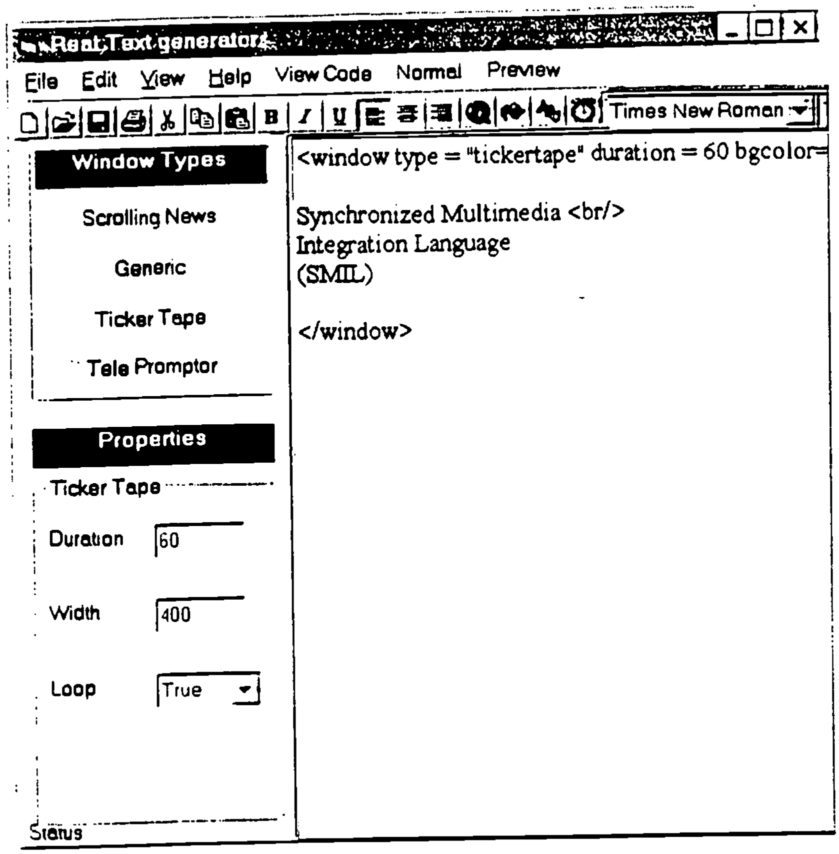


Figure 1: Interface for the RealText Generator

The interface for the RealPix Generator has four sections (See Figure 2). The Image Window allows the user to view images and add them to the presentation. The Images Window lists all images that have been added to the presentation. The Transition Window previews the source image and lets the user select the type of transition (crossfade, fill, fadein, fadeout or wipe) to be used. The Time Window lets the user sequence and time the use of images and transitions.

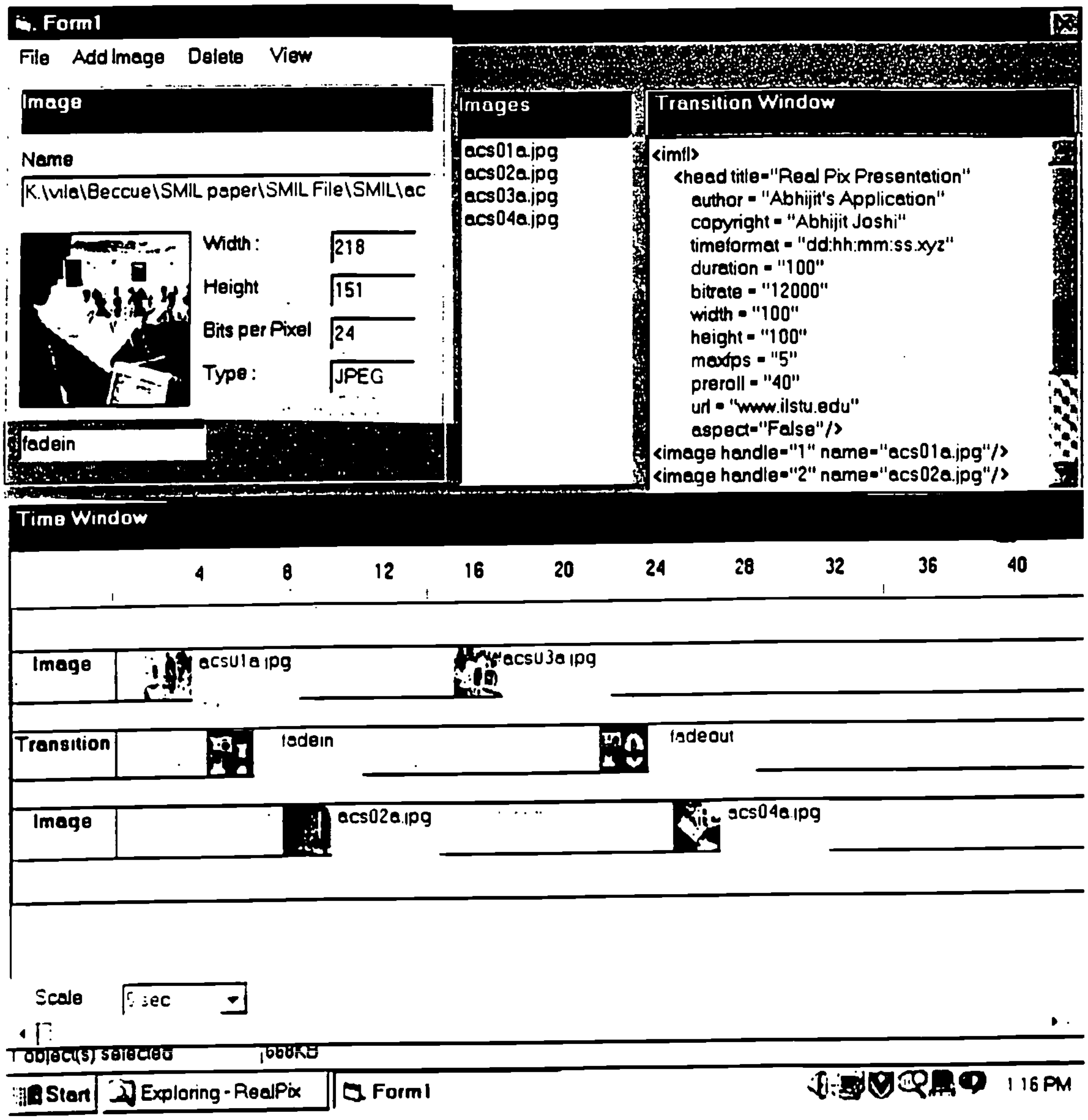


Figure 2: Interface for The RealPix Generator

The interface for the SMIL Generator has four windows: Object Toolbox, Properties, Layout and Sequence (See Figure 3). Real time files can be added to the presentation by clicking on the appropriate button in the Object Toolbox Window. A dialog box opens and lists available files of the type specified. The user can then select the file to be added to the presentation. The added files can be viewed in the sequence window. The Layout Window is used to define the size of the real player screen and to create regions.

BEST COPY AVAILABLE

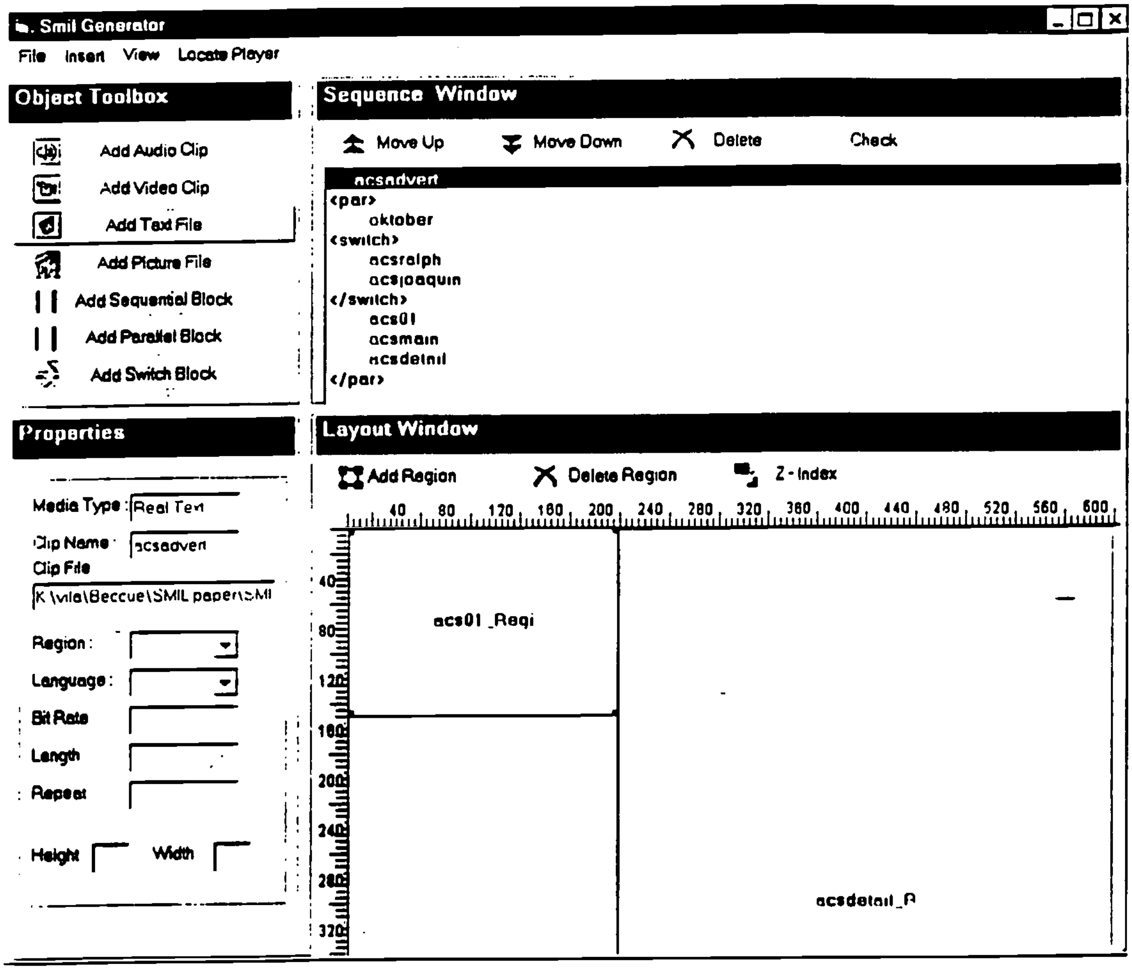


Figure 3: Interface for the SMIL Generator

Technical Description of the SMIL Presentation Generator

The SMIL Presentation Generator is an application which facilitates the production of SMIL presentations by providing templates for the developer to use in order to generate these web-based multimedia presentations. The tool is composed of three programs: the SMIL Generator, the RealText Generator and the RealPix Generator. The SMIL Presentation Generator was implemented using Visual Basic. In addition to generating SMIL, RealPix and RealText files, each of the generators is capable of loading and interpreting the native formats and reverse engineering the output file type into the generator format. Thus, a user can create, load and save SMILs for deploying, editing and updating.

The RealText Generator helps the users generate their own RealText files in a format that meets RealText specifications. Using the generator, the user can either create an original RealText file or convert an existing text document into a RealText file. The users can select the type of window style and the rate at which the text would flow. They can also add links to web sites and presentations. The RealText application presents text in synchronization with other media elements. All contents of a RealText document are contained within the <window> tag and are stored in files with the .rt extension. There are four window types: generic (the default mode), ScrollingNews, TickerTape and TelePrompter. The markup is basically the same for all window types.

The RealPix Generator helps the users generate their own stream images in the RealPix format which meets SMIL specifications. The user can select images, can specify the order of the selected images, the time for which each image stays on the screen and the transition effects. Graphics in this format can be streamed over the web as part of a SMIL application. The RealPix file is defined between two tags which define the beginning and end of the RealPix file. RealPix can stream images in the following formats: GIF87, GIF89 (*.gif), and JPEG (*.jpg). Both interlaced and noninterlaced GIFs will work, but RealPix does not take advantage of any features of interlaced GIFs. RealPix does not support animated GIFs. RealPix can use RGB baseline JPEGs; however, progressive and grayscale JPEGs are not supported.

The SMIL Generator is a SMIL authoring tool. It can use the files produced by the RealText and the RealPix Generators plus additional types of media. As an authoring tool, it lets the user partition the presentation screen into a number of regions. The user can then define the type of media (video, audio, RealText, RealPix) associated with these regions. The user can also specify the time for which each of these media items would play in the specified region. The output from the SMIL Generator is a SMIL file that can be played using a SMIL capable browser such as the RealPlayer.

Summary

The emerging SMIL specifications provide new avenues for delivering multimedia applications that can be used in academia for web-based instruction. However, the use of SMIL requires technical knowledge and understanding. The SMIL Presentation Generator can be used by instructors who do not have this expertise but do have an interest in developing web-based instructional modules with ease. The information captured by means of the Generator's templates will be translated into SMIL presentations that can be made available over the Internet to students.

References

W3C - The World Wide Web Consortium. (1999) "World Wide Web Consortium Issues SMIL 'Boston' First Working Draft," http://www.w3.org/

RealNetworks, RealSystem™ G2. (1998) "RealText™ Authoring Guide" Revision Date: December 21, 1998 http://service.real.com/help/library/guides/realtext/realtext.htm

RealNetworks, RealSystem™ G2. (1998) "RealPix™ Authoring Guide," Revision Date: December 21, 1998 http://service.real.com/help/library/guides/realpix/realpix.htm

Bouthillier, L., (1998) "Larry Bouthillier's SMIL Demo Page", http://www.people.hbs.edu/lbouthillier/smil/

Acknowledgments

The authors wish to acknowledge the work done by Abhijit Joshi during the implementation phase of the *SMIL Presentation Generator.*

Structural Communication and Web Based Instruction

Carlos Villalba, M.Sc.

Doctoral Candidate, Instructional Design, Development and Evaluation

School of Education, Syracuse University, USA

cavallal@syr.edu

Alexander Romiszowski, PhD.

Research Professor, Instructional Design, Development and Evaluation

School of Education, Syracuse University, USA

alexromi@sued.syr.edu

Abstract

The paper first reviews the authors' recent comparative studies of existing online learning environments and makes the case that no current commercially available system effectively supports intensive collaborative and creative discussion in a way that may compete with facilitated small-group methodologies such as for example the Harvard case study method. Second, it reviews earlier work, spanning some thirty years, on a methodology named Structural Communication that achieved some success in automating and individualizing such methodologies. Then, the paper describes a methodology that combines some aspects of Structural Communication with interactive Web-based discussion to create an effective and efficient alternative to classroom-based case study discussions. Finally, some key research findings are summarized, suggesting that this hybrid methodology may be more effective than the facilitated small group for promoting creative ideas, as well as being more efficient and multipliable.

Introduction: Key Issues in Use of CMC in Higher Education

The variety of Internet-based synchronous and asynchronous communication systems keeps growing. In addition to the already well known forms of asynchronous Computer-Mediated-Communication (CMC) systems, such as email, listserv and threaded discussion lists, we now use a variety of new synchronous communication alternatives, such as electronic whiteboards, Internet Relay Chat, Web-based audio and video conferencing and a growing variety of "groupware" packages. As the power of the Internet grows, so does the complexity of the material posted. Ever more ambitious examples of interactive multimedia are launched on the Web every day. A number of novel research questions and issues arise in relation to the design and use of these new systems.

Much existing research is related to earlier forms of text-based CBT. Some of these results may be equally valid within the context of multimedia distance education/training systems. However, we may expect many new issues and questions to emerge as these broad band multimedia, multimodal communication systems link both people and remote databases into one seamless information and communication environment. One recurrent problem is that we hop from one recently-emerged technology to another currently-emerging technology that promises some new potential, without ever learning to fully exploit the potential of the old. It is a sobering thought that in all the centuries since the Gutemberg print technology facilitated the mass dissemination of text, we are still struggling with the issues of mediocre textbooks, instructional manuals that fail to instruct and communications (including on-line texts and hypertexts) that just do not communicate.

In addition to the communication-technology and instructional design variables, another aspect to consider for improvement of existing on-line learning environments is the promotion of effective "conversational" interaction between groups of students (and instructors) engaged on a joint project. There is a growing need for the implementation of learning exercises that prepare students for the new profession of "Knowledge Work". These exercises should allow students to work creatively, collaboratively and at a distance on complex, leading-edge problems that impact their life and work. Teaching methods such as seminars or case studies are traditionally employed for developing creative thinking skills through collaborative effort. They are typically implemented in small or medium sized groups, led by skilled and experienced "facilitators". The success of these methods depends much on the facilitators and the skill with which they perform their roles: focus the discussion; guide the approaches adopted by the participants; use the natural group dynamics to stimulate interest; promote and support participation and deep involvement by all; and pull together what has been learned in the final debriefing discussion. Can such participatory discussion methods be effectively orchestrated at a distance? How might this be done? And, most importantly, how might we do it so as to create practical and sustainable WBT systems that will survive the test of time as the initial enthusiastic "early adopters" move on to other projects and their place is taken by the rank and file of the teaching/training profession?

There are also other pressures, both organizational and philosophical, that are increasing the amount of autonomy, self-direction and responsibility that learners have in respect of their own education and development. Given the increasingly competitive nature of business in the international marketplace and the critical importance that access to and use of up-to-date information and methods plays in a company's competitiveness, it is not surprising that the concept of human resources development as "self-development" is taking root. This concept sees keeping up-to-date and employable as the responsibility of every employee. The employer's responsibility is to make this possible, by helping to identify the needs of the individual and by facilitating access to the resources necessary to satisfy those needs. This will ever less frequently call for lengthy courses organized either within the company or by outside providers, but will instead make much more use of networking, access to external databases and electronic libraries, small specialist group tele-training and self-instruction in all its forms (Eurich, 1990).

An integrated research agenda

The research focus adopted by the authors is on the effective implementation of group discussion, or "conversational", methodologies on electronic telecommunications networks. This focus is particularly important, as we know much less about how to converse effectively on electronic networks, than we do about electronic self-instruction. There is a long history and fairly developed technology of the design, development and delivery-at-a-distance of self-study materials. There is much less known about the running of effective group-discussion sessions at a distance (Chang, 1994).

In a recent study reported elsewhere (Villalba and Romiszowski, 1999) the authors performed a comparative analysis of typical on-line learning environments currently used in higher education and the typical ways in which these environments are used to implement collaborative group learning activities. The findings indicated that few currently implemented on-line courses actually include a strong emphasis on collaborative small-group learning and, when such activities are implemented, this is generally as a relatively unstructured on-line group discussion, using either synchronous "chat" sessions or, more frequently, asynchronous email driven discussion lists. There is little if any research, however, indicating that such environments are conducive to in-depth reflective discussions of the type required to develop critical and creative thinking skills. And there are some studies (e.g. Romiszowski and DeHaas, 1989, Romiszowski and Chang, 1994) that suggest they are singularly ineffective in this respect. As a means of verifying these suggestions, the authors selected one of the previously evaluated on-line learning environments, Aulanet, for further in-depth study.

Aulanet is a web based instruction environment, developed in Brazil at the Catholic University of Rio de Janeiro (Lucena et.al. 1998) which is also available in an English language version. It was selected as it offered a wider variety of on-line discussion environments than most other currently available systems. In addition to the regular e-mail, both threaded and unthreaded asynchronous discussion environments and text-based synchronous "chat" rooms, options are available for audio, audio-graphic and full video-conference sessions in small or large groups. In addition, the creators of Aulanet claim the system is based on or influenced by contemporary theories of cognition and constructivism. The present authors have observed and analyzed the use of Aulanet as a delivery system for four courses running through the spring and the fall semesters of 1999. These courses form part of a graduate (Masters and Doctorate) program in Educational Technology in a leading North American Research University. The study involved both the observation of student use of different collaborative learning environments provided within Aulanet and the analysis of student questionnaire responses and user-evaluations administered during the course of the 1999 academic year.

In that study the students made some quite significant suggestions for enhancement of the learning environment. A major observation is concerned with the structure of facilities for constructive educational "conversations". The many and various components of Aulanet that permit both synchronous and asynchronous student/teacher and student/student interaction are seen to be no different from the facilities that exist in many other online learning packages currently on the market. Both faculty and students have come across limitations in the available group communication facilities that limit what they can implement in the way of "creative group work at a distance".

In the present study we are seeking ways around these limitations. In order to perform this research we have developed a web based automated case discussion system. To do this, we turned to a methodology called Structural Communication, originally developed in the United Kingdom in the late 60's and early 70's as a methodology for writing and presenting interactive print-based exercises. An adaptation of this methodology had shown itself to be effective for automating and individualizing small-group learning methods such as the Harvard Business Case methodology (Hodgson et. al. 1971). Later studies demonstrated the effectiveness of the methodology in reducing the amount of human facilitator or monitor interaction necessary in order to lead the exercise to a satisfactory conclusion (Romiszowski, 1990; Romiszowski & Chang, 1992; Chang, 1994).

Structural Communication is an instructional approach that provides a simulated dialogue between an author of instructional materials and the students. It has been called "an interactive technique for communicating understanding" (Egan, 1976). Understanding is "inferred if a student shows the ability to use knowledge appropriately in different contexts, and to organize knowledge elements in accordance with specified organizing principles" (Egan, 1972, p. 66). The technique was designed to encourage creative thinking in learners, allowing them to develop an understanding of a topic, not simply to memorize facts. Furthermore, Structural Communication was designed to promote learning for social action. Hodgson, in line with many current constructivists, viewed the social contexts of the learning activity to be critical for the transfer of learning to practical situations (Egan, 1976). The distinctions between the learning of knowledge and the learning for social action are evident in the actual components Hodgson designed into the Structural Communication technique. The typical components of a Structural Communication unit are described below.

Intention	The opening statement, which defines what is to be studied, provides an overview, possibly an "advance organizer", and sometimes a rationale. It is used to provide a context for the content of the study unit.
Presentation	The material, experience, exercise, case study, etc. which supplies the essential facts and concepts of the domain being studied. This may be an existing text, a video, a case study, a simulation, or real-life experience, depending on the overall strategy of the exercise. This could also be any sort of computer-based instruction, including simulations.
Investigation	A set of problems for solution, which are designed to present the "intellectual challenge" that is an essential part of the Structural Communication methodology. These problems are interrelated and are open-ended to allow multiple responses and viewpoints. The purpose of the investigation section is for the learner to interact with the subject matter.
Response Matrix	A randomized array of items which summarize key parts, concepts or principles from the knowledge base that is being used and studied in the exercise. Often it resembles a "key point summary" of the Presentation. The student composes a response (outlines an essay) by selecting any number of these items as a "best" response to a given problem.
Discussion	The Discussion has two parts: a Discussion Guide and a set of Discussion Comments. The Guide is a set of if-then rules, which test the student's response for omission or

inclusion of certain significant items, or combinations of items. The Comments are constructive statements that discuss in depth the rationale for including or excluding certain items.

Viewpoints An outline of the author's, and other alternative viewpoints; this may review some aspects stated in the Intention, make explicit some biases or standpoints held dear by the author, draw attention to other views in the literature, etc. Ideally, the viewpoint section plays a final, interactive role between author and learner.

An additional aspect of the Structural Communication study unit is the assessment of the learner's responses to the questions posed by the study unit. Hodgson developed a numerical measure called the coherence index. According to Egan (1976), the coherence index is an objective measure of how well the student organizes knowledge about the specific topic in the study unit. However, the constructivist may reject this interpretation, since it implies a correct set of responses based upon the ideal organization and analysis of the presented data. Constructivists are more likely to view the coherence index as an objective measure of the degree of agreement of the student with the author of the Structural Communication unit. They may well be more interested in measures of divergence of viewpoints rather than convergence on a uniform, or coherent, viewpoint on the issues being discussed.

A Revised Structural Communication Methodology

The original SC methodology was redesigned in order to create a somewhat more "constructivist" and collaborative learning environment. Some of the most important features of the SC method, for example individualized learning of basic content and access to expert opinions, were maintained. However, the revised form provides open-ended discussion environments for students to share, argue, persuade, and negotiate their perspectives on the expert's feedback comments as well as on their own opinions. In the original method, the planned learning activity ends with reading the expert's comments. Since the revised method is designed for small group collaborative learning, from this point on, further learning activity occurs collaboratively with group members. After completing their work individually, students browse what each group member did. A summary table tells the group members who selected which items in the response matrix during individual study. With the summary table as a guide, group members can access any item and read the viewpoints and justifications of other group members. They are asked to react to each other's justifications stating whether they agree or disagree with each other.

As the process continues, the pool of the students' discussion log grows. The software is designed to save every justification and discussion statement that students make, and to enable students to browse those reactions and opinions in a cumulative mode as the process continues. While they are performing these activities, the nature of their interaction may vary along several dimensions, which are under the control of the software. For example, they may, or may not, access expert's feedback comments to inform them on "what the experts say". Similarly, they may have to construct their opinions and justifications in their own words, or merely select them from a long list. Four different versions of the revised Structural Communication software were developed for experimental purposes. These vary along "simple-to-complex interaction structures" and "more or less constructivist philosophy" dimensions (Chang, 1994).

Practical Conclusions and their Implications for Conversational WBT

Several conclusions were drawn from this study. One practical conclusion was that the discussion environments based more closely on the original SC exercise model, offer an appropriate environment for intensive small group conversational interaction via CMC networks, even if these seem to be less in line with currently popular philosophical positions. However, the environments must support the discussion process in an effective and efficient manner. This implies, among other things, ensuring that the discussion process is motivating and not over-taxing in terms of workload. The researchers found no trace of the supposed "perils" of limiting the creative and critical thinking of the discussion participants by exposing them to "expert" viewpoints. The more tightly structured SC environments produced more frequent creative insights than the supposedly more "constructivist" environments.

As regards student motivation, there is little doubt that exercises organized in the form of Structural Communication are most effective. The several hundred students who participated in the above-mentioned 4-treatment study worked voluntarily and without recompense in the form of grade points throughout a whole semester with very low dropout rates. The students in earlier studies showed similar levels of motivation. This finding is important in the context of conversational CMC-type WBT in that the study materials placed in a publicly "open" WBT environment will survive and prosper, or alternatively wither and die, as a function of their ability to attract voluntary participation from a significant number of WWW navigators.

It may well be that the reasons for the high levels of motivation encountered in these studies are not entirely and uniquely a consequence of the SC format. As mentioned before, the quality of design of the exercises themselves is probably a most critical factor. In Khan's recent collection of essays on Web-Based Instruction (Khan, 1997), two chapters are devoted to issues of motivation in WBI (Cornell & Martin, 1997; Duchastel, 1997). Both chapters review several well-known approaches and models for the design of motivational learning materials, such as ARCS (Keller, 1983). However, Structural Communication's unique mechanism of the response matrix is an approach that has been largely overlooked. The response matrix allows for easy and rapid responding to complex multi-faceted problems, at the same time allowing one to explore one's own and each others' cognitive structures in some detail. This is the inherent attractiveness of the methodology to the interested and reflective student.

We should not leave the question of motivation without also considering the motivation of the instructor or discussion facilitator. Cornell & Martin (1997) address the question of instructor motivation in Web-based learning. The authors mention seven reasons for lack of instructor motivation (as compared to twelve for student motivation) and, interestingly, this list of seven reasons does not include the avoidance of extra workload. However, experience and research suggest that CMC-delivered courses almost always involve significantly more instructor time than conventional courses. We therefore feel that one should add this eighth reason to the list. Furthermore, we believe that Structural Communication offers, at least in part, a solution to this eighth reason.

In discussions organized within a SC-based CMC environment, the problem of instructor overload is much reduced. The automatic generation of extensive and constructive feedback to students on the basis of the pattern of responses they select from the response matrix acts like a first-round live reaction from thc instructor to specific aspects of the students' overall response. In practice, these automatically generated feedback messages satisfy well over 70% of the students' needs for clarification or orientation. The remaining 20% to 30% of feedback interactions generate second-round student responses in the form of electronic messages that pose supplementary questions or comments, usually at a deeper and more reflective level of discourse. The effects of this on the motivation of the instructor are twofold. First, the overall workload of responding to students (measured in terms of the number of messages to compose) is reduced by some 70%. Second, the messages to be responded are on issues that are often more interesting and always relatively original and non-repetitive.

Having touched on the issue of workload as it relates to the instructor/facilitator, we may mention our experience with the SC response-matrix mechanism as a device for the reduction of student workload. In selecting a subset of response elements from the universe represented by the items in the response-matrix, the student is in effect composing a complex, structured response to the problem under analysis. This is analogous to the preparation of an outline for an essay or live seminar presentation. The intellectual effort necessary to evaluate the relevance of each item of the matrix to the problem being studied is equivalent to that expended in planning an essay or presentation. However, the time and effort involved in writing an essay or preparing and delivering a presentation are saved.

We have also observed that students spend more time, more productively, in the intellectual restructuring of ideas and the creation of their own knowledge structures than is often the case in conventional instruction. To be sure, students do restructure their ideas when they engage in free, unstructured, small-group discussion with their peers and teachers, but not with the frequency and depth of insight that seems to be generated in the SC environment. And, in our view, the relatively unstructured discussion lists that abound in current WBT environments, even the popular "threaded" discussions, are less effective in promoting creative idea-generation. Furthermore, they are more wasteful of student time than both the SC environment and the conventional small-group seminar presentation, in that every single contribution must be produced as an original typed message.

In conclusion, it is not our argument to eliminate written communication from the ideal WBT environment. There are strong learning benefits to "putting pen to paper" (or fingers to keyboard). As Albert Einstein replied when asked what he thought of a novel scientific issue: "I do not know what I think until I have written it down". However, as in real life time is always limited, why not use it most efficiently? In the SC-based form of WBT environment, the student is saved the effort of writing out surface-level arguments that mainly serve to "get the ball rolling" by acting as stimuli for comments from instructor/facilitators or peers. The discussion is set in motion by means of the response matrix. The writing of "what I think" then does occur at the second and subsequent rounds of in-depth discussion. We close by stressing the importance of implementing effective, efficient and multipliable small group collaborative learning environments online. Otherwise, due to the difficulties and costs of arranging sufficient opportunities for facilitated small-group collaborative learning by conventional means, tomorrow's educational systems will offer "less and less of what learners need more and more".

References

Chang, E. (1994). *Investigation of Constructivist Principles applied to Collaborative Study of Business Cases in Computer-Mediated Communications*. Doctoral thesis, Instructional Design, Development and Evaluation. Syracuse, NY: Syracuse University School of Education.

Cornell, R. & Martin, B.L. (1997). The role of motivation in web-based instruction. In B. Khan (ed.) *Web-Based Instruction.* Englewood Cliffs, NJ: Educational Technology Publications.

Duchastel, P. (1997). A motivational framework for web-based instruction. In B. Khan (ed.) *Web-Based Instruction.* Englewood Cliffs, NJ: Educational Technology Publications.

Egan, K. (1972). Structural Communication: a new contribution to pedagogy. *Programmed Learning and Educational Technology*, 9(2), 63-78.

Egan, K. (1976). *Structural Communication.* Belmont, CA: Fearon Publishers.

Eurich, N.P. (1990). *The Learning Industry: education for adult workers.* Princeton, NJ: Carnegie Foundation for the Advancement of Teaching.

Hodgson, A.M. (1972). Structural learning in social settings: some notes on work in progress. *Programmed Learning and Educational Technology*, 9(2), 79-86.

Hodgson, A.M. & Dill, W.R. (1971). Programmed case: reprise of the missfired missive. *Harvard Business Review*, Jan/Feb 1971, 140-45.

Keller, J. (1983). Motivational design of instruction. In C. Reigeluth (ed.) *Instructional Design Theories and Models: an overview of their current status.* Hillsdale, NJ: Erblaum.

Khan, B.H. (1997). *Web-Based Instruction.* Englewood Cliffs, NJ: Educational Technology Publications.

Lucena, C. J. P., Fuks, H., Milidiú, R., Laufer, C., Blois, M., Choren, R., Torres, V., and Daflon, L. (1998). AulaNet: Helping Teachers to Do Their Homework. *Multimedia Computer Techniques in Engineering Education Workshop*, Technische Universitat Graz, Graz, Austria, 16-30.

Romiszowski, A.J. (1990). Computer-mediated communication and hypertext: the instructional use of two converging technologies. *Interactive Learning International*, 6, 5-29.

Romiszowski, A.J. & Chang, E. (1992). Hypertext's contribution to computer-mediated communication: in search of an instructional model. In M. Giardina (ed.) *Interactive Multimedia Environments* (pp. 111-130). Heidelberg: Springer-Verlag.

Romiszowski, A.J. & DeHaas, J. (1989). Computer-mediated communication for instruction: using E-mail as a seminar. *Educational Technology*, 24(10).

Villalba, C. & Romiszowski, A. (1999). AulaNet and other Web-based Learning Environments: a comparative study in an International context. Proceedings of the *1999 ABED International Conference*, Rio de Janeiro, August, 1999. São Paulo, Brazil: Associação Brasileira de Educação a Distância (ABED). www.abed.org.br

An Empirical Study Concerning Graphical User Interfaces that Manipulate Files

Maria Virvou, Katerina Kabassi
Department of Informatics,
University of Piraeus,
Karaoli & Dimitriou 80,
Piraeus 18534, Greece
mvirvou@unipi.gr, kkabassi@unipi.gr

Abstract: This paper describes an empirical study conducted within users of Graphical User Interfaces that deal with files and folders in a similar way as the Windows 98/NT Explorer. 10 human experts analysed user protocols, which were collected using computer logging, so that the most common user errors could be identified. The comments made by the human experts served as a basis for the requirements specification of a second executable release of a GUI called IFM that incorporates intelligence. IFM reasons about users' actions so that it can provide spontaneous help to users' errors. The user protocols collected during the empirical analysis were used in the formative evaluation of the second executable release of IFM. The reactions of IFM were compared to the comments of the human experts that had taken part in the empirical study.

Overview

Graphical user interfaces are user friendlier than others, such as command language interfaces. However, as McGraw (1994) points out, they may prove difficult to traverse and use if they are poorly designed; hence in addition to basic user interface guidelines, developers may also want to consider the feasibility and benefits of using AI to enhance the user interface.

Intelligent File Manipulator (IFM) is a graphical user interface that incorporates intelligence. It is used for a file manipulation program similar to the Windows 98/NT Explorer. However, it can also reason about users' actions. IFM's main aim is to provide spontaneous help and advice to users who have made an error with respect to the hypothesised intentions. IFM is meant to operate like a human expert who watches a user over the shoulder and provides spontaneous advice. This advice may, in time, enhance novice users' skills in operating file manipulation programs. Therefore, IFM may also be used as a learning environment for novice users of a GUI (Virvou & Kabassi 2000).

Indeed IFM may provide an environment where novice users would be more protected from their errors and would have more informative advice from the system. In this way they could become familiar with file manipulation programs and thus learn how to use them. IFM can be used for teaching purposes in student computer labs. Each student can give a password so that s/he may get individualised support.

IFM has been developed based on an object oriented life cycle model, the Rational Objectory Process (Quantrani 1998; Kruchten 1999), which supports many iterations of the development phases. A first prototype of IFM has been completed (Virvou & Stavrianou 1999). Its design originated from another system called RESCUER that was meant to provide assistance to users of command language interfaces, such as the interface of UNIX (Virvou 1998; Virvou & Du Boulay 1999).

In order to enhance the design, the first prototype of IFM was evaluated. As (Dix et al. 1993) point out, evaluation is an integral part of the design process and should take place throughout the design phase of the life cycle; most techniques for evaluation at this stage are analytic and involve using an expert to assess the design against cognitive and usability principles. Evaluation of the design of IFM, at this stage, was conducted through an empirical study. Ten human experts commented on the actions made by users of a standard manipulation program (Windows 98/NT Explorer). The human expert's reactions were then compared to IFM's recommendations. All of the human experts who commented on user actions had a first and/or higher degree in Computer Science and had ~~used~~ extensively used programs like a standard file manipulation program. Many of them had also teaching experience related to the use of such programs in computer labs.

The users who participated in the empirical study were both expert and novice. The experts who were involved as users were different from the experts who were used to comment on users. All users were asked to work with a standard file manipulation program, as they would normally do. Computer logging was used to record all users' actions during their interactions with the system. Computer logging has been used in evaluating user interface designs for a long time (Bradford et al. 1990). The major advantages of computer logging are that it automatically and continuously collect objective data for further analysis and interpretation and does not interfere with users during their interactions with a system (Chou 1999).

The collected user protocols were passed on to the 10 human experts so as to analyse them. All of the human experts gave their comments on every user's action. One of the aims of this kind of analysis was to find usability problems of a standard Explorer, through heuristic evaluation (Nielsen 1994). In particular, human experts were asked to focus on two usability heuristics specified by Nielsen:

1. Error Prevention.
2. Help users recognise, diagnose and recover from errors.

Therefore, the human experts' comments should include whether they thought that the user had made an error and what sort of advice they would give to these users to recover from their errors. Hence, the empirical study revealed a lot of usability problems of a standard file manipulation program in terms of user errors.

Half of the user protocols were also given as input to IFM at that stage. IFM's reactions were compared to the human experts' comments. The conclusions from this comparison were used for the construction of a second executable release of IFM. In the second release, IFM's knowledge base was enriched with categories of error that IFM could not recognise in the previous release.

A formative evaluation of the second executable release of IFM involved the rest of the user protocols, which had been collected during the empirical study, were commented by the human experts but were not used for the requirements specification of the second executable release of IFM. In most cases, IFM's reactions were ~~found~~ similar to the comments made by the majority of human experts at this stage. However, some limitations were also identified. These limitations are meant to be addressed in the third executable release of IFM.

Life Cycle of IFM

In the development of IFM, the iteration of several phases of the development was considered crucial. Therefore the Rational Objectory Process formed the basis for the life cycle of the system. Using the Rational Objectory Process, an iterative development is advocated, in which the architecture is actually prototyped, tested, measured, and analysed, and then refined in subsequent iterations (Kruchten 1995). Rational Objectory Process divides the software life cycle into cycles, each cycle working on a new generation of the product. The process divides one development cycle in four consecutive phases: the inception, the elaboration, the construction and the transition phase (Quantrani 1998; Kruchten 1999).

In the inception phase, a primary executable release of IFM was developed (Virvou & Stavrianou 1999). In the phase of the elaboration an empirical study was conducted involving a number of expert and novice users. All users were asked to work with the regular Windows 98/NT Explorer for two hours. While working, the system was monitoring users' actions without interrupting them. The user actions were recorded using the computer logging method and then were analysed in order to identify the errors that users make while completing certain tasks. Human evaluators, using the video recording method observed the commands that the users issued during their interaction with the regular explorer and wrote down their comments about each action. The empirical study showed the misconceptions users have while navigating through the Windows 98/NT Explorer and which were not identified by the previous version of IFM. Based on the results of the empirical study, the extension of the design of IFM was described.

In the construction phase, the primary executable release of IFM was expanded based on the limitations of IFM that were identified during the empirical analysis. In the phase of elaboration, a formative evaluation of the second executable release of IFM was conducted. The outcome of the construction phase is a product ready to be used by its end-users (Quatrani 1998; Kruchten 1999).

Design of IFM's Primary Executable Release

IFM constantly reasons about users' actions, so that it can diagnose problematic situations and give advice concerning users' errors. As Cerri and Loia (1997) point out, if error diagnosis is to be performed, a user modelling component should be incorporated into the system. Therefore, IFM has a user modelling component that generates hypothesesis about users' intentions and possible errors. However, there may be ambiguities about errors, since there may be different explanations of observed incorrect users' actions (Mitrovic et al. 1996). Ambiguity resolution about errors is done in IFM by using two different reasoning mechanisms: a simulator of human error generations and a limited plan recognition mechanism.

The simulator of human error generations is based on a cognitive theory that attempts to formalise the reasoning that people use. This theory is called Human Plausible Reasoning (Collins & Michalski, 1989). Intelligent File Manipulator uses an adaptation of this theory to simulate possible errors of a user. For example, if a user has clicked on a certain file having a certain name s/he could be considered to have intended to click on a different, similarly named, file.

The limited plan recognition mechanism is used by the system to improve control and is based on what we call "instabilities". Every user action is categorised in one of four categories, namely expected, neutral, suspect, erroneous, depending on its degree of compatibility of the users' hypothesised intentions. For example, an action is considered "expected" if it deletes instabilities. Instabilities are added and/or deleted from a list as a result of user actions. Instabilities are deleted when an action results in a file store state that should not contain them. In this sense the deletion of an instability represents the continuation of a user plan that started earlier. In the current implementation, a file store is considered to be absolutely stable if it does not contain:

1. empty directories
2. directories with only one child
3. multiple copies of a certain file
4. folders with the name 'New Folder'
5. files with the name 'New File'
6. a file placed in clipboard by a cut or copy command and not have further use.

Empirical Study

The empirical study involved 15 users. Among them, 7 users were novice and 8 users were experts. These users were given a program that was very similar to a standard Explorer and were asked to use it, as they would normally do. Computer logging was used to capture their actions in video, so that the human experts would be able to watch and comment them. 10 human experts were involved in the empirical study, in order to comment on the 15 users. All 10 experts commented on all 15 users. In some cases all of the experts made the same comment and suggested the same replacement command. In these cases we have 100% agreement of experts. In other cases there was a diversity of opinions. (Tab. 1) illustrates an example of a user protocol, among the ones collected, together with the comments that the majority of experts provided. The experts had actually seen the exact user actions, e.g. clicking on a certain object, dragging a selected object, and so on. However, for the purposes of illustration of the example in limited space, we use the meaning of each action rather than showing the exact screenshots.

USER ACTIONS	HUMAN EXPERTS COMMENTS
1. Copy(A:\House2\Room2\)	S/he wants to copy the folder A:\House2\Room2\
2. Copy(A:\House1\)	100% suggested the replacement command Paste(A:\House1\)
3. Paste(A:\House1\)	With this action, the following error message has occurred 'The destination folder is the same as the source folder'
4. Copy(A:\House2\Room2\)	S/he wants to copy the folder A:\House2\Room2\
5. Paste(A:\House1\)	S/he wants to paste the copied folder in A:\House1\
6. Delete(A:\House2\Room2\)	S/he wants to delete the folder A:\House2\Room2\
7. Delete(A:\House1\book.bmp)	S/he wants to delete the file A:\House1\book.bmp
8. Delete(A:\House1\Room1\)	89% suggested the replacement command Delete(A:\House2\Room1\)
9. Mkdir(A:\House3\)	100% suggested the replacement command Mkdir(A:\House2\)
10. Del(A:\House3\New Folder\)	S/he wants to delete the new folder that was created by mistake

Table 1: A real Explorer-user interaction with the comments of human experts

One of the aims of the empirical study was to identify the most frequent errors that expert and novice users may make while interacting with a standard Explorer. Another aim of the empirical study was to compare the human expert comments to IFM's reactions, in order to identify IFM's limitations. These would lead to further requirements specifications for a second version of IFM. Therefore, half of the protocols were given as input to IFM, in order to evaluate IFM's reactions, in comparison to the human expert comments.

Some conclusions drawn from the empirical study, were the following:

- Users, expert or novice, tend to reproduce the same mistakes over and over. Therefore, user profiles can be very useful for providing individualised help.
- Evaluation of user auditing's results showed that expert users generally make different types of mistakes than novice users. Consequently, we propose a different user approach, taking in consideration a user's level of experience. Empirical study has revealed that novice users are usually very careful but make mistakes due to lack of knowledge, whereas expert users tend to be very confident but careless. This results in different categories of errors. For example novice users are prone to command selection and/or execution mistakes and experts usually confuse neighbouring objects with similar names.
- Frequent error categories, among the ones identified, are the following:
    1. Users tend to forget to rename a new object (e.g., a folder or a text file) from the default Windows name (e.g. 'New Folder', 'New Text Document'). This results in a mess of identically named objects in the file store.
    2. Another error is that users often *copy* or *cut* one or more files but they do not know how to complete the move or copy operation. Finally, users tend to *paste* the same group of files to more than one location.
    3. Some of the recognised errors are believed to result from the novice users' lack of knowledge of the regular Explorer's structure. For example, they tend to confuse the parent folder at the left part of the Explorer with the folder shown at the right part of the program.
    4. Another significant error category, committed by both novice and expert users, concerns the deletion of objects. This error category is considered dangerous because the results of such an error can be devastating. Users often delete a folder whose content they are not aware of. A subset of this category concerns users that delete an object after they have copied it, though have not pasted it.
    5. Another conclusion derived from user auditing concerns object similarities, namely, the case when a user confuses an object with another. Users may mistake an object for another if they are neighbouring objects, or in case of objects with similar names. In the latter case, similarities in terms of names may be categorised.

The comparison of the human expert comments to IFM's reactions showed that in cases where IFM had diagnosed an error, it had also been successful at generating advice, which was similar to the majority of the experts' advice. However, a lot of limitations of IFM were also identified. These resulted in the enhancement of IFM's design, as explained in the following section.

Design Extension after the Empirical Study

The conclusions drawn from the empirical study were used for the extension of IFM's design. The results are described below.

1. New Instabilities added

   A. Observation: Users often neglect to provide a name for a new object.
   Addition: An instability is added in case of the creation of a new object. This instability is removed when the user renames that object.

   B. Observation: Users often tend to leave a copy/cut - paste task incomplete.
   Addition: An instability is added when a user performs the copy or the cut part of the task that places something new in the clipboard. In order to delete such an instability, the user has to perform a paste command.

   C. Observation: The user performs the paste part of a copy/cut-paste action more than one time.
   Addition: A new instability is added every time a user performs a paste command for the same object. Such an instability is removed when one of the objects being pasted has been modified.

2. Potential Deletion Errors Detected
   A. Observation: Users often do not pay great attention to the contents of a folder that is placed deeply in a path and this results in deleting objects without realising.
      Addition: IFM is constantly monitoring the user throughout his/her navigation. If the user has not visited the folder containing an object to be deleted, then the system considers the action suspect and informs the user. Otherwise, the deletion action is being performed without further notice.
3. Users' misconceptions
   A. Observation: Users often make mistakes due to neighbouring location of objects
      Addition: A new category of error was introduced, to detect erroneous actions that are caused by users' misconceptions about either neighbouring objects or objects with similar names.
4. Users' behavior
   A. Observation: Users reproduce the same mistakes.
      Addition: In order to have more individualised user advice, IFM keeps a long term user model, which consists of long term information about a user (Rich 1979; Jones & Virvou 1991). The long term user model holds the individual features of the user, that have been recorded in previous interactions, so that IFM can diagnose and provide advice in a more precise way.
   B. Observation: Users issued more commands than those included in the domain representation of IFM's primary design.
      Addition: The domain representation was extended to include several new commands.

Evaluation of IFM

IFM's second executable release was evaluated using half of the protocols collected during the empirical study. Again the human experts' comments were compared to IFM's reactions. (Tab. 2) illustrates the protocol example that was presented in the previous section. However, this time in the second column we show how IFM categorised each command of the protocol. In case a command was characterised as suspect or erroneous, IFM generates alternative commands and suggests the user to replace the issued one with the new one. In the third column, we give the degree of compatibility of IFM's suggestions to the human experts' suggestions for a particular command.

USER ACTIONS	IFM SUGGESTION	DEGREE OF COMPATIBILITY WITH THE COMMENT OF THE MAJORITY OF EXPERTS
1. Copy(A:\House2\Room2)	A neutral command	
2. Copy(A:\House1\)	A suspect command, IFM suggested the alternative command Paste(A:\House1\)	100%
3. Copy(A:\House2\Room2\)	A neutral command	
4. Paste(A:\House1\)	An expected command	
5. Delete(A:\House1\Room1\)	A suspect command, IFM suggested the alternative command Delete(A:\House2\Room1\)	100%
6. Delete(A:\House2\Room2\)	An expected command	
7. Delete(A:\House1\book.bmp)	A neutral command	
8. Delete(A:\House2\Room1\)	An expected command	
9. Cut(A:\House1\Room1\)	A neutral command	
10. Paste(A:\House2\)	An expected command	
11. Mkdir(A:\House3\)	A suspect command, IFM suggested the alternative command Mkdir(A:\House2\)	100%

Table 2: IFM's reasoning on a sample of a real Explorers' user interaction

IFM was quite successful at achieving a high degree of compatibility with the experts' advice. However, in many cases there were a lot of alternative commands that IFM generated. In most of these cases, one of the alternative commands was compatible with the suggestion of the majority of the experts. Still, the limitation of the generation of many alternatives needs to be addressed in a subsequent executable release of IFM.

Conclusions

The empirical study conducted within expert and novice users of a standard file manipulation program has revealed a lot of usability problems of such programs. The incorporation of intelligence can indeed enhance a GUI in terms of user error prevention and recovery. IFM incorporates intelligence and provides spontaneous assistance to users.

IFM's reactions as compared to the human experts' comments who took part in the empirical study showed that IFM can reproduce a great deal of the human expert advice. However, there are still some limitations that need to be addressed in a subsequent version of IFM. One important limitation is that IFM generates too many alternative commands to be shown to the user in case it diagnoses that there has been a problem. This problem can be addressed by extending IFM to include a subsystem that would calculate certainty degrees about alternatives so that these can be ranked before being presented to the user.

References

Bradford, J. H., Murray, W. D., & Carey, T. T. (1990). What Kind of Errors do Unix Users Make? *Proceedings of IFIP INTERAAACT'90 Third International Conference of Human-Computer Interaction* (Cambridge, U.K., 27-31 August). 43-46.

Cerri, S. A., & Loia, V. (1997). A Concurrent, Distributed Architecture for Diagnostic Reasoning. *User Modeling and User-Adapted Interaction*, 7(2), 69-105.

Chou, C. (1999). Developing CLUE: A Formative Evaluation System for Computer Network Learning Courseware, *Journal of Interactive Learning Research*, 10(2).

Collins, A., Michalski R. (1989). The Logic of Plausible Reasoning: A core Theory. *Cognitive Science* 13, 1-49.

Dix, A., Finlay, J., Abowd, G., & Beale, R. (1993). *Human-Computer Interaction*, NY: Prentice-Hall.

Jones, J., Virvou, M. (1991). User modelling and advice giving in Intelligent Help Systems for UNIX. I*nformation and Software Technology*, 33, 121-133.

Kruchten, P. (1995). The 4+1 View Model of Architecture. *IEEE Software,* 12 (6), 42-50.

Kruchten, P. (1999). *Rational Unified Process-An Introduction*, Addison-Wesley.

McGraw, K., L. (1994). Performance Support Systems: Integrating AI, Hypermedia and CBT to Enhance User Performance. *Journal of Artificial Intelligence in Education*, 5 (1), 3-26.

Mitrovic, A., Djordjevic-Kajan, S., Stoimenov, L. (1996). INSTRUCT: Modeling students by asking questions. *User Modeling and User Adapted Interaction*, Vol. 6, No. 4, pp. 273-302.

Nielsen, J. (1994). *Usability Inspection Methods*, John Wiley, New York.

Quatrani, T. (1998). *Visual Modeling with Rational Rose and UML*, Addison-Wesley.

Rich, E. (1979). User Modelling via Stereotypes. *Cognitive Science*, 3 (4), 329-354.

Virvou, M. (1998). RESCUER: Intelligent Help for Plausible User Errors. *Proceedings of ED-MEDIA, ED-TELECOM 98, World Conference on Education Multimedia and Educational Telecommunications,* 2, 1413-1420.

Virvou, M. (1999). Automatic reasoning and help about human errors in using an operating system. *Interacting with Computers*, 11(5), 545-573.

Virvou, M., & Du Boulay, B. (1999). Human Plausible Reasoning for Intelligent Help. *User Modeling and User Adapted Interaction,* 9, 321-375.

Virvou, M., & Stavrianou, A. (1999). User Modelling in a GUI. *Proceedings of the 8th International Conference on Human-Computer Interaction (HCII 99)*, Munich, Germany, 1, 262-265.

Virvou, M., & Kabassi, K. (1999). An Intelligent Learning Environment for Novice Users of a GUI. To appear in *Proceedings of the 5th International Conference on Intelligent Tutoring Systems(ITS'2000)*, Montreal, Canada.

TeamCMU: An Electronic Toolset For Collaborative Development Projects

Randy S. Weinberg
Carnegie Mellon University
Social and Decision Sciences
5000 Forbes Avenue
Pittsburgh PA 15213
rweinberg@cmu.edu

Diana Bajzek
Carnegie Mellon University
Technology Enhanced Learning Lab
5000 Forbes Avenue
Pittsburgh PA 15213
db33@andrew.cmu.edu

Abstract: TeamCMU is an electronic toolset developed to support team collaboration and learning in team oriented, project based university level courses. It was developed to meet the needs of student teams and instructors efficiently and at low cost. TeamCMU provides most of the electronic support that work groups expect and need, but is highly configurable, easy to use, flexible, low cost, low maintenance, and portable.

Introduction

TeamCMU was developed at Carnegie Mellon University to meet the need for an enabling, electronic environment that supports learning through both theoretical and experiential exposure to complex team assignments and team processes. TeamCMU is an electronic, web based, integrated, easy-to-learn and easy-to-use software environment that supports collaboration and communication within and among student project teams. It is intended to provide students with the electronic support they need to develop complex systems projects. It was developed to meet the needs of student teams and instructors efficiently and at low cost. TeamCMU provides most of the electronic support that work groups expect and need, but is highly configurable, easy to use, flexible, low cost, low maintenance, and very portable.

Today's workplace increasingly emphasizes teamwork, especially in technical fields such as information systems. Employers of new college graduates in information systems, software engineering, technical communications and related areas value students' experiences working as members of a team. Academic classroom settings, however, have traditionally been successful in providing students with the theory and practical skills needed for small individually completed development projects. Students often have not had appropriate learning opportunities and skill-building support for larger team-based projects and, as a result, do not usually bring practical collaboration skills into the workplace.

At Carnegie Mellon University, students majoring in Information and Decision Systems, Technical Writing, Public Administration and many other disciplines complete substantial, live-client team projects as part of their courses. Students in these project courses deal with all of the challenges common to student project teams - difficulty coordinating schedules, synchronizing and stabilizing their work products, and communicating effectively with each other (Phan & Weinberg 1995). To complete their work successfully, however, members of software development teams must learn to successfully manage their time, their work products, and their interactions with fellow team members and their sponsoring clients. Effective coordination, communication, and use of shared resources are crucial skills for team members to master. The use of high quality electronic tools to support development team efforts can play an important and useful role in facilitating successful team collaboration and project development as discussed in (Humphrey 1997). With few commercial toolsets readily available, however, most project teams have had to rely on standalone products and email for effective coordination and communication of their work activities and work products.

The TeamCMU Project

Using TeamCMU, students gain familiarity and experience with the types of electronic support tools they will use on the job. Because the tools included in the TeamCMU environment are easily mastered, students can be productive with a minimum of training or faculty support services. Students gain valuable exposure to the types of team support environments they will find in industrial and governmental software development practice.

Additionally, TeamCMU includes facilities to support faculty needs in teaching projcct based courses. Faculty who use TeamCMU in their courses also gain experience in managing electronic communications in an organized way, reducing the need for email and other forms of communications with class members. The emphasis in the first version of the toolset is on team organization, communications, and process for software development project teams. Later versions will provide support for project management and project tracking.

The toolset is rich in useful features, flexible and extensible and provides support for both student teams and faculty. For student team members, the initial version of TeamCMU includes

- personal calendars
- team calendars
- course calendars
- secure server space for team work products
- version and access control with check-out and check-in protection
- time sheets for recording work hours
- meeting agendas and minutes
- discussion boards for course, team and client communications.

All facilities of TeamCMU are accessible to students from a homepage configured by the faculty in charge of the course. Because all communications and artifacts relating to a project are maintained and organized in a logical, cohesive way, TeamCMU reduces the need for members to communicate and share documents and electronic artifacts via email and other means. The TeamCMU project URL is : http://www.cmu.edu/acs/telab/teamcmu/.

TeamCMU helps keep students in team-based project courses focused on accomplishing educational objectives. Students easily learn the tools and apply them to their group project assignments. We expect students to benefit from use of the toolset in several ways: reduced process time, better coordination of team resources, enhanced communication among themselves and with their instructors, and reduced rework. Further, in the case of the Information and Decision Systems curriculum, it is expected that the students will mature in their use of the toolset during their junior and senior years, showing increased team integration, effectiveness and competence.

For faculty, Team CMU includes configurable links to supporting course documents including syllabus, course description, and faculty information. It also includes an announcement board for posting important course related information and assignment boards which enable students to submit time-stamped assignments electronically and securely. Faculty are permitted to access each team's public workspaces and discussion boards to view project progress and assess toolset usage. Further, the toolset includes background, passive instrumentation for faculty assessment and evaluation of toolset usage and team effectiveness. With minimal modification, individual faculty can tailor the toolset by adding additional features as needed.

To promote communications among faculty, two special teams exist - a faculty team consisting of all faculty members established in the toolset's installation and course-faculty teams consisting of all faculty members jointly teaching an individual course. Faculty in these teams may share documents and communicate using the same facilities as the student team members.

An important design objective has been to make the toolset very convenient and easy to learn and use for both faculty and students. The interface to the toolset requires only a web browser and a single login to provide authenticated access. Consistent with our design objectives, we have selected customizable components that are affordable, portable, extensible, and easily maintained. We have selected these components with an eye toward easy substitution as future technologies evolve and become available. Thus, the toolset itself is based on established web based, nonproprietary technologies – HTML, cgi scripting via perl, and SQL databases. To keep the toolset development costs and complexity down, some of its internal components are low-cost licensed software components and custom created databases.

TeamCMU can be customized or extended to meet the needs of a wide variety of individual instructors and individual courses. The tools will support the needs of faculty in evaluating student learning of content and process and in providing appropriate feedback grounded in the student's work. For faculty assessment and evaluation of student teamwork, special modules provide administrative capabilities as well as online support for administering and collecting assignments, work products, periodic surveys, weekly hours-worked time sheets, peer assessments, and other research instruments. Faculty will be able to track project status and progress and follow team communications, as the majority of the team communications will be posted electronically. As students learn to use the tools and follow established team management procedures such as structured meeting management principles, more information will be accessible to the faculty. Grading for team projects will be enhanced based on factual information gathered from and via the toolset. Instrumentation built into the toolset will allow researchers to learn more about patterns of usage.

Over time, TeamCMU will be incorporated into numerous courses that teach or require skills in process management, team management and team organizational skills. We hope to use TeamCMU as a vehicle for better understanding how electronic tool support can enhance the teaching and learning process. While our initial efforts have focussed on supporting the needs of software development teams, the toolset was developed with a view toward more general applications for project teams, curricula, and content of various disciplines. Additional development in the future will support differing team-based methods used in other project courses.

Two departments at Carnegie Mellon University introduced TeamCMU into their courses as a pilot test during the Fall Semester, 1999: Information and Decision Systems (IDS) with two courses and Master of Professional Writing Program (English) with one course. Target courses are Fundamentals of Systems Development (a junior-level IDS course with 90 students), Information System Applications (a senior-level IDS course with 70 students), and Writing for Multimedia (a masters-level English course with 25 students). Other departments will be using the toolset during Spring Semester, 2000. After successful completion of the pilot testing during AY 1999-2000, the toolset will be made freely available to the Carnegie Mellon academic community with an eye toward wider dissemination in the future.

References

Humphrey, Watts (1997). *Managing Technical People: Innovation, Teamwork, and the Software Process.* Reading, MA, Addison-Wesley.

Phan, D. D. and Weinberg, R. S. (1995). Survey of Group Collaboration Efforts in Information Systems Projects. Proceedings of the 1995 ACME International Conference, Minneapolis, MN.

Acknowledgements

This project was funded, in part, by a grant from the US Department of Education.

The development TeamCMU was a collaboration between Randy Weinberg - faculty in Social and Decision Sciences – and Diana Bajzek, Director of the Technology Enhanced Learning Lab (TELab) a faculty resource center in the central Computing Services Division of Carnegie Mellon University.

Taking Our Own Medicine: Learning "Learning with Multimedia" with Multimedia

Martin Wessner[1], Cornelia Seeberg[1,2] & Ralf Steinmetz[1,2]

[1]Integrated Publication and Information Systems Institute (IPSI)
GMD - German National Research Center for Information Technology
Dolivostr. 15, D-64293 Darmstadt, Germany

[2]Industrial Process and System Communications (KOM)
Department of Electrical Engineering & Information Technology
Darmstadt University of Technology
Merckstr. 25, D-64283 Darmstadt, Germany

E-Mail: {wessner, seeberg, rst}@darmstadt.gmd.de

Abstract: In this paper we present the design of a course on multimedia-based learning and a case study carried out at the Darmstadt University of Technology. We describe the course, the interdisciplinary audience and the employment of computer-based communication and cooperation. In more detail we introduce VITAL, a computer-supported cooperative learning environment. We state the results of the evaluation of the course. Finally, we come to the conclusion that by using the computer as a communication and cooperation medium new forms of discussion arise which have more of a brainstorming character than a continuous coherent discussion.

1. Introduction

Currently, we are experiencing a boom in demand for the use of multimedia technology to support teaching and learning at various levels of education and training. Multimedia technology (we use this term in short to refer to multimedia, hypermedia and telemedia technologies) is a basis for enabling new forms of teaching and learning in domains such as virtual universities, distributed organisations and life-long learning.

In order to qualify students for designing multimedia learning units and environments we developed a seminar on "Learning with Multimedia" which is based on the following principles:

- Learning about new technologies in education should take place not only by hearing and reading about these technologies but by using learning software based on these technologies.
- Knowledge about learning with multimedia should not be learned isolated but embedded in an authentic context.
- The task of designing and realizing multimedia learning units and environments is complex and usually done not by a single person but by a team.
- These teams should consist of experts of various disciplines, e.g. computer science, pedagogy, and media design.

The course on "Learning with Multimedia" addresses these principles:

- The course includes lectures about educational technology as well as hands-on learning experiences.
- The learning software is used to learn about the content of the course - "Learning with Multimedia"
- During a larger part of the course the students work in small groups (2-5 members) on the task of designing a lesson about a specific subtopic of "Learning with Multimedia".
- Students participating in the course should have a background in a related discipline, such as pedagogy, computer science, psychology, or media design.
- In addition, seminar tutors should (re)present multiple perspectives on the topic, in order to foster interdisciplinary work in the teams.

In sum, our goal was to create a harmony between the content of the course and the methods used to deliver it. The ideal course should provide hands-on learning experiences punctuated with short demonstration and discussion sessions. At the end of the course, participants should be able to judge and design multimedia-based instruction.
The remainder of this paper is structured as follows: In the next section we describe the course "Learning with Multimedia". Then we sketch the virtual learning environment VITAL and the ways we used VITAL during the course. In section four we present some results of our evaluation based on interviews and questionnaires.

2. Course Description

The seminar took place in the summer term of 1999 at the Darmstadt University of Technology, Germany, lasting three months and taking two hours per week. The aim of the course is to learn about and discuss the basics of multimedia-based learning. The students are supposed to actively contribute to the seminar. The curriculum comprises the topics of learning with multimedia, web-based learning systems, tele-teaching, computer-supported cooperative learning, learning processes supported by computers, and new forms of teaching and learning. For this specific course the audience consisted of 15 students, ten with a more technical background (computer science and electrical engineering) and five with a pedagogical background. The lecturers of this course were also interdisciplinary: one with both a computer science and a pedagogical degree and one with a degree in Mathematics and Linguistics. The intention of the lecturers of this course was to teach the topics not only in a theoretical way but to give the students real experiences with these programs etc. The seminar was supposed to integrate the content with the way in which it was taught.

The students were divided into five interdisciplinary teams of three students each. Three of the teams included pedagogic students. These teams had two tasks: They each had to develop a lesson about one of the following topics:

- Hypertext learning system
- Cooperative learning methods
- Characteristics of geographically distributed learning
- Communication in CSCW (computer-supported cooperative work) / CSCL (computer-supported cooperative learning) systems
- Comparison of commercially available CD-ROM learning systems for Mathematics in elementary school
- Visualization with interactive simulations

The second task was to generate these lessons with computers and to present them as a computer program. To support communication and cooperation both within the teams and within the whole group

the students were asked to use the virtual learning environment VITAL which is described below in detail.
(The lecturers were aware of the self referencing: A seminar about multimedia-based learning were the students are supposed to work in a multimedia-based way on producing lessons about multimedia-based learning.)

The course started with four group sessions. The students were given an overview about the technical and pedagogical problems concerning multimedia-based learning, and an introduction to the VITAL system. This period was followed by three weeks of team work. During this time, VITAL served as a blackboard for announcements and references to literature. The students were invited to come to the course room and, if needed, seek for advice from the lecturers, but had to find their own way of working within the groups. After this period, the intermediary results of each team were presented to the other groups. Here, problems concerning information retrieval, using VITAL, finding a common language between the disciplines, selecting the suitable sections to present in a lesson etc. were discussed. After another week of team-work the final presentations were made.

During the period of working in a team, the students had diverse possibilities to communicate. They could meet face-to-face either with or without a lecturer, they could telephone, email, use the chat tool of VITAL, or employ the learning repository provided also by VITAL. Some of the groups communicated nearly exclusively via the computer environment, and some groups used more the traditional means including email.
Also the final presentations were performed differently by the various groups. One team, having used exclusively VITAL all the time, used also VITAL as a presentation tool. Others did not use a computer for the presentation at all. The team preparing the lesson about learning with hypertext presented their results as hypertext. The discussion about this took place as an asynchronous session within VITAL. For ten days this hypertext system was part of the World Wide Web and each student had to read it and had to take part of the on-line discussion.

3. The Virtual Learning Environment VITAL

The course design included the provision of rich opportunities for the students and the lecturers to communicate and cooperate during the course. In addition to standard communication means such as phone, email and the world-wide web, we used the virtual cooperative learning environment VITAL (for Virtual Teaching And Learning) developed at GMD-IPSI (Pfister et al. 1998). VITAL aims to support small and medium sized teams of adult learners. Its main objective is to enable users to learn about a large range of topics (i.e., VITAL is domain-independent) by providing a virtual environment and a set of tools that are intuitive to use and conducive to the coordination, communication and cooperation processes that are typical for learning.

In VITAL, all users work with *cooperative hypermedia documents*. They can view documents and create new ones of arbitrary complexity by means of introducing new links. Users live in so-called *virtual rooms*, which make up the *learning world*. Virtual rooms provide a metaphor that serves the purpose of supporting orientation and group-awareness in the learning environment. Users who occupy the same room have the same view on the presented material, they are aware of each other, can communicate with each other, and they are able to cooperatively manipulate documents. Virtual rooms are especially useful for providing smooth transitions between synchronous and asynchronous modes of learning, since persons in the same room have full group-awareness for synchronous work, but objects (texts, pictures, etc.) remain persistent in a room for later asynchronous work. Figure 1 shows some major components and functions of VITAL.

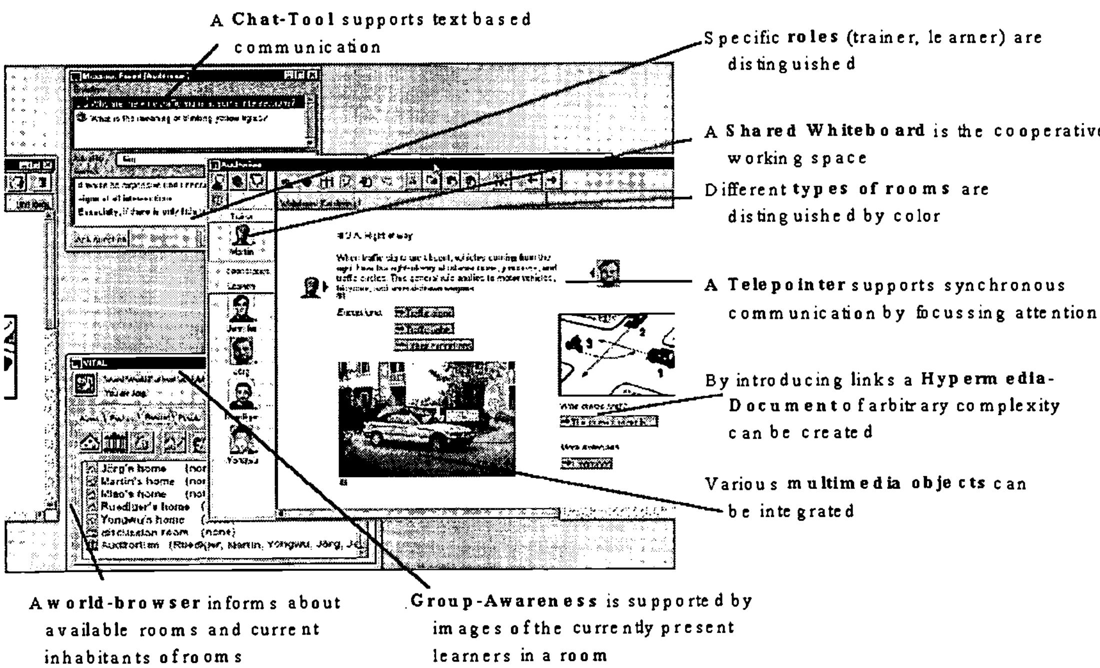


Figure 1: A VITAL auditorium window, a chat window, and the world browser

As can be seen in Figure 1, most of a virtual room consists of a shared whiteboard, where users can cooperatively view and create hypermedia documents. Group-awareness is supported by showing images of all persons currently in a room, and by using personalized telepointers. Synchronous communication is performed via a chat-tool, or by an audio connection. (The latter was not used in the case study because of technological constraints). Asynchronous communication is performed either by sending emails or by leaving text-messages on the shared whiteboard.

VITAL provides three types of virtual rooms: (i) *private homes* for individual study, (ii) *group rooms* for discussion and self-organized cooperative learning, (iii) *auditoriums* for presentation and teacher-guided learning. In an auditorium, two roles are distinguished, that of a learner and that of a trainer. The trainer controls the learners' access to the material presented as well as to the cooperation tools.

In the remainder we focus on the following three usage scenarios of VITAL in the course:

- Synchronous distributed group work:
  Students meet in virtual group rooms and communicate via the VITAL chat tool. The chat tool provides only text-based communication. In addition learners can refer to material on the shared

whiteboard in the virtual room. The room also provides awareness of the other inhabitants of the room by the way of small pictures for each learner (see Figure 1).

- Asynchronous presentational discussion:
  The students use the learning environment for discussion by sticking their contribution at an arbitrary position on the whiteboard in the virtual group room used for the discussion. Technically students add a link to another hypermedia page. This link can be labeled to express the core idea of the contribution. The referred hypermedia page can contain information in various formats such as text, pictures, and tables.
- Learning repository:
  In this scenario VITAL is used as a persistent storage of arbitrary information. Thus, teams can deposit (intermediary) results for their colleagues or the tutors in their group room, the tutors can announce up-to-date information, provide references to the literature, e.g., in an auditorium, and monitor the progress of the group.

4. Evaluation

The evaluation of the course consisted of student interviews at the beginning and at the end of the course, and questionnaires in the middle of and at the end of the course.

An initial interview about their motivation to select this course discovered two main reasons for course selection:
The reason which was given by most of the participants was the interdisciplinary character of the seminar. The participants were curious about learning and working with students from another academic background. The second-most common reason was their interest in learning more about the topic of computers and learning.

In the middle and at the end of the course questionnaires were used to gather data from the students. The questionnaire consisted of 14 questions concerning the individual work and the team-work, the usage and usefulness of the communication and cooperation tools as well as of the tools for the realization of the team projects. Another set of questions addressed the satisfaction of the students with their group, the course, and the results of the individual work and the team-work. Due to the small sample size, all quantitative results should be taken as purely descriptive information (no statistical test were performed). Selected results are presented in Figure 2.

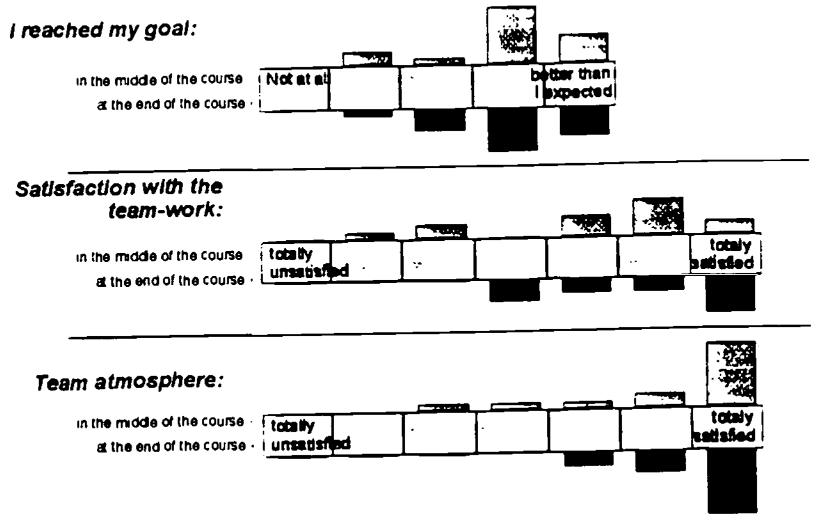


Figure 2: Selected questionnaire results

The general acceptance of the course, the groups and the results was rated as fairly high. With respect to the usage of the tools, results are more mixed. Though students generally had a positive attitude towards the tools a few students had serious technical problems.

In addition to the quantitative questionnaire interviews with the students were conducted. The issues can be grouped in the following way:

- The interdisciplinary constitution of both the complete group and the teams provided some difficulties but very positively effected the methods and the results of the team-work and the course as a whole.
- The sequence and the proportion of sessions with the whole group and periods of team-work was perceived differently by various students. A trade-off between the depth and quality of team-work and of the work in the course with the whole group was detected.
- The computer-supported communication and cooperation was different from earlier experiences of the students.

In the following, we concentrate on the last issue:
The students described their experiences with the computer-based communication and cooperation during the phases of team working. Three kinds of such a communication were used:

- Synchronous distributed group work: Two groups never used this possibility. One team used it quite a lot for social chat but not for issues concerning the course. Two groups communicated via the chat tool occasionally. Both complained that it is laborious not only to type everything instead of just speaking, but to have to make explicit that which in a face-to-face discussion is expressed by mime or gestures. There was also a problem of sequencing since there were three students in each team and it was not always clear who answered whom. Nevertheless, the students judged this kind of communication of high value, when used for organizational matters.
- Asynchronous presentational discussion: Many of the students were disappointed by the standard of the discussion. Whereas they liked the fact that each student and both of the two lecturers joined

BEST COPY AVAILABLE

the discussion, they remarked that the contributions are not intertwined, but rather disjointed statements.

- Learning repository: The usage of this component was not uniform. One team split their task into three subtasks. Each student solved one of the subtasks and placed her/his results into the repository. The others read and debated this contribution. They met only occasionally. Another group used it to exchange literature. However, the other three groups did not employ the learning repository. One reason for this was the limited word processing facilities as well as the limited number of import/export facilities provided by the system.

Based on the results of the quantitative and qualitative evaluation of the case study we come to the following conclusions:

- Traditional forms of discussion cannot be transferred easily into virtual learning environments.
- Synchronous creative, productive discussions are quite hard and should be avoided for groups of more than two or three members. However, arrangements are made much easier than by telephone as soon as more than two people are involved.
- Asynchronous discussion of a bigger group based on a thesis or a work known to everybody, has more of a brainstorming character and should only be used for this purpose.
- Repositories make sense when they are integrated in the existing tools. Then they are very helpful for exchanging documents and for giving external users an impression about the status of the ongoing work. They also serve very well as blackboards for announcements and background information.

The results match to evaluation results of other courses in which the learning environment VITAL was used in a different setting during a synchronous lecture (Pfister, 1999). For the next run of the course, we plan to replace VITAL by its successor, the CROCODILE system. The CROCODILE system provides so-called learning protocols (Wessner et al., 1999) which help the learners to structure their cooperative learning process.

5. References

Pfister, H.-R., Wessner, M., Beck-Wilson, J., Miao, Y., & Steinmetz, R. (1998). Rooms, protocols, and nets: metaphors for computer-supported cooperative learning of distributed groups. Proceedings of the Third International Conference on the Learning Sciences *(ICLS-98), Dec. 16-19, 1998. Georgia Tech, Atlanta,* 242-248.

Pfister, H.-R., Wessner, M., Holmer, T & Steinmetz, R. (1999). Evaluating distributed computer-supported cooperative learning (D-CSCL): A framework and some data (pp. 234-241). Proceedings of the 2nd International Conference on New Learning Technologies, University of Berne.

Wessner, M., Pfister, H.-R., & Miao, Y (1999). Using Learning Protocols to Structure Computer-Supported Cooperative Learning. In: Proceedings of the ED-MEDIA'99 - World Conference on Educational Multimedia, Hypermedia & Telecommunications, pp. 471-476, Seattle, Washington, June 19-24, 1999

Acknowledgements

We would like to thank all participants of the course, especially Maike Gilliot and Clara Möller, for their enthusiasm and high degree of patience (with us and with themselves). We would also like to thank our colleagues at GMD-IPSI, especially Christian Schuckmann and Jan Schümmer for technical support with VITAL, and Hans-Rüdiger Pfister for the help with the evaluation design.

Teachers, Students and the University Walking Together in One Direction: Analyzing the Potential for ICT in Higher Education from Different Perspectives

Joachim Wetterling
University of Twente
Center for Telematics and Information Technology
Enschede, The Netherlands
Wetterli@cs.utwente.nl

Abstract: As technology changes so many parts of life also education and the academic society cannot escape. Because of the many different perspectives of people involved in higher education predicting success of innovations such as the integration of ICT is considered a difficult problem. The paper intends to structure the perspectives of students, teachers and management in higher education related to change. Survey data illustrate the conclusion that there is potential for change but potential success is often characterized by uncertainty such as attitudes, individual key experiences and support infrastructures.

Introduction

The quality of higher education is both very difficult to assess and very important as one of the indicators for decision-makers to allocate substantial resources for universities and colleges to maintain their academic education infrastructure. But how to measure the quality of higher education? And how to relate quality to efforts needed to achieve and maintain quality?

A term related to the improvement of quality in higher education which is used in the Netherlands is 'studyability' (in Dutch: studeerbaarheid) (VSNU, 1998). This term means 'the characterization of the optimal context for supporting students in achieving learning goals'. Avoidable obstacles for students are to be taken away as much as possible. It is expected that, when the 'studyability' of a curriculum is improved, also the efficiency will improve. Improvement of studyability at first sight concentrates on student characteristics and perspectives. But the teacher and the university perspective are also important to consider in the context. A research project has been started to investigate ways to improve studyability at the University of Twente by integrating information and communication technology in the curriculum (Wetterling & Moonen, 1998). The project called IDYLLE (IDYLLE stands for 'Innovative Distributed Learning Environments') is situated in the Center for Telematics and Information Technology (CTIT), a research institute at the University of Twente. In the CTIT research is done on telematics and information technology systems, including the application of these systems in user environments. The IDYLLE project is a multidisciplinary project containing components from educational technology, computer science and ergonomics.

The paper concentrates on one of the parts of the IDYLLE project that investigates the implementation process for university teaching staff as Information and Communication Technology (further to be referred to as 'ICT') is concerned and how to deal with problems occurring in this process. Accents are on the different perspectives of analysis, the uncertainty of decision-making and attempts to structure support mechanisms to improve effectiveness and efficiency of using ICT in higher education.

Scenarios for ICT Integration in Higher Education: Different Perspectives

The success of implementing ICT in higher education is determined by a variety of parameters such as educational, technological and organizational (Harmon & Jones, 1999). These parameters are operational at a diversity of levels such as the student level, the instructor level and the faculty / university level. Additional factors that make the implementation of ICT in universities and the prediction of success a complex issue are the rapid developments in the ICT and education sector and the difficulties experienced in research on evaluating the impact of ICT on educational effectiveness (Moonen, 1997). The implementation of ICT in university teaching can be analyzed from the perspective of the student, the university or the instructor. Even tough all of these are relevant to the success of integration of ICT this paper concentrates on the teacher perspective.

As the student perspective is concerned, three aspects are to be acknowledged in the context of ICT in universities. The first two are related to the input and output of the university. Input means implementation targets are on serving a greater flexibility in student enrolment such as more part time students, continuing education target groups and distance students. ICT is integrated to optimize quality for a greater variety in student characteristics. Output means ICT is integrated to deal with more specialized requirements for graduates in their future work environment. As the measurement of input (enrolment statistics) and output (graduation rates and salaries of graduates) indicators are relatively easy the quality of the education process and the influence of ICT integration in the curriculum is more difficult. One of the indicators in this context if the time students spend on study tasks. Concerning this problem a survey was carried out within the IDYLLE project resulting in a model for determining factors that influence study time and study habits of students in university (Kamp, 1997a, 1997b). The University perspective concentrates on the macro level of analysis, which means preparing a situation in which ICT can be implemented successfully in parts or all of the university. At the University of Twente successful developments are on their way in this direction (Collis, 1997, 1998).

The remainder of this section concentrates on the teacher perspective, as the survey results to be discussed in the paper are directly related to this perspective. If the teacher perspective is compared to the student perspective one of the main differences is that teaching staff in higher education often has not such a varied background as students. Even tough there are old and young teachers, teachers with more or less experience with ICT and teachers in technical, social or behavioral sciences, they all have a common task in design, delivery and maintenance of courses in a specific domain area where learning and research should be integrated. And by integration of ICT roles and tasks for teachers change and there are differences in how teachers deal with these changes (Shotsberger, 1998). The teacher perspective in this paper is differentiated in three characteristics: first the educational scenarios, in which teachers deliver their courses, second the personal factors of the teacher and third the infrastructures of the faculty in which they deliver their courses.

A series of educational scenarios can be identified in higher education settings. First the traditional scenario as higher education has persisted for decades almost during the whole century. In this scenario students attend lectures and read their study material, mostly books or readers at home and sometimes they go to workshops where they discuss assignments or have practical lab work assignments. Then there is the scenario of distance education. This scenario is characterized by students who do not live near or on the campus, the (almost) absence of instructional activities where students and teachers meet at the same location and the accentuation of high quality study material to structure learning and instruction for students. A third and final scenario is project-based learning. In this scenario students are usually located near the campus. Traditional lectures and workshops are replaced by group discussions with a teacher who performs roles of coach, tutor or guide. Students also do a lot of literature study, assignments and practical work either individually or within the project group.

The use of the World Wide Web and other forms of ICT can be integrated more or less in all three scenarios. In the traditional scenario students can retrieve lectures from the web for later review and assignments can be structured on the web thus saving time at workshops for discussion. In the distance scenario written material can be enriched by multimedia and communication facilities on the web and it would also be easier to communicate between teacher and students. The work of project groups can be structured on the web using workflow management environments and offering discussion platforms for efficient interaction among group members and active learning opportunities. A really useful categorization of educational scenarios related to integration of telelearning was presented by Kerres (Kerres, 1998).

The personal characteristics of the teacher are one the most important factors to determine the success of the integration of ICT in higher education. Let's differentiate four indicators for the personal profile of the teacher. These indicators are (1) the workload of the teacher, (2) the expertise of the teacher related to ICT, (3) the resources available to the teacher and (4) the attitudes of the teacher towards integration of ICT. These four indicators can be used to predict the success for a specific teacher to integrate ICT in his or her courses. The problem (and also interesting challenge) is how to estimate the parameters for the four indicators. As addition to these characteristics incentives are important to teachers. Change means more often than not extra efforts to be invested and extra efforts need incentives. The teacher perspective on ICT is to a large extent depending on external influences such as incentives and disincentives (Williams & Peters, 1997).

The past, the present and the future

The university of today is seen as a component of society. Today's society is rapidly changing due to technological, political, sociological and organizational developments. One of the main problems to keep universities op to standard in the curricula is that these curricula prepare students for work after graduation and thus that these students usually learn to work with technologies that are outdated when the are ready to apply them in their work environments. This means that universities either should come closer to requirements of business and society as technology and their applications are concerned; or a basic curriculum in ICT is offered followed by an advanced program for those needing more specialized skills and knowledge in the context of their working area after graduation. Both of these approaches show a need for a more flexible and individual learning program. Integrating ICT should be considered as one of the solutions to improve higher education and meet the goals of flexibility and individualization. But it is also acknowledged that it could be better to build new ideas on existing proven foundations instead of building new concepts from scratch with all pre-programmed uncertainty to consider (Holtham e.a. 1998).

Survey

How is the integration of ICT in the university curriculum perceived by those who have to deal with the innovation in their everyday job? A survey has been conducted among teachers at the University of Twente to achieve data on the perspectives of teaching staff on integration of ICT and telelearning. For the survey a sample was drawn of 100 instructors in 10 faculties from those staff members involved in one or more student courses. Subjects were sent an e-mail message with information about the survey. The survey questionnaire was attached to the e-mail message. A response rate of 28 was achieved for the survey. The results unveil two major characteristics of the analysis of success of potential ICT in higher education: these characteristics are uncertainty and trends. Uncertainty because of the difficulty to predict effects of decisions made today on tomorrow's situations and trends because of the preference at teacher and institution level to some ICT application over others. Another problem with interpreting results of the survey is the background of the respondents. Subjects that already either have a stronger attitude to ICT or use ICT in their courses can be more motivated to return the survey which can bias results. The questionnaire contained 12 closed questions about the following topics: Opportunities for ICT in university courses, instructors experience with different ICT tools, the ICT-infrastructure in the university, teacher support and reasons for using ICT.

The survey started with two general statements. These were used as indicators for the expectations of instructors from ICT on student learning and quality of education. The first statement was "ICT has a positive impact on student learning". On this statement 11 respondents either agreed or strongly agreed. Three respondents disagreed and only one strongly disagreed. The second statement was "ICT will improve higher education quality". On this statement 18 respondents either agreed or strongly agreed. One respondent disagreed and there were no 'strongly disagree' responses. Another item asking for longer-term expectations of ICT in university teaching confirmed these data as 14 respondents rated this high against 6 low and 7 had no opinion.

One item asked for the ICT tools from which instructors expected the most for improvement of the communication between instructors and students and among students. In this item e-mail and the World Wide Web were rated highest whereas chat and videoconferencing were rated lowest. This has a high correlation with item 4, asking for instructor's experience with ICT tools. Here also e-mail and WWW were rated highest and chat lowest. Another item later in the questionnaire asked what tools respondents used most. Here also e-mail and the WWW scored highest. The correlation between these two items is not unexpected. It also indicates that future developments should consider carefully the prior knowledge and experience of the teachers in the target group to optimize the impact. On the other hand low instructor experience should not be considered too much a reason to avoid investigating the potential of these technologies in the university.

Another item asked for the support instructors receive from the faculty or university level. Response shows a high perception of motivational (15 out of 28 (strongly) agree) and financial (12 out of 28 (strongly) agree) support from the side of the management but instructors do not often perceive they have sufficient time to integrate ICT in their courses (8 out of 28 (strongly) agree). The University of Twente has three major support institutes for the faculties. These are the libraries, the computing center and the educational support center. Respondents were asked how important they find these three institutes on a 5-point scale. 16 out of 28 respondents rated the educational support center as important or very important. 10 out of 28 gave this rating to the computing center and 11 out of 28 for the library. There is a trend to combine these types of support institutes in one large organization in order to make service more efficient and more effective within the university.

What factors influence the quality of ICT in university courses? Respondents were given five factors, which they rated on a five-point scale. These factors were: 'instructor capacities', 'student motivation', 'quality of learning material', 'technology policy of the university' and 'reliability of the hardware and software'. Four out of five of these factors scored very high in the item (21 or more out of 28 respondents found the factor important or very important). Only 'technology policy of the university' was rated a little lower, even tough almost half of respondents rated this as (highly) important. ICT is expected to have more impact in individualized, personalized education activities rather than in group teaching. Respondents were asked to indicate for a series of educational activities whether they think ICT could have a positive impact on the quality of these types of activity in the future. Activities in which the most respondents expected a positive ICT impact were the presentation of learning material, the coaching of project groups and the individual coaching of students.

The last item asked respondents about the reason why they use ICT in their courses. Respondents were given eight 'reasons' on which they could answer 'yes', 'no' or 'don't know'. The two reasons that scored highest on this item (18 and 19 times 'yes') were 'the course content has opportunities for ICT use' and 'the innovation-mindedness of the instructor'. About eight or nine respondents circled 'yes' on the reasons 'too many students fail exams on my course', 'the university wants me to use ICT' and 'students complain about the course'. A very small majority indicates that they use ICT to decrease their workload or to increase student numbers. No respondent uses ICT to decrease student workload in the course.

Conclusion

Getting ICT into the university and especially realize that staff uses ICT in a way that improves quality and efficiency of the university product such as education and research is perceived as a long an enduring process. All phases in this process have their own characteristics influencing the success or failure of the integration process. This includes situational characteristics such as the availability of resources or infrastructure but also personal characteristics such as the attitude of teaching staff and students or expertise of instructors. A large variety of these factors are expected to have impact on the probability of successful integration of technology. So what can be said about the way ICT is integrated in the university and the way instructors deal with this process on the basis of the data collected and analyzed in the survey in this study? First there seem to be high expectations and positive perspectives on the side of the instructors in higher education. But on the other hand many instructors have some resistance to ICT because of the initial efforts needed to get things started. As the ICT tools are concerned, results show that especially e-mail and the World Wide Web is used frequently. It could be interesting to find out how other areas such as videoconferencing or groupware can be stimulated among university staff. Another aspect in the survey is the role of the support institutions such as the library, the computing center and the educational center. There is a trend to integrate these support institutions to increase efficiency in universities. The rather equal distribution of how respondents perceive the value of the three institutions seem to support integration efforts but more research is needed to validate the impact. A final conclusion deals with the value of ICT for specific instructional activities. Results show a high score for ICT as to improve communication and interaction scenarios in course delivery. Especially the support of student groups by the use of ICT is perceived as being a valuable contribution and addition to traditional instruction.

References

Collis, B. (1997). *Implementing ICT in theFaculty: Letting a 1000 Flowers Bloom or Managing Change?* Keynote presentation for the national conference, "Studying in Digital Learning Environments", University of Utrecht, December 1997.

Collis, B. (1998). *Implementing Innovative Teaching Across the Faculty via the WWW.* Paper for the conference "SITE 98" (Society for Information Technology in Teacher Education), March 1998, Washington, DC.

Harmon, S.W., & Jones, M.G. (1999). The Five Levels of Web Use in Education: Factors to Consider in Planning Online Courses. *Educational Technology, November/December 1999, 28-32.*

Holtham, C., D'Cruz, M., & Tiwari, A. (1998). *The Application of Intranet and Business Groupware Technologies to Support Collaborative Learning with Face-to-face Students.* In: R.Hazemi, S.Hailes & S.Wilbur (eds.), The Digital University: Reinventing the Academy. London: Springer. Pp.267-280.

Kamp, I.N. van de (1997a). *Studeerbaar Hoger Onderwijs. Literatuuronderzoek.* Internal IDYLLE-publication. Enschede: University of Twente, CTIT.

Kamp, I.N. van de (1997b). Studeerbaar Hoger Onderwijs. Uitkomsten Enquête en Aandachtspunten. Internal IDYLLE-publication. Enschede: University of Twente, CTIT.

Kerres, M. (1998). *Multimediale und Telemediale Lernumgebungen: Konzeption und Entwicklung.* München: Oldenbourg.

Moonen, J. (1997). The Efficiency of Telelearning. Journal of Asynchronous Learning Networks, 1(2),. [WWW document] URL http://www.aln.org/alnweb/journal/issue2/moonen.htm.

Shotsberger, P.G. (1997). *Emerging Roles for Instructors and Learners in the Web-based Instruction Classroom.* In: B.Khan (ed.), Web-based Instruction. Englewood Cliffs, NJ: Educational Technology Publications. Pp.101-106.

Vereniging van Samenwerkende Nederlandse Universiteiten (1998). *Studeerbaarheid en Kwaliteitszorg Beoordeeld. Issue in Series on Quality of Higher Education in the Netherlands.* Utrecht: VSNU.

Wetterling, J., Moonen, J. (1998*). Supporting Telelearning on the University of Twente: The IDYLLE Project.* In: K.Lehmann (ed.), Studieren 2000: Alte Inhalte in Neuen Medien? Münster: Waxmann. Pp.163-182.

Williams, V., Peters, K. (1997). *Faculty Incentives for the Preparation of Web-based Instruction.* In: B.Khan (ed.), Web-based Instruction. Englewood Cliffs, NJ: Educational Technology Publications. Pp.107-110.

Faculty Reaction To WebCT: One University's Experience

Sharon Alayne Widmayer
George Mason University
4400 University Drive
Fairfax, VA 22030
swidmaye@gmu.edu

Cynthia L. McCourt
George Mason University
4400 University Drive
Fairfax, VA 22030
cmccourt@gmu.edu

Abstract: This paper will report on a pilot study which surveyed faculty to determine their attitudes towards WebCT during its first year of use at George Mason University. Faculty who responded to the survey seemed to be generally satisfied with both the WebCT tool and the WebCT support available on campus. However, faculty also reported barriers to WebCT usage, including difficulties using the designer interface and the amount of time involved in learning WebCT and setting up a WebCT folder.

Introduction

In January 1999, George Mason University began use of WebCT, an online course management system designed to facilitate the creation of web-based instructional material and instructional supports. Currently, WebCT is being used by some faculty and is considered to be in its early stages of implementation. Up to the present time, no systematic assessment of WebCT's implementation has taken place. This paper presents a pilot study attempting such an assessment by looking at faculty satisfaction with WebCT. Data for the current study was gathered through surveys, and a large student including both surveys and interviews with selected faculty is planned. Before beginning a discussion of the data, a definition of an online course management system is provided.

What is WebCT?

WebCT is an on-line course management system that assists faculty in the creation of complex educational websites. It provides faculty with three types of tools: (1) an interface to help with aspects of page design and layout, (2) educational features such as a quiz-creation tool, a glossary, and a student presentation tool, and (3) a course management system to help instructors manage and distribute grades, and release course content according to grades, dates, and other related criteria. (Goldberg, 1997b)

Related Research

According to Phipps, R., & Merisotis, J. (1999) "There is a relative paucity of true, original research dedicated to explaining or predicting phenomena related to distance learning." (Page 2). Much of the body of research that does exist dealing with on-line learning "are more anecdotal than systematically empirical or critical." (Hara & Kling 1999). In addition Windschilt (1998, as quoted by Hara & Kling 1999) also notes that much of the published literature dealing with computer-mediated on-line instruction consists of descriptions of software or anecdotal accounts of how technology was integrated in a course or classroom.

To date, there has been virtual no research on faculty reaction to WebCT or other on-line course management software. The only article published dealing with faculty attitudes have been "testimonials" published by faculty on their individual experiences with teaching on now (Ruth, Foreman, & Tschudy 1999, Goldberg 1996). Although these articles are usually positive, they are usually written by faculty who were previous technology (Phipps & Merisotis1999) or even the developer of the software they are using in the course (Goldberg, 1996). Although their research focused primarily on students, Wermet & Oliges (1999) noted that learning curve was high for faculty learning WebCT. Pauley & Cunningham (1999) noted that faculty emphasized the importance of developing an understanding of the effects & implications of distance learning & needs of adult learner. They also noted that faculty emphasized the importance of the instructional support staff.

An investigation and review

The investigations were design to explore and gather information that could possibly be used to formulate a hypothesis to be tested. The following sections discuss the methodology used and threats to the validity and reliability of the data collected.

Faculty Survey Process

The faculty reaction survey consisted on 19 questions dealing with faculty reaction to the WebCT software as well as their judgment as to the quality of support provided by the university's Instructional Resource Center. Questions also included asking if they had ever used the Internet for instruction previously and how many WebCT workshops they participated in. The survey was then sent out on the university's WebCT_users e-mail list, to which all faculty are added when they request their first WebCT course. The list usually serves as a forum for announcements concerning WebCT, discussion of problems with WebCT, and posts of upcoming WebCT related campus events. In addition to the WebCT_users list, the survey was also sent to all faculty and staff who had attended a WebCT workshop since March. An e-mail was sent out to all the above-mentioned faculty and staff containing the required cover letter for research projects exempt from Human Subjects Review. In the body of the e-mail below the cover letter information was the survey. Participants could complete the survey in one of three ways: (1) print out the e-mail, fill it out by hand, and send it back via intercampus mail, (2) reply to the e-mail and type their responses right in their reply, and (3) completing an on-line survey at a URL provided. Faculty were given 10 days to complete the survey. The multiple modes of completing the survey were designed to encourage participation and also to prevent the possibility of difficulty filling out the survey affecting the outcome of the study.

Threats to validity and reliability

As all faculty at the university involved in WebCT were surveyed, threats to validity due to selection were not relevant. However, as with all survey studies, results are based on those subjects who choose to participate and return the survey and who are therefore self-selected. Due to the desire of the Instructional Resource Center to gather data from as many faculty as possible and due to the short amount of time available for this study, this threat to internal validity was not compensated for and must be taken into account in our discussion of results. In addition, WebCT has only been used at George Mason University since January 1999, and most faculty who have been trained in WebCT and/ or decided to use this tool began only this past summer. Consequently, faculty attitudes may be tainted by a novelty affect, and a follow-up study after several more semesters of WebCT usage is planned.

Since this is the first known study of faculty reaction to WebCT, there currently exists no other surveys or research with which to compare either the instrument or results of this study. However, the survey was constructed in such a way that it would be easily adaptable to other institutions for future research. Most questions in the study were multiple choice, precluding the possibility that researcher bias could affect the results. In addition, there were a number of free response questions which will be discussed below.

Preliminary Survey Analysis

Survey response rate:

One hundred seven people received the request to complete the survey. Of those eleven were eliminated because they were staff members in the department running the survey rather than faculty. Of the 96 remaining, twenty-two had completed the survey during the time period requested, a 23% response rate. A few additional surveys have been returned since the deadline, but they have not yet been added to the database yet.

Overall level of satisfaction:

As for WebCT itself, faculty rated it at an average of 2.05 on a scale of one (excellent) to four (very poor), with only 2 respondents saying that WebCT was either poor (3) or very poor (4). A large majority gave WebCT a rating of 2 (good). Faculty who have actually used WebCT with their students generally reported that their students level of satisfaction was good. In fact, faculty rated students as slightly more satisfied than the faculty, with an average rating of 1.9375. Faculty were then asked to rate the usefulness of particular WebCT tools on a scale of one (very useful) to four (very unuseful). Few faculty rated all tools, since they were asked to only rate the tools they had experience with. Ratings ranged from an average of 1.43 for the bulletin board to 2.22 for the White Board. Very few tools received scores of very unuseful, although ratings of unuseful were somewhat common.

Level of satisfaction w/ training & support:

Faculty who responded to the survey seemed to be generally satisfied with both the WebCT tool and the WebCT support available on campus. On a scale of one to four, with one being the best, faculty rated WebCT workshops as 1.47. While only approximately half of the respondents took advantage of opportunities for one-on-one help, those who did rated it very highly, with eleven respondents saying this help with excellent (1) and two replying that the one-on-one help was good (2) for an rating average of 1.15.

Best / Worst aspects of WebCT:

Faculty expressed the most satisfaction with the things that WebCT did to make their lives easier. These included the ability to post grades for students and to cut down on the number of paper copies that needed to be distributed, and the self-grading quizzes with automatic feedback.

Faculty thought the biggest drawback to WebCT was the "clunky interface." It is "over-complication" with a "somewhat scattered and cumbersome array of elements." Another big drawback was the time involved in learning WebCT and setting up a WebCT folder. "I still don't know how to use most of the applications," complained one, "That is, it is tremendously time-consuming to prepare course materials for on-line use and I just don't have much time."

In fact, most of the faculty who are not using WebCT cited either the clumsy interface or their lack of time as their reason. "I haven't decided NOT to use it, but haven't had the time to get geared up yet," said one. Another responded, "a program should not have to require so [many] workshops. We ought to be able to figure [it] out ourselves. . .it made things a lot harder to do."

Conclusions and future directions:

Although the data collected so far represent one of the few attempts to collect information on faculty reaction to WebCT, it is currently only skimming the surface. While faculty seem to be, by and large, satisfied with WebCT and with the WebCT support offered at George Mason University, it is also clear that they find some aspects of WebCT confusing and that many also find it difficult to set aside the time that they need to learn WebCT and design their WebCT folder. In order to get a clearer understanding of how faculty are using WebCT, how successful they feel that that use is, and how the university could best support WebCT course development, it will be necessary to do further research. Interviews with randomly selected WebCT faculty are planned. In addition, we plan to send a reminder to all faculty on the webct_users distribution list to attempt to get surveys from those who did not complete them by the initial deadline.

References:

Goldberg, M. (1997a) "CALOS: First Results From an Experiment in Computer-Aided Learning" Proceedings of the ACM's 28th SIGCSE Technical Symposium on Computer Science Education. Retrieved 29 September 1999 from the World Wide Web: http://www.webct.com/papers/exper.html

Goldberg, M. (1997b) "WebCT and First Year Computer Science: Student Reaction to and Use of a Web-Based Resource in First Year Computer Science ", Proceedings of the ACM's ITiCSE Conference on Integrating Technology into Computer Science Education, June 1-5, 1997, Uppsala University, Uppsala, Sweden. Retrieved 29 September 1999 from the World Wide Web: http://www.webct.com/papers/csover.html

Hara, N. & Kling, R.(1999) "Students' Frustration with a Web-based Distance Education Course: A Taboo Topic in the Discourse." CSI Working Paper. Retrieved from the 29 September 1999. World Wide Web: http://www.slis.indiana.edu/CSI/wp99_01.htm

Phipps, R., & Merisotis, J. (1999, April). What's the difference? A review of contemporary research on the effectiveness of distance learning in higher education. A Report from The Institute for Higher Education Policy. Retrieved September 29, 1999 from the World Wide Web: http://www.ihep.com/PUB.htm.

Pauley, R., Cunningham, M., and Childress, R. (1999) "A Quantitative Analysis of Graduate Students' Perceptions of WebCT." Proceeding of the First Annual WebCT Conference on Learning Technologies. June 17-18, 1999. Vancouver, Canada.

Ruth, S., Foreman, J. & Tschudy, T. (1999) "Exploring the Middle Ground: A Course on Teaming in Cyberspace." The Technology Source. Retrieved September 29, 1999 from the World Wide Web: http://horizon.unc.edu/TS/cases/1999-09.asp.

Wermet & Oliges (1999) "Using WebCT for Educating Practice Professionals." Proceeding of the First Annual WebCT Conference on Learning Technologies. June 17-18, 1999. Vancouver, Canada.

Acknowledgements:

The authors would like to acknowledge the feedback they received from Dr. Chris Dede while working on this paper. We would also like to thank Jerry Drake for presenting this paper at the Ed-MEDIA conference in our absence.

Designing Virtual Reality Learning Spaces for Students With Special Needs

William R. Wiencke
Media & Instructional Technology
College of Education
State University of West Georgia
United States
wwiencke@westga.edu

M. D. Roblyer
Media & Instructional Technology
College of Education
State University of West Georgia
United States
mroblyer@westga.edu

Abstract: The paper reviews the past uses of Virtual Reality (VR) applications for students with special needs. Although VR technology shows promise for helping these groups, applications have been slow to emerge. Reasons for the lag in development include the expense of VR components, special skills required to develop learning environments, and special challenges of educational applications. Research in the use of VR in physical rehabilitation and remediation for cognitive deficits are discussed. Design issues and variables are reviewed together with a description of new developments in the use of low-end VR systems and the Internet.

Background on Virtual Reality Applications for Special Needs Students: Potential vs. Performance

It is likely that no technology has created greater hope for improving the quality of life and learning for students with cognitive or physical disabilities than Virtual Reality (VR). Although VR environments for military training were first developed over 20 years ago, and applications in education have been in development since the early 1990's, VR applications to remedy or compensate for cognitive or physical disabilities have been much slower to emerge. Several reasons seem to account for this lag.

- **Expense of VR components** – Until recently, the software and devices required to develop and use VR environments were so expensive as to be prohibitive for schools, since they requried well-funded research and development settings.

- **Special skills required** – Because of the expense and complexity of the systems, few educators have skills required to design virtual reality programs. Most environments have been developed in university labs or by special projects. Long term research and development efforts to address the needs of special populations have been rare.

- **Special challenges of educational applications** – Students with special needs usually cope with a combination of physical and cognitive problems that make learning in any environment problematic. VR environments can add another layer of required adaptation.

- **Difficulty of demonstrating need** – The expense of VR systems in comparison to the small number of people in various special needs populations has made it difficult to justify extensive development in this area.

It is apparent that the relatively high costs of VR systems has been the single greatest obstacle to past progress in this area. However, recent developments in low-end VR systems may decrease the impact of all these factors. This paper describes examples of past work in this area and work currently under development by the authors. The presentation accompanying this paper will demonstrate sample VR systems that use either lower-end software or the Internet as a means of accessing virtual environments.

Research To Date

Descriptions of VR applications for students with special needs have appeared both in medical and education literature since around 1992. Environments in experimental phases have been described in two major areas:

- **Physical rehabilitation** - VR environments have been designed to restore skilled movement in students with physical disabilities resulting from various traumas and diseases (Andrae, 1996; Ira, 1997; Kuhlen & Doyle, 1994; Latash, 1998; Rose, Johnson, & Attree, 1997). Some systems have focused on the needs of people with motor problems due to cognitive processing difficulties. Krais, Kuhlen, and Friedewald (1993) reported on the use of systems to assess apraxias, loss of ability to organize and coordinate movement sequences spatially and/or chronologically. Molendi and Patriarca (1992) explored environments for helping people coping with ataxia, a condition in which visual stimuli are highly distorted. Stanton, Foreman, & Wilson, 1996; Stanton, Foreman, Martin, & Wilson, 1997) used VR to teach building navigation to students in wheelchairs, teaching them to locate and activate fire alarms and hoses and find exits from the building.

- **Remediation for cognitive deficits** - Cromby, Standen, Newman, and Tasker (1996) assessed the utility of "virtual shopping trips" on the life skill development of students with moderate to severe degrees of mental retardation. Christiansen, Abreu, Ottenbacher, Huffman, Masel, and Culpepper (1998) evaluated the feasibility of virtual reality meal preparation procedure with thirty subjects who had mental deficits due to Traumatic Brain Injury (TBI). Strickland, Marcus, Mesibov, and Hogan (1996) worked with children exhibiting autistic behaviors, placing them in immersive environments that simulated safe procedures for crossing a street.

As recent reviews have noted (Cass & Roblyer, 1999; Roblyer & Cass, 1999), few of these reports include any actual research and data on the design problems and impact of VR environments. Interestingly, most of the research results come from two groups in England: research teams at the University of Nottingham and the University of Leicester. It is evident from the limited data available that students vary considerably in the length of time it takes them to adapt to this kind of environment. However, each of the R&D groups experimenting with this technology feel that their results to date encourage them to be optimistic about VR's future impact.

Selecting VR Environments to Design

Even though VR costs are coming down, the complexity of these systems and the time and expense of designing them make it imperative that we assess carefully the reasons for choosing VR as an educational environment and the feasibility of implementing it in schools and classrooms. Two areas of criteria seem to emerge from past applications that can help us determine the future usefulness of VR.

- **Safety concerns** – When students need to acquire skills in areas that help them become functional, independent human beings (e. g., cooking, crossing streets), but learning these skills involves a degree of risk to their personal safety, VR seems to be the learning medium of choice.

- **Mobility issues** – Because of its capability to simulate real environments using varying degrees of real-life complexity, VR also seems the best choice for students who need to re-acquire physical or mental abilities lost due to illness or accident or to make up for physical limitations. Though it is not often recognized as a priority, some educators who work with students with physical disabilities have high hopes for improving the quality of life of these students through VR simulated participation in sports and games.

Design Issues and Variables

From the limited experience educators and trainers have had with designing VR learning environments, it is evident that this already-complex endeavor carries even more problems and issues when the target population is students with special needs. It is critically important that research studies help us address the design and implementation issues that have emerged from prior work.

- **Side effects from immersion environments** – Some studies have observed symptoms similar to motion sickness (Latash, 1998), and others (Strickland, Marcus, Mesibov, & Hogan, 1996) have noted difficulties adapting to headgear. These reports are rare, but cannot be ignored.

- **Transfer issues** – Several different kinds of challenges emerge in developing systems to teach skills that will transfer successfully to real life activities. Even fully immersive environments with goggles and data gloves do not provide perceptual experiences identical to real environments. There are differences, and the impact of differences on skill transfer are largely unknown.

- **False safety issues** – Another problem related to transfer of skills has been hypothesized but remains unexplored. Some students with mental deficits may learn to feel such confidence in their ability to operate in this less complex, simulated world that they achieve a "learned recklessness" in real environments. If this aspect is ignored, it has the potential to negate the benefits offered by VR systems.

New VR Development Resources

Recently, VR software systems have been developed that do not require the high-end computer systems of prior VR generations. Some of the groups that have developed these systems have found that completely immersive environments do not appear to be necessary to achieve the desire impact. Thus, rather than requiring headsets and data gloves, students can manipulate the environment using a 3D mouse and a standard monitor.

An added capability that makes these systems more feasible for implementation in schools is being able to access them over the Internet. One current example, *SuperScape* software (developed by SuperScape, Inc.), which was used by several of the R&D groups described in this paper, provides a plug-in that can be downloaded from their website and would allow schools to use the environments with a browser and a desktop computer. More such Internet-accessible VR environments are sure to follow in the near future.

Conclusion

As development continues, other issues may emerge that must be addressed before VR environments can be made functional components of educational plans for students with special needs. However, as one recent reviewer noted, VR represents "the new frontier for a field that represents perhaps the most exciting pioneering work in educational technology" (Roblyer & Cass, 1999, p. 53). Recent developments in VR software and Internet-access resources also may mean we are closer to closing the gap between potential and performance of VR for special needs students.

References

Andrae, M. (1996). Virtual reality in rehabilitation. *British Medical Journal International, 312*(7022), 4-5.

Botella, C., Banos, R., Perpina, C., Villa, H., Alcanez, M., & Rey, A. (1998). Virtual reality tretament of claustrophobia: A case report. *Behavior Research and Therapy, 36*, 239-246.

Brown, D., Kerr, S., & Wilson, J. (1997). Virtual environments in special-needs education. *Communications of the ACM, 40*(8), 72-75.

Cass, M., & Roblyer, M. D. (1999). A review of experimental research on virtual reality in special education: The status of the dream. *VR in the Schools,4*(2) [Online]. Available at: http://soe.eastnet.ecu.edu/vr/vrits/4-2cass.htm

Christiansen, C., Abreu, B., Ottenbacher, K., Huffman, K., Masel, B., and Culpepper, R. (1998). Task performance in virtual environments used for cognitive rehabilitation after traumatic brain injury. *Archives of Physical Medicine and Rehabilitation 79*, 888-892.

Cromby, J., Standen, P., & Brown, D. (1995). Using virtual environments in special education. *VR in the Schools, 1*(3) [online]. Available at: http://eastnet.educ.ecu.edu/vr/vrits/1-3Cromb.htm

Cromby, J., Standen, P., Newman, J., & Tasker. H. (1996). Successful transfer to the real world of skills practised in a virtual environment by students with severe learning disabilities. In *Proceedings of the First European Conference on Disability, Virtual Reality, and Associated Technologies*. Maindenhead, Berkshire, UK, pp. 93-101.

Darrow, M. (1995). Increasing research and development of virtual reality in special education: What about mental retardation? *VR in the Schools, 1*(3) [online]. Available at: http://eastnet.educ.ecu.edu/vr/vrits/1-3Darro.htm

Dickson, S. (1996). Scientific concretization: Relevance to the visually impaired student. *VR in the Schools, 1*(4). [online]. Available at: http://eastnet.educ.ecu.edu/vr/vrits/1-3Darro.htm

Ira, V. (1997). Virtual reality and mobility skills. *Exceptional Parent, 27*(11), 50.

Kuhlen, T., & Doyle, C. (1994). Virtual reality for physically disabled people. *Computing in Biological Medicine, 25*(2), 205-211.

Krais, K., Kuhlen, T., & Friedewald, M. (1993). Einsatz von multimedia-und virtual reality-techniken fur die diagnostik und therapie motorischer storungen. Technical report, Institute of Technical Computer Science, Aachen Technical University.

Latash, M. (1998). Virtual reality: A fascinating tools for motor rehabilitation: To be used with caution. *Disability and Rehabilitation, 20*(3), 104-105.

Middleton, T. (1992). Applications of virtual reality to learning. *Interactive Learning International, 8*, 253-257.

Molendi, G., & Patriarca, M. (1992). Virtual reality, medical researches. Technical Report 1/92, Universita degli Studi di Milano.

Muscott, H., & Gifford, T. (1994). Virtual reality and social skills training for students with behavioral disorders: Applications, challenges, and promising practices. *Education and Treatment of Children, 17*(4), 417-434.

Powers, D., & Darrow, M. (1994). Special education and virtual reality: Challenges and possibilities. *Journal of Research on Computing in Education, 27*, 111-121.

Rose, F., Johnson, D., & Attree, E. (1997). Rehabilitation of the head-injured child: Basic research and new technology. *Pediatric Rehabilitation, 1*(1), 3-7.

Roblyer, M. D., & Cass, M. (1999). Virtual reality in special education: Still more potential than performance. *Learning and Leading With Technology, 26*(8), 51-53.

Stanton, D. (1997). Enhancing spatial cognition in disabled children using virtual reality. Unpublished dissertation thesis, University of Leicester.

Stanton, D., Foreman, N., & Wilson, P. (1996, July). Uses of virtual reality in training: Developing the spatial skills of children with mobility impairments. In Shakey, P. (Ed.). *Proceedings of the First European Conference on Disability: Virtual Reality and Associated Technologies*, Maidenhead, England.

Stanton, D., Foreman, N., Martin, & Wilson (1997). Successful transfer of spatial knowledge from a virtual to a real school environment in physically disabled children. Unpublished report, University of Leicester.

Strickland, D., Marcus, L., Mesibov, G., & Hogan, K. (1996). Brief report: Two case studies using virtual reality as a learning tool for autistic children. *Journal of Autism and Developmental Disorders, 26*(6), 651-659.

Taylor, W. (1997). Student responses to their immersion in a virtual environment. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, Illinois, March 24-28 (ERIC Document No. 407 931)

Wilson, P., Foremen, N., & Tlauka, M. (1996). Transfer of spatial information from a virtual to a real environment in physically disabled children. Rehabilitation Engineering, 18(12), 633-637.

Implementing a 'Scaffolding by Design' Model in a WWW-based Course Considering Cost and Benefits

Koos Winnips
Betty Collis
Jef Moonen
Faculty of Educational Science & Technology, University of Twente, The Netherlands
Contact author: winnips@edte.utwente.nl

Abstract: A model for 'scaffolding by design' is implemented in a course (called ISM-2) about the fundamentals of media design for education. This model tries to combine the focus on task-performance of cognitive-apprenticeship with the fading of support of scaffolding, and the flexibility of telelearning. To explore the impact of this model it is applied in the ISM-2 course. A scaffolded group (creators) is compared with a non-scaffolded group (reflectors). On a multiple-choice test for a knowledge and a transfer type of questions no significant difference was found between the two groups. The dropout rate for the scaffolded group was lower and their overall time-investment for the course was higher. It is concluded that the extra cost of using this approach of scaffolding can - at this moment - not be justified by the measured learning results.

Introduction

A scaffold is a support, such as the temporary framework that supports a building when it is built. When the building is finished, the support is removed and the building will stand on its own. In instruction scaffolding serves the same role as the scaffold for a builder (Wood, Bruner, & Ross, 1976):

1. It helps to ensure the learner's success.
2. It extends the learner's competency in a new territory.
3. It can be taken away as the learner becomes more responsible.

Scaffolding is part of the cognitive-apprenticeship theory (Brown, Collins & Duguid, 1989), in which a student is modeled and coached to perform a specific task. Reflection, and articulation of reflection takes place, after which a -more free- phase may follow where students can self-reliantly explore, set their own subgoals and frame problems. In this way the student gradually becomes an expert in the performance of a specific task.

Nowadays, cognitive apprenticeship is being used in a number of telelearning settings (see for example: Guzdial & Kehoe, 1998; McLouglin & Oliver, 1998, Suthers, 1998). Part of the appeal of using cognitive apprenticeship and thereby scaffolding in telelearning situations is its promise of flexibility. As the performance of the student, and not that of a lecturer is key (Pressley, Hogan, Wharton-McDonald, Mistretta, & Ettenberger, 1996), a lecturer does not always have to be present to support students. Students can work in their own time and place, and receive and ask for support from peers, or use support that is received in an a-synchronous fashion from an instructor.

Some other appealing factors of scaffolding are:

- Support at the level of the student, as stressed by Vygotsky (1978), attention is paid to the specific difficulties of a student when solving a problem.
- It's focus on the self-reliance of the student. When the level of the student rises, support is faded, so that the student learns to self-reliantly perform a task. This again is an advantage for telelearning situations where the continuous presence of the lecturer during learning is not possible.

When the aforementioned focuses on task-performance of cognitive apprenticeship, the fading of support, and the flexibility of telelearning are combined, the model seen in Figure 1 can be constructed. Performance has a main role in the model, fading is visualized by the decreasing part of the task that is performed by the instructor, and the increasing performance of the student. Using prototypes as a means of monitoring progress of students provides flexibility. In this model the prototypes provide proof of performance via which communication can be structured. The initial support provided is support that is already available in a learning environment. They can can take the form of explanations provided, videoclips, process worksheets, or parts of the solution to a problem.

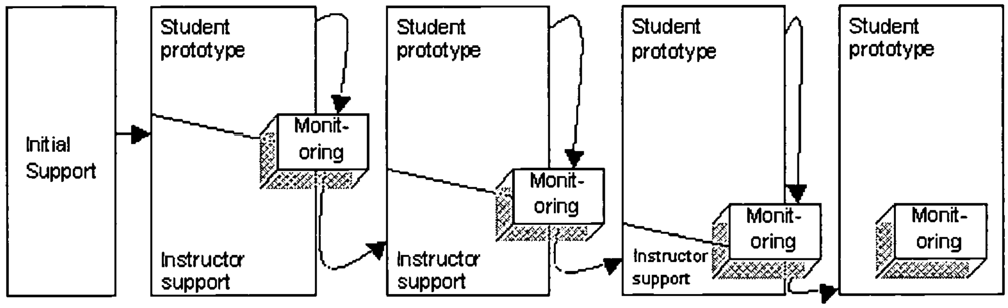


Figure 1. The 'Scaffolding by Design' model.

Scaffolding is a time-consuming and demanding form of instruction (Pressley, et. al., 1996). In order to scaffold students on their own level of development, and to scaffold students based on the progress they have made, much effort needs to be invested in monitoring or tracking of the progress of students. Therefore a part of the challenge of implementing this approach of scaffolding is a cost-effective application in telelearning environments.
In this paper an experiment is described whereby the model for 'scaffolding by design' is implemented in a course (called ISM-2) about the fundamentals of media design for education. More specifically the research questions for this experiment were:
- What impact does the implementation of this model for scaffolding have on students learning, measured by students course completion, study behaviors during the course, and student achievement on the final examination of the course?
- How much extra time is involved for students and instructors, for a scaffolded variant of the course compared to a variant of the course without WWW-supported scaffolding? If there is a difference in time investment, is this extra cost balanced by the benefits received?

Context: The course ISM-2, fundamentals of media design for education

The course ISM-2 is an obligatory course for second-year students in the Faculty of Educational Science and Technology. It is the second of a number of courses that introduce the student to the field of work of the Department of Educational Instrumentation (abbreviated *ISM*). The Department ISM focuses on the design, development, and use of technological tools and resources for learning-related purposes. While the first year course (ISM-1) provides a practical introduction to the work of the department, ISM-2 provides a more-theoretical perspective, especially focusing on human-computer interaction and the design base of the field. ISM-2 is worth 2 points of credit, representing 80 hours of study by the students.

Experimental design

To address the research questions, two experimental groups were formed. One group participated in a variety of required learning activities involving group collaboration and discussion, using a variety of WWW-based resources, participating in decision making and preparation of a summary of an article as an addition to the course study materials (therefore called creators), and interacting with the instructors in personalized and substantial scaffolding activities. The other group (called reflectors) had access to the same resources and activities, but not in a required way. Both groups attended the same four lectures; were responsible for reading the same set of study materials, and wrote the same final examination (worth 70% of the course mark).
A statement often referred to is that 'conditions of learning determine the learning effect' (Aronson & Briggs, 1983). In this case, the learning effect of the groups will be different, as the conditions, the WWW based learning environment and the interaction with instructors and peer-students are designed differently. As the creator group was making links outside of the initial course materials, by searching for articles for their summary, they were expected to better be able to use their knowledge in different contexts. So, at the final examination, they could also have a better score on a transfer type of questions, asking for application of a known concept in a new domain. The Reflectors were presented with the content of the course and did not have to find or contribute new materials to the course. So,

it was expected that they could spend more time studying, and reflecting on the materials presented, and have a better score on a rctention type of questions, asking for definitions and direct recall of information.
Participants were 29 second-year university students participating in the course ISM-2. From the students that were present in the first lecture of this course the creator and reflector groups were formed. Because there were six topics available (in three cycles) for contributing a summary to the course, students were assigned to the creator group first. The remaining students were assigned to the reflector group. The creator group consisted of 18 students, the reflector group consisted of 11 students. The creator group was divided into 6 subgroups of three students each.
The course made use of the C@mpus+ course support environment developed at the Faculty of Educational Science and Technology (Tielemans & Collis, 1999). The two groups had access to their own version of this environment. They had however the same communication tools, instructor notes, and course information available, with only the roster (used for structuring information and providing forms and deadlines relating to the assignments in the course) being different for the groups.
To measure the time investment of both students and instructors, a time investment form was designed to be filled in with an estimate of the number of minutes spent on the different activities of the course.
The final examination of the course consisted of a multiple-choice test, with a total of 36 questions covering all the objectives of the course. In this multiple choice test 18 knowledge type of questions were included, and 18 transfer type of questions. As a pretest, the results from the first year course ISM-1 were used in order to compensate for possible differences in ability between the two groups. The courses ISM-1 and ISM-2 can be compared, as there is continuity between them in content, nature of the examinations, and instructors.

Procedure

During the course the creators have actively constructed the knowledge that was used as study materials for the reflector group, thereby scaffolded by the instructors. As initial introduction to the topics of the course, three introductory lectures were given. In the week after the lectures the creators were asked to work with the materials presented in the lectures (and in the reader of the course), and find additional sources of information. This could be information from several sources, such as the WWW, staff members, CD-ROMs, etc. Each student had to find one source and submit some information about it, suitable for the topic. The sources were discussed in the groups, and one of the sources was selected. Of this source a summary was prepared as study materials for all students. The sources found, the choice for one of three sources, the group's motivation for this choice, and a draft and final version of the summary were all included in the WWW environment.
The instructors each gave careful feedback to the groups. The feedback was related to the choice of articles and the quality of the (draft) summary. The instructors gave personal comments to the group about the quality of the chosen articles and the suitability for their topic. The instructor could add personal feelings about a source, add some background information about the author of the source, suggest a different article, or add some information about the impact the chosen article had on the field. Typically, each of the feedback comments by the instructors were about one or two pages of typed text. The comments were uploaded to the WWW site and were only visible by the students of the creator groups.
In a face-to-face session following the posting of these comments, each group discussed the comments with an instructor, and revised their summary. When the final version of the summary was approved by one of the instructors, it was posted to the course WWW site as part of the study material. Also, the summaries were now available to the reflectors. By the end of the face-to-face session, the summaries should be posted, and the reflectors would have the whole week to read and study the materials posted. All of the creators' work, including draft submissions, and instructor feedback, can be viewed at the course WWW site, at http://education2.edte.utwente.nl/193032.nsf/guest?readform. (Most of the work and communication is in Dutch.)
Students in the reflector group followed the same lectures as the students in the creator group. They studied the materials provided in the reader, and the summaries provided by the creator groups. Further, they individually prepared three essays around three topics of the course. They received feedback on these essays from the instructors, but did not have to improve the essays, nor were they used as study materials.

Results

All students in the creator group participating fully in the activities designed for them. All groups submitted the sources, draft summary, and final summary. On average the grade for the summaries was 8.25 on a 10-point scale. All students in the creator group participated in, and passed for the final exam.
Of the students in the reflector group 4 of the original 11 students failed to submit their essays and 4 out of 11 were not present at the final exam. The average mark for the essays was 7.55 on a 10-point scale.
Creators were more often present at the lectures than students in the reflector group. Of the creator group, 4 out of 18 creators attended all four lectures, 8 out of 18 attended three, and 6 out of 18 attended two or less. Of the reflector group, none of them attended all lectures, 2 attended three lectures, and 4 out of 7 attended two or less lectures.

Results on the Final Examination

The scores for the final examinations of the courses ISM-1 and ISM-2 are given in Figure 2. The average scores for the creator and reflector groups are given under the graph, with the standard deviation given in brackets.
There was no difference found between the groups based on the score of the previous course ISM-1 (t(22)= 0.352, p=0.730). No significant difference was be found between the groups on the score of ISM-2 when the overall grade for the final examination is con- sidered (t(22)=1.270, p=0.222). When the knowledge items and the transfer items on the final examination are considered separately, there remains no difference between the groups (t(22)0.103, p=0.919 for knowledge questions, and (t(22)2.083, p=0.054) for transfer questions).

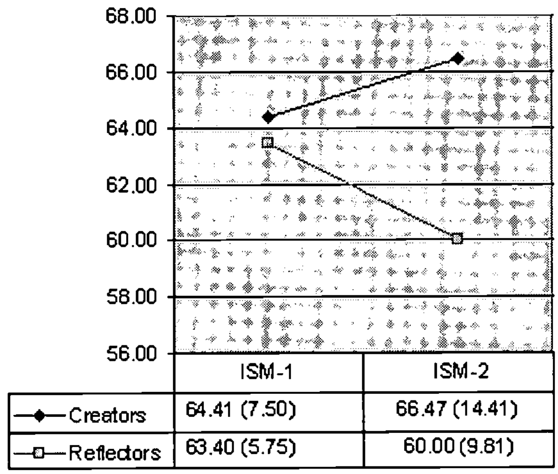


Figure 2. Student performance on final examination, average and standard deviations.

Time-investment by Students and Instructors

Table 1 gives on overview of the time-investment of students for the course, split into creator and reflector groups. When an asterisk (*) is printed there was a significant difference between the groups.

Activity	Minutes, Creators (means and standard deviations,rounded)	Minutes, Reflectors (means and standard deviations, rounded)
Searching on the WWW	79 (93)	56 (35)
Searching in books and journals*	337 (186)	7(13)
Inserting materials into the course WWW site	144 (135)	N/A
Learning to work with the course WWW site	25 (23)	19 (28)
Dealing with computer problems	10 (15)	69 (156)
Creation of essays	N/A	592 (425)
Use of a shared workspace	No use	No use
Use of a course mailing list	1.53 (4.9)	0.43 (1.13)
Personal discussions with the instructors (face to face or via the WWW)*	31(21)	9 (15)
Personal discussions with fellow students	95 (82)	44 (56)
Studying the instructor-provided materials*	1,611 (953)	872 (563)
Attending the lectures*	265 (67)	167 (81)
Other activities	102 (288)	0.7 (1.89)
Writing the final examination	85 (22)	91 (3.78)
Total time spent on course	2,802 (1077)	1,932 (933)

Table 1. Participation and time of participation in course-related activities (* Significant, p<.05).

The time invested by the instructors of the course can be found in Table 2. Times are gives in minutes.

Task	Primary instructor	Instructor 2	Instructor 3	Total (minutes)
preparation of lectures	3,770	840	960	5,570
Preparation of assignments for students	190	300	150	640
Giving feedback to assignments	1,230	1,500	680	3,410
Preparing and entering materials on WWW site	10	495	875	1,380
Personal discussions with students	360	270	435	1,065
Attendance at lectures	460	220	250	950
Maintain WWW site; ongoing administration of student data	30	0	705	735
Other	510	30	900	1,125
Total per instructor	6,580 minutes (110 hours)	3,655 minutes (61 hours)	5,180 minutes (86 hours)	15,415 minutes (257 hours)

Table 2. Tasks and time on task of instructors (in minutes)

Discussion

No significant differences were found when comparing the performance of the creator and reflector groups on the final examination of the course. The creator group however spent considerably more time on the course than did the reflector group (2,802 minutes compared to 1,932 minutes). So, the extra time spent by the creators in ISM-2 did not result in overall better performance on the final examination. However, the nearly significant difference on the transfer type of questions (p=0.054) suggests that there may be a significant difference when more-sensitive test questions are used. Further, the payoff may be more related to higher level insights than to knowledge level retention.

There are some other indicators of differences between the groups. There were fewer dropouts in the creator group of the course, and as a result of this more students of the creator group finally passed the course.

With regard to the time-investment of students there were some interesting differences (Table 1). The time spent searching in journals and books was 337 minutes for the creators, while only 7 minutes for the reflectors. With the time spent searching for sources on the WWW there was less difference: 79 minutes for the creators, and 56 minutes for the reflectors. These results suggest that the WWW seems to invite students to search for additional materials to the course, much more than the library seems to invite our students to read additional materials.

Further, the creators spent nearly twice as much time studying the provided materials than did the reflectors (1,610 minutes compared to 872 minutes). It seems that the scaffolded approach used with the creators stimulated them not only to spend more time on the activities required for them, but also to spend more time on activities that were expected to be more important for the reflector group. This point is further illustrated by the total time investment of both groups, which was higher for the creators than for the reflectors (2,802 compared to 1,932 minutes). Time-investment overall was lower than the expected 4,800 minutes (80 hours).

The instructor time spent was considerably higher than the time spent by the students of the course. A part of this invested time may be reduced next year, such as the time for redesign of the course and the course WWW site, time for discussing the new approach followed, time for designing the final examination questions, and time for redesign of the lectures. Another part of this invested time will remain, for example for giving elaborate feedback to students (total: 3,410 minutes). This time could however be reduced by using other forms of giving feedback, such as peer-feedback, and using other media, such as audio for giving feedback.

Conclusions

So, what has been the impact of applying this model for scaffolding on this course? The first research question (about the impact of implementing this model for scaffolding) is answered as follows: the impact of the model has not been expressed in a significant difference on the final examination favoring the creator, or reflector group. There was an impact however on the attendance at lectures, overall time spent for the course, and completion rate of the course.

The second research question (about the balance of extra cost with benefits) can now also be answered. Due to the lack of measureable differences found in the results, the extra cost, in terms of time-investment of both students and instructors, can at this moment not be justified.

Research on scaffolding does not stop here. First, the measurement of the results could be greatly improved. While the results point in the direction of a gain in transfer-type of knowledge. These skills may be more-sensitively measured with a different instrument than multiple-choice questions.

A second point is the improvement of efficiency. Not all aspects in a course need to be scaffolded. When an instructor knows what are the most important or hardest parts for the students, the scaffolding can be focussed on this part of the course. Further, scaffolding does not necessarily need to be done by writing elaborate feedback, but could also be done in the form of impersonal or general feedback remarks, as suggested in studies of Visser (1998) and Gordijn (1998).

The last point is related to the preference of the instructor. Instructors may believe that the changes occurring in the division of roles between student and teacher, with the student taking over the learning process as much as possible, collaborating with an instructor, and learning to regulate their own learning, may be important developments for the future. If instructors believe this, it is worth exploring scaffolding, and further improving the efficiency of scaffolding.

References

Aronson, D. T., & Briggs, L. J. (1983). Contributions of Gagne and Briggs to a prescriptive model of instruction. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: An overview of their current status.* (pp. 75-100). Hillsdale NJ: Lawrence Erlbaum Associates.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, (18),* 32-42.

Gordijn, J. (1998). *Computergestuurde feedback in modulen. [Computer supported feedback in modules].* Unpublished doctoral dissertation, University of Twente, Faculty of Educational Science and Technology, Enschede.

Guzdial, M. and C. Kehoe (1998). Apprenticeship-based learning environments: A principled approach to providing software-realized scaffolding through hypermedia. *Journal of Interactive Learning Research, 9*(3/4), 289-336 [URL] http://guzdial.cc.gatech.edu/papers/ABLE/

McLoughlin, C., & Oliver, R. (1998). Planning a telelearning environment to foster higher order thinking. *Distance education, 19*(2), 242-264.

Pressley, M., Hogan, K., Wharton-McDonald, R., Mistretta, J., & Ettenberger, S. (1996). The challenges of instruction that supports student thinking. *Learning Disabilities Research & Practice, 11*(3), 138-146.

Suthers, D. (1998, April). Representations for scaffolding collaborative inquiry on ill-structured problems. Paper presented at AERA 1998, San Diego. [URL] http://advlearn.lrdc.pitt.edu/advlearn/papers/aera98/AERA98.html

Tielemans, G., & Collis, B. (1999). Strategic requirements for a system to generate and support WWW-based environments for a faculty. In B. Collis & R. Oliver (Eds.), *Proceedings of ED-MEDIA '99*, Vol. 1, (pp. 346-351). Charlottesville, VA: AACE.

Tiessen, E., & Ward, D. R. (1997). Collaboration by design: Context, structure and medium. *Journal of Interactive Learning Research, 8*(2), 175-197.

Visser, L. (1998). *The development of motivational communication in distance education support.* Unpublished doctoral dissertation, University of Twente, Faculty of Educational Science and Technology, Enschede.

Vygotsky, L. (1978). *Mind in society: the development of higher psychological processes.* Cambridge MA: Harvard University Press. (Original material published in 1930, 1933 and 1935).

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of child psychology and psychiatry, 17*(2), 89-100.

Developing a Storyboarding Process for Online Content:

From Microsoft PowerPoint to Macromedia Flash

Jennifer A. Wolverton, M.A.
Brigham Young University
Center for Instructional Design
Provo, Utah, USA
jaw23@email.byu.edu

Greg Waddoups, Ph.D.
Brigham Young University
Center for Instructional Design
Provo, Utah, USA
greg_waddoups@byu.edu

Abstract: The development of a Statistics 221 course at Brigham Young University required that a large number of multimedia objects (>800) be created in a relatively short period of time (<8 months) by over 20 employees, most of whom were students with varying schedules and abilities. As a means of providing a standard communication device in the development of the course, a storyboard was created in Microsoft PowerPoint. The effectiveness of the storyboard design was then evaluated by surveying all project participants. The results of the evaluation were used in redesigning the storyboard for use in the development of additional online courses.

Need Statement

The development of a Statistics 221 course at Brigham Young University required that a large number of multimedia objects (>800) be created in a relatively short period of time (<8 months) by over 20 employees, most of whom were students with varying schedules and abilities. These objects then needed to be inserted into web pages with other instructional elements (assignments and activities) to form the basis of the course. For the most part, these media objects are discrete multimedia objects embedded in instructional modules programmed in Macromedia Flash.

In a previous project, written and verbal descriptions of multimedia objects had been used to manage their production. However, our experience with that project provided insight about using written and verbal descriptions of media objects. The following weaknesses were observed:

1. Text descriptions of media objects are very time consuming to write.
2. Text descriptions never adequately convey what the designers want created.
3. Verbal descriptions required arranging expensive meeting times between designers, artists, and programmers.
4. Because verbal descriptions are not stored, they can be easily forgotten, misinterpreted or changed.
5. Verbal descriptions are also difficult to track.

The nature of these objects was part of the problem. Many of the objects, in addition to being very visual, were also designed to take advantage of Flash's highly interactive capability, making them difficult to describe.

Search for Existing Solutions

Various solutions to managing the output and quality of these kinds of multimedia objects were explored, but neither instructional design software (like Designer's Edge from Allen Communications) nor movie storyboarding software (such as Storyboard Artists from PowerProduction Software) filled the need. Problems encountered included the inability to print text and visual instructions on the same page and the inability to recognize a broad range of standard files types. A standard tool that content experts could learn quickly, and that adapted to our specific need was needed and existing solutions did not meet our needs.

Our Solution

The development of multimedia objects in Flash was actually the second phase of the course development project. An earlier version of the course had been created using PowerPoint. The purpose of migrating from PowerPoint to Flash was to take advantage of Flash's more robust animation and interactive capabilities and to make the discrete objects more suitable for the web. Yet, it was determined that the older, PowerPoint versions of the lessons could serve as the basis for the storyboards.

Because the objects were going to be animated in Flash, it was decided that the content experts would not spend additional development time animating multimedia objects in PowerPoint. Rather, the slide layout feature of PowerPoint would be used to design the visual content of the course (see Fig. 1 Feature 2). Then, the "Notes" feature of PowerPoint was used to provide additional art and animation instructions to the artists and programmers developing the content (See Fig. 1, Feature 6).

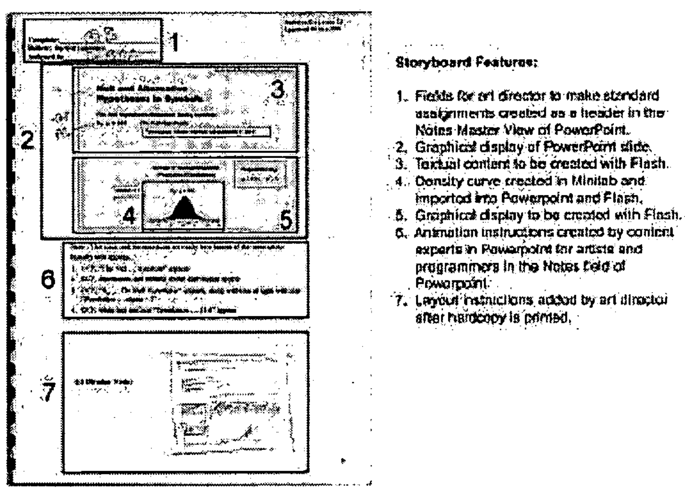


Fig. 1 Page from a Statistics Storyboard

This solution lent itself particularly well to the statistics course because so much of the preliminary work had already been done in PowerPoint and because there are many visual elements of the course that required statistical precision. These elements had to be specified by a content expert. The artist could then modify the statistical information to improve the aesthetic presentation to the degree that the statistical content remained accurate.

A design process was developed in which the content experts and instructional designers used PowerPoint as the medium through which the course content was developed. Statistical software such as Minitab was used to produce charts and graphs (see Fig. 1, Feature 4), which were then imported into PowerPoint. The content experts added textual instructions to the artists and programmers (see Fig. 1, Feature 6).

Once the storyboards were approved by the content experts, the Notes Template feature in PowerPoint was used to create a header on every page where the art director could indicate which art template would be used and which artist would be assigned to the project (see Fig. 1, Feature 1). Space was also provided at the bottom of the notes section for the art director to draw the layout that should be used and give other instructions to the artists (see Fig. 1, Feature 7). The ability to embed objects and add textual instructions in PowerPoint was useful. But allowing the art director to add freehand sketches allowed us to compensate for the limitations of the tool.

After the art director finished making comments on the storyboard, copies of the storyboard were made for each department participating in the project. These copies were bound and distributed to the Art Department, Instructional Designer, Statistics Department, Programming/Authoring Department, and Video Department. Additionally, the final electronic copy of the storyboard was distributed to the Art Department so that the Minitab graphs could be imported into Flash. The Art Department would create specific media objects while the programmers created the Flash file in which the text of the presentations and the media objects were embedded (see Fig. 1, Features 3 and 5). Once a produced, the instructional designer and content team reviewed the objects and requested revisions if necessary (compare Fig. 1 and Fig. 2).

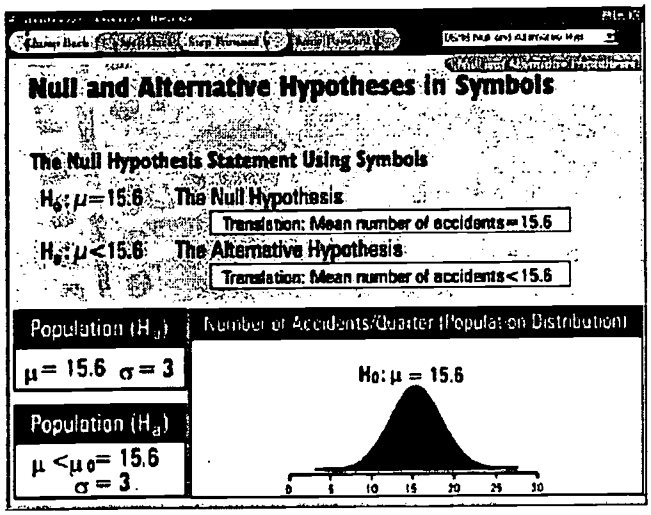


Fig. 2 Screenshot of a statistics lesson. End-product of the media objects requested in the storyboard above.

The hardcopy of the storyboard then served as the design document that all members of the party could reference.

Results

After using the storyboards for the statistics project, we conducted an evaluation of the storyboarding process as a means of determining whether or not it would be useful in additional course development projects and how it could be improved.

All the storyboard users who participated in the project were identified. This included the instructional designer, 6 members of the content team (1 faculty member content expert and 5 student content experts), 19 members of the art team (1 full-time senior production designer, 16 student artists, and 2 photographers), and 17 programmers (1 full-time lead programmer and 16 students).

Each type of storyboard user was asked how the storyboard was used, what elements of the storyboard were useful, and what elements of the storyboard were not useful. All storyboard users were contacted via email with the exception of the lead faculty content expert and the instructional designer. These two participants were interviewed in more detail.

The summary of the results follows in the detail given below.

Content Team

<u>How it was used</u>
The content experts used the storyboards as a basis of communication in the design process and during production. They compared the final product with what was requested in the storyboard to determine whether or not the media objects met the original specifications.

What worked

1. The storyboards were useful as a tool to compare the final product with the original production requests.
2. The storyboards provided a tool to help the content experts organize the logical flow of the lesson. As one student content expert reported, "The storyboards helped me organize the lesson in a logical flow, without being bogged down in the details of artistic content."
3. The storyboards a single point of reference for all participants of the project to communicate with.

What didn't work

1. The content experts felt that the animated nature of many of the objects was not adequately described on the static storyboards. He felt that when objects were designed, he could not visualize what they would look like when animated. This led him to desire revisions to the media object design after it was produced because he felt if reworked, they would work better in the classroom.

2. The content experts felt that artists took artistic license in revising objects that needed to be copied precisely. As a result, the statistical accuracy of some objects was altered, requiring additional revisions.

Instructional Designer

How it was used

The instructional designer used the storyboard as a means of communication while designing the content of the course with the content expert and his assistants. She then used it as tool to communicate production specifications to the artists and programmers. It was also used as the standard against which produced objects were checked for accuracy.

What worked

1. Useful as a single point of reference for all project participants.
2. Because of the large number of objects, it was helpful way of documenting design specifications.

What didn't work

1. The storyboard was intended to be used as a design document. It became obsolete when design changes were requested after objects were in production.
2. Many of the statistically accurate objects were embedded in the electronic version of the PowerPoint file that was distributed to the artists. When artists created objects from scratch instead of using the statistically accurate charts and graphs provided them, it became problematic.

Artists

How it was used

The artists used the storyboard as the design document. Essentially, it was their sole set of instructions for producing an object.

What worked

1. Useful as a single point of reference for all project participants.
2. The storyboards helped the artists understand what the content team wanted designed. For example, when student artist said, "They provided detailed directions of how to present the concept, making it possible for animators who have not taken the course yet to still know how to teach the concept."

What didn't work

1. Visual decisions were made by content experts rather than by artists. The artists viewed this as a problem for two reasons. First, the artists felt that many of the layout decisions were artistically inferior to what the artists could suggest. The result was decreased job satisfaction because artists were not allowed to be as creative as they would like.

2. Storyboard authors assumed their audience had a greater understanding of statistical audience than they really did. Problems incurred included confusing directions (because artists did not understand the terms); difficulties with accuracies of graphs because artists would make artistic changes to graphs, not realizing the changes made them statistically inaccurate; references to non-ascii characters were unclear (authors would refer to a spelled out version of a non-ascii character (i.e. "alpha" for α); the text references were spelled out and the visual storyboard used symbols; artists lacked the necessary knowledge to correctly identify them as the same character, making the instructions confusing.

3. Content experts requested additional design changes after storyboards were in production.

4. Storyboards were not thought-through enough. The artists felt that requests for design changes and misspellings in the storyboards were evidence of the content experts not thinking through their production requests thoroughly enough in the pre-production process.

By using PowerPoint to storyboard a Flash object, the capabilities of Flash were not maximized. The artists felt that more innovative animations could have been created in Flash. By using PowerPoint to design the storyboards, it limited the content experts to the technologies they were designing with.

Programmers

How it was used

The programmers used the storyboards for several purposes. First, the referenced the storyboard layouts to create the Flash file which contained the lecture and all embedded media objects. Second, once the media were produced, they would reference it to see where all the media objects needed to be inserted and how they should work. Finally, they referenced the storyboard for instructions on programming java applets.

What worked

1. Detailed instructions were useful.
2. A single point of reference for all participants in the project. For example, one programmer reported that, "The storyboards gave a common ground for everyone working on the stats lessons to work from."

What didn't work

1. Revisions made in the art process were not communicated effectively to programming. As a result, by the time the programmers were ready to insert media objects, their storyboard were often out-of-date.
2. Degree of detail and instructions led to decreased job satisfaction. Like the artists, the programmers felt that they were not able to fully utilize their programming skills.
3. The amount of revisions occurring in production was problematic. As one programmer stated, "We would make changes and then take them to the professor to approve and then we would make more changes and this would be repeated many times."
4. Storyboarded objects sometimes didn't take into account programming issues in Flash. Essentially, the design instructions presented to the artists and programmers did not reflect a consideration of how to best develop the objects given the selected technologies.

Conclusions and Recommendations

All project participants responded positively to having a single point of reference for all the objects being designed in the course. Most of the frustration identified by all participants of the project stemmed from the amount of revisions implemented after objects were produced. This frustration can be significantly reduced by helping content experts in the design process think understand that once the design stage ends and production begins, revisions can only be made when produced objects do not meet specifications rather than when a new idea for improving the object occurs. Such adherence to feature lock be understood by all parties in the project as well as the decision-making level of the organization.

Assuming that the revision process is decreased, the storyboard seemed to be quite useful. The storyboard is being used in the creation of an introductory biology course. In this case, a word processing tool is being used in place of

PowerPoint. The decision to not use PowerPoint was made for several reasons. First, the biology project is a self-contained, fully-online course rather than an in-class presentation. As a result, PowerPoint does not lend itself as well to the format of the course. Second, PowerPoint is a very time-consuming tool to storyboard in. It was selected for statistics since most of the content was in PowerPoint to begin with. But, in the case of the biology course, it is more time-efficient to use a word processor.

The biology course storyboard is divided into two sections, in attempt to address the needs of programmer and artists more specifically. The programming section includes a hardcopy of the entire script of a given biology lesson with instructions as to where to insert specific media objects. The art section dctails the instructional objective and production instructions for each object. Once again, space is provided for the art director to add addition comments, sketch layouts, etc. In addition to the programming and art sections, the front of the storyboard includes the specification for the navigation of a particular lesson as well as a Table of Contents listing each media object, the outline of the lesson, and the file names for each object in the lesson. As with the statistics storyboard, the biology storyboards are bound and distributed to all project participants.

The intent of the biology storyboard is to improve upon the features that worked in the statistics storyboard such as providing a single set of instructions to al participants. At this early stage, participants have indicated that the new-and-improved storyboard addresses most of the problems of the first type of storyboard and is much for useful.

Creating Multimedia Instructional Projects: Fun or Frustration?

C. James Wong
Instructional Technology & Distance Learning, Learning Resources Division
Southwestern Illinois College
cjwong@mail.southwestern.cc.il.us

Abstract: The purpose of this case study is to investigate language teachers' experiences in developing multimedia instructional projects. This paper reports two language teachers' project development experiences, difficulties, successes, and concerns, and reflections. Implications and suggestions for technology training programs for language teachers are discussed.

INTRODUCTION

Media and technologies have had an inevitable impact on education. Multimedia software programs have been made available to teachers and students by commercial companies. Multimedia hardware and software are tools that offer possibilities for improving the learning process, but the teacher will have to integrate them into the curriculum in a way to facilitate teaching and learning (Heinich, Molenda, Russell, & Smaldino, 1999). In such integration process in language education, finding useful software applications can be a difficult task due to the following factors: (1) A large number of commercial applications are designed for personal use, not for classroom use. (2) Some applications might be useful, but too expensive to buy enough licenses for all the computers in a language learning lab (Aoki, 1996). Therefore, language teachers often need to create their own multimedia instructional materials customized for their instructional objectives and their students' learning goals, in their specific teaching and learning contexts, and at their students' language proficiency levels.

The purpose of this case study is to investigate language teachers' experiences in developing multimedia instructional projects. The results of the study are expected to help teacher trainers discover and gain insights about language teachers' experiences (such as successes, difficulties, and concerns) in creating multimedia projects. The understanding of such experiences is intended to (1) enhance teacher trainers' facilitation in preparing language teachers (both pre-service and in-service) to develop multimedia instructional projects, (2) helps language teachers be informed of the possible difficulties they might encounter before attempting to start the multimedia development process, and (3) allow language teachers to reflect upon their own experiences in developing multimedia instructional materials and thus improve the development process in a more effective and efficient fashion.

BACKGROUND

More and more teacher education and professional development programs offer educational technology courses such as development of multimedia instructional programs to both pre-service and in-service teachers. Especially in the fields of science and math education, many teacher educators have been incorporating multimedia development training into their curriculum. In the meantime, this trend is being or will be soon adopted by language education programs. As Feyten, Taylor, and Nutta (1996) noted, "It is imperative, then, that our teacher preparation programs integrate instructional technology into their curriculum, to begin to correct this deficiency, and to produce future foreign language teachers who are comfortable with and adept at the implication of the media into their classrooms."

In the process of developing multimedia instructional projects, teachers' experiences might vary and depend upon a number of possible (or assumed) factors such as computer anxiety, previous computer experience, training, subject area, and creativity. However, these factors may or may not be applicable to every teacher, especially a language teacher. Thus, an understanding of language teachers' experiences in creating multimedia instructional projects may help teacher educators improve their educational technology programs based on various learner's needs and their individual differences. However, only have a few studies (Mitchell & Hunt, 1997; Anderson et al., 1993; Tucker et al., 1990) been conducted to explore the experiences of teachers in developing multimedia instructional materials. Research studies of such focusing on language teachers in particular are even rare.

LITERATURE REVIEW

In the research literature, studies on language teachers' experiences in developing multimedia instructional programs are rare. However, there are a few studies on multimedia development experiences of teachers of other subject matters.

Mitchell and Hunt (1997) state that higher education must train pre-service physical education (PE) teachers based on the requirements of more technologically literate students. In their study conducted at the University of Central Florida, an innovative way to develop lesson plans has been discovered by using multimedia authoring software, such as HyperStudio, that lets students integrate text, graphics, video, audio and digitized images into their lesson plans. They reported that a multimedia lesson plan can become a three-dimensional lesson plan that is advantageous in PE as it can show physical movements.

Hatfield (1996) describes a project that combines technology, teacher education, and the use of manipulatives for mathematics instruction to enhance the professional development of prospective teachers. The multimedia developed in the project are means of bringing the classroom environment to the university to facilitate discussions about prospective teachers' beliefs about mathematics teaching.

Another study (Anderson et al., 1993) was conducted in Scotland to determine whether untrained classroom teachers could learn HyperCard from a minimal manual and then create their own stacks. The development of the minimal manual is discussed, use of the manual and software is analyzed, and teachers' attitudes are examined.

In a 3-year project started in 1989 to train faculty in the College of Education to incorporate hypermedia into their curriculum at the University of South Alabama, Tucker et al. (1990) reported that evaluation of the program concentrated on program context, process, and product. Data sources included review of project proposals, analysis of internal evaluation data, visitation to field applications, interviews, and photo-interviews. Photography was chosen as an evaluation method because of its holistic quality, the volume of detail it provides, and the role it plays as a source of discussion. Results of the program evaluation reveal that: (1) most early adopters had prior experiences with technology; (2) HyperCard has been used by program participants in presentations, interactive video and animation projects, and reading analysis; (3) the biggest need cited for skills training was "time to practice"; (4) photo-interviews yielded rich data and provided a means to describe and explain the program and its consequences; and (5) photo-interviewing can serve as an instructional as well as an evaluative strategy given the projective nature of visual images.

According to another line of foreground research studies which concentrate on attitudinal effects, teachers' attitudes toward computers have significant impact on their decision to use specific instructional media including computers in the classroom and the curriculum (Dupagne & Krendl, 1992; Kluever, 1994; Pina &

Harris, 1993; Savenye, 1992). For instance, in a review of literature on teachers' attitudes toward computers, Dupagne and Krendl (1992) described that "early studies reported some resistance to computer implementation" (pp. 420-421), and this statement correlated with teachers' ambivalent attitudes toward computer technology revealed in the studies conducted in the 1970s and 1980s (Dupagne & Krendl, 1992). When teachers are found holding negative attitudes toward computer technology, their concerns about computer use in the school environment must be considered and pinpointed since there are a number of factors contributing to such attitudes. Some of the factors identified include computer anxiety, efficiency, liking, and instructional usefulness (Kluever, 1994). Furthermore, knowledge of and training on applications of computer in education and the actual limitations of the computer hardware and/or software may also be concerns of teachers (Dupagne & Krendl, 1992).

Due to the lack of research literature similar to the study, the literature review provided in this section might not be directly associated with the phenomenon to be discovered and addressed in the study. First, the research studies discussed above dealt with contexts different from those in the study, for example, the content areas of teaching in the literature review differ from that in the study. Second, the participants in the studies outlined above might also differ from those in the study who are teacher education students ranging from undergraduate to doctoral levels and who have or have not served as language teachers. Third, the most important aspect of the phenomenon considered as background, which is the whole phenomenon understood as a complex system that is more than the sum of its parts, is the whole experience of language teachers in developing multimedia instructional programs from a holistic perspective; nevertheless, no research evidence exists to help understand this aspect of the phenomenon.

METHOD

A semi-structured questionnaire was utilized in the study. With the voluntary permission of the participants, the responses were stored electronically and then analyzed. The participants were language teachers enrolled in a semester-long course, Seminar in Curriculum & Instruction: Introduction to Computer-Assisted Language Learning (CALL) at the University of Missouri-Columbia. Their participation was optional. Two individuals participated in the case study by completing a semi-structured questionnaire with a large number of open-ended questions. They were then asked to respond to follow-up questions via e-mail to clarify and confirm the accuracy of the interview interpretation made by the researcher, and the researcher also collected copies of their multimedia instructional project proposal, class reading journals, and other documents which illustrate their multimedia instructional project development activities.

RESULTS

The Chinese Language Teacher's Case

Minjuan, a doctoral student, has taught three levels of Chinese to undergraduate students for a year at a major public university in the United States. She rated her computer anxiety as "high" on a five-point scale. She has experience in "CALL courseware authoring" and HTML editing, also familiar with other "basic tools" such as word processing, spreadsheet, Internet applications, image manipulation, and audio editing. Minjuan hasn't utilized computers in her language classroom before but did provide a one-on-one tutorial with the use of a CD-ROM software. She has developed about four multimedia programs

The Development Experience: Minjuan developed the "Practical Chinese Reader," a courseware designed for university level Elementary Chinese course. She stated that the guidelines provided by the instructor who is teaching this course set up an excellent beginning for this project. It took her about 4 weeks to develop a set of multimedia instructional programs supplementary to six chapters of the textbook students are using. "The work was really time-consuming, but lots of fun," she summarized. "The final project works well" though there are "some problems in font-displaying" and in one of the chapters, "audio is not played well, due to the quality of the audio."

Difficulties, Successes, and Concerns: As Minjuan described, "It took too much time. The biggest challenge is creating the glossary. I need to look up in the dictionary, to make sure all the words and phrases are correctly annotated." However, she exclaimed that "the success is to see the program works well after it is finished. All links are good, audio is well played, pictures are shown up." As a language teacher, Miss Chan's concern with developing her multimedia program is "how to integrate it into the classroom instruction."

Reflections: "It's a long process. But I enjoyed the creativity," Minjuan commented. She followed Philip Hubbard's design and development modules which have "given very good guidance on methodology." Both knowledge on the targeted language and skills in using the authoring software are most important. Her extrinsic motivation was to finish this project as a class assignment, and the intrinsic one was to present it at a conference related to language education.

The ESL Teacher's Case

Sheila, a master's degree program student, has taught English as a second language (ESL) for three years in junior high and senior high schools in Japan. She rated her computer anxiety as "none" on a five-point scale. Spending about two years using computers, she has learned word processing and basic HTML, computer art tools, and Macromedia Director at a major public university. She has used software such as word processing, spreadsheet, Internet applications, audio and video editing, image manipulation, HyperStudio, and HyperCard. Sheila has not utilized computers in a language classroom before. She developed two simple multimedia programs and thought that "both were interesting experiences, but a little frustrating given the amount of effort involved to produce a not very professional product."

The Development Experience: In commenting her experience in developing her multimedia instructional program, a web-based program for people learning Japanese, Sheila described it a "sometimes frustrating, but on the whole, a really enjoyable experience. I enjoyed practicing using new technology and being creative." She had problems with putting video on the web because the file size was too huge, and the end result was very disappointing. As she explained, "Planning first and keeping it simple (i.e., without too many bells and whistles) is what works. Aiming for too much (taking advantage of everything you can offer students on a web site) doesn't."

Difficulties, Successes, and Concerns: Sheila complained that her web space provided by the university was too small to accommodate all the sound files and movies she had, "things seemed to change a lot overnight, without having even touched them, and different browsers (even different computers) give different results in spite of following what a web development book said were standards." However, Sheila had some positive comments: "the sound files are great. I was really pleased to be able to put something worthwhile for Japanese learners on the web. Also, the quizzes (housed at the University of Hawaii) are a valuable, and enjoyable, in addition to the lesson. These features (along with the fact that anybody can access it free at any time), really made the web-based lesson far more valuable than a text version would have been." "Though worth it in the end," as a language teacher, Sheila's only concern was that the development process was "extremely time consuming."

Reflections: Sheila felt excited and challenged by the development process in which planning (storyboarding) was an essential stage because she had to "think first in terms of educational value rather than what's technologically possible." The "ability to honestly assess educational value of the multimedia project and a good sense of what's really practical and useful for students" were important, she explained.

"On the technical side, knowledge of how to create web pages is a must." Intrinsic motivation for Sheila was to get a good job that she enjoys doing, and she described, "personal work satisfaction which would be achieved by helping students (particularly disaffected ones) get motivated and interested in learning by/for themselves. The desire to create something worthwhile, be useful and productive, and make a difference is strong." She would not mind if someone is willing to pay her "lots of money for this."

DISCUSSION

Previous Computer Experience

The participants in this study are considered as intermediate to advanced users of the computer and multimedia production software. In the future, beginning users and non-users would be included in order to reveal their experiences which might be different from those described above, so the assumption about novice users tending to report more technical difficulties and higher frustration as well as anxiety level than experienced users will then be discovered.

Both participants emphasized that having the technical skills is crucial. An issue related to this is whether pre-service and in-service language teachers should take a series of technology courses prior to taking the CALL course which focuses on both theory and practice, or they should learn most of the technical skills like using multimedia production software in the CALL course. For this issue, two sides of the coin need to be examined. If novice users take a certain number of technology courses that are of interest to them first, they will have at least some good working knowledge about computers when they are taking the CALL course later. However, if they first take the CALL course partly as an introduction to software available to them; once they have a basic understanding of the technical functionality and feasibility of the software, they then can decide later which technology course(s) they would like to take in the future and utilize those skills acquired from such course(s) to create their multimedia instructional programs.

Difficulties and Concerns

Both participants reported that the development of their multimedia instructional programs required a tremendous amount of time although approximately one third of the class time was devoted to developing. In math and science education, lab and tutorial hours are supplementary to regular class meetings. Likewise, for a course in language education that has a multimedia development component, it might be adapted to the model used in math and science courses.

Technical difficulties are no surprises: just to name a few, limitation of web space and poor audio clip. Participants should be able to request a larger web space if they intend to create a complex multimedia web-based program. The computer lab should be equipped with acceptable quality of multimedia production and editing software and hardware. In terms of dealing file content instability on the web server, participants in a CALL course are advised to keep a master copy of the entire web-based program for recovery and a working copy for revision. Similarly, such dual copy approach can be adapted and adopted by participants creating other multimedia programs than a web site.

One of the participant's concerns was how to incorporate her multimedia program into the classroom. During the planning stage, it is essential to invite participants in a CALL course to conduct a user analysis of their multimedia program. A review of the target audience will help developers to focus on the content and interface of the multimedia program. Philip Hubbard's (1996) design module provides a concrete framework to guide developers building the ideas theoretically and practically. Besides, participants in a CALL course should strongly be encouraged to create something they will use in their own classrooms as an authentic learning and production experience.

Positive Comments

Though both participants encountered frustration, difficulties and challenges in the process of creating their multimedia programs, they agreed that it was an enjoyable experience after all, particularly the opportunity for them to express their creativity though the final product. When things have come to work, the degree of satisfaction and a sense of achievement are positive driving forces for these amateur multimedia developers.

IMPLICATIONS

More participants, especially those with various levels of computer literacy, will be needed to share their experiences for this on-going research study, so a larger scope of experiences can be documented and revealed. The researcher of the study has found the data collected so far very useful in refining the current CALL program designed for language teachers.

REFERENCES

Anderson, A. et al. (1993). Teaching teachers to use HyperCard: A minimal manual approach. British Journal of Educational Technology, 24(2), 92-101.

Aoki, N. (1996). HyperCard programs for CALL. In S. Fotos (Ed.), Multimedia Language Teaching. (pp. 57-69). Tokyo: Logos International.

Dupagne, M., & Krendl, K. A. (1992). Teachers' attitudes toward computers: A review of the literature. Journal of Research on Computing in Education, 24(3), 420-429.

Feyten, C., Taylor, G., & Nutta, J. (1996). Interfacing teacher preparation and cyberspace: An innovative approach. In J. Price, J. Willis, D. Willis, & B. Robin (Eds.), Technology and Teacher Education Annual, 1999 (pp. 865-869). Charlottesville, VA: Association for the Advancement of Computing in Education (AACE).

Hatfield, M. M. (1996). Using multimedia in preservice education. Journal of Teacher Education, 47(3), 223-228.

Heinich, R., Molenda, M., Russell, J. D. & Smaldino, S. E. (1999). Instructional media and technologies for learning. (6th ed.). Upper Saddle River, NJ: Merill/Prentice Hall.

Hubbard, P. L. (1996). Elements of CALL methodology: Development, evaluation, and implementation. In Pennington, M. C. (Ed.), The Power of CALL (pp. 15-32). Houston: Athelstan.

Kluever, R. C. (1994). The computer attitude scale: Assessing changes in teachers' attitudes toward computers. Journal of Educational Computing Research, 11(3), 251-261.

Mitchell, D. L., & Hunt, D. (1997). Multimedia lesson plans - help for preservice teachers. The Journal of Physical Education, Recreation & Dance, 68(2), 17-21.

Pina, A. A., & Harris, B. R. (1993, November). Increasing teachers' confidence in using computers for education. Paper presented at the Annual Meeting of the Arizona Educational Research Organization, Tucson, AZ.

Savenye, W. C. (1992). Effects of an educational computing course on preservice teachers' attitudes and anxiety toward computers. Journal of Computer in Childhood Education, 3(1), 31-41.

Tucker, S. A. et al. (1990, March). Training university faculty to integrate hypermedia into the teacher training curriculum. Paper presented at the International Conference on Technology and Education, Brussels, Belgium.

A Cognitive-Affective Framework for Instructional Interactivity: CAFI^2

Michael Yacci
Associate Professor
Information Technology
Rochester Institute of Technology
Rochester, New York 14623 USA
may@it.rit.edu

Abstract: Interactivity is a popular, although little understood term. This paper provides a short definition of interactivity in instruction. It then proposes a framework to study interactivity that addresses both content learning and affective benefits that arise from instructional interactivity.

The Nature of Instructional Interactivity

The proclaimed educational benefits of the "new media" are their potential for increased and improved interactivity. However, the nature of interactivity is a conceptual area that has historically been poorly developed. This paper presents a cognitive-affective framework for instructional interactivity (CAFI^2), and describes the general rationale for the framework. The CAFI^2 is currently being used as part of an ongoing cataloging and evaluation project, described later in the paper.

In his keynote address at AACE, Thomas Reeves (1999) suggested that we do not have a very good definition of interactivity in instruction, suggesting that "teacher-in-a box" has been the prevailing approach. The Institute for Higher Education Policy's recent review on distance learning (1999) cited the lack of a conceptual or theoretical framework as a major shortcoming in studying distance learning.

Research on various aspects of interactivity seems to focus on either the cognitive or affective aspects of interaction, but not both. For example, human-computer interaction studies generally concern themselves with the way that users understand computer systems, the mistakes that they make, and the previous knowledge that they bring into play, among other issues. These types of studies are generally cognitive in their concerns with a user's understanding of the principles and concepts of a system. On the other hand, affective issues are frequently brought to light in teacher training and educational literature as issues of motivation, group support, participation, collaboration, and attribution among others.

Therefore, a framework that describes both cognitive and affective interactivity within a single framework provides a mechanism for integrating past and future research. This framework would also become a structure by which evaluators could more thoroughly study distance delivered courses.

This paper describes the rationale behind the Cognitive-Affective Framework for Instructional Interactivity (CAFI^2), an attempt to link previous research across the cognitive and affective domains into a contemporary framework for analyzing instruction. This framework has been initially intended to provide a map and a terminology by which designers can catalog and describe the components of distance learning courses. It is hoped that this framework can provide a mechanism for analysis of current instructional designs so that teachers and designers can ensure that courses are appropriately providing for cognitive aspects of instruction as well as affective aspects.

Interactivity Defined

The term interactivity is itself troubling. While the term is common in the literature, the exact meaning of interactivity is generally quite vague. We attempted to create a structural definition of interactivity that

The term *affective benefits* was selected because learning and growth in the affective domain is not as straight-forward as growth in the cognitive domain, where the principle of complexity (Krathwohl et.al., 1964) is the primary organizational principle. It also would appear that affective growth is not the primary reason for including certain types of interaction. Motivational and social benefits as they relate directly to the student, independent of cognitive learning, seem to be the underlying results--not growth in a direct sense.

Previous research shows that affect is a significant contributor to academic achievement (Khan,1969), but the area still has much that is unknown (Brophy, 1999). It is our belief that affective benefits provide value added beyond academic achievement. For example, it would seem that affective benefits can be reduced or eliminated (in a purely Spartan approach to content learning) but at the cost of lessened student satisfaction. Therefore, we believe that these affective benefits need to be examined outside of their role in academic achievement.

Krathwohl, Bloom, and Masia (1964) proposed their original taxonomy for the affective domain to "clarify and tighten the language" of instruction. In a similar manner, it is believed that the $CAFI^2$ framework can help to link a variety of research interests in interactivity in instruction. The remainder of this paper sketches the three major areas of the framework.

1. Directive (learner-instructor) interaction.

This area represents the face-to-face, mediated real-time, and/or asynchronous contact that a student has with an instructor. In some cases, the instructor may be mediated, as in the case of videotapes, books, or computer-based training. In some circumstances, the instructor is "live" in the sense of being physically proximate to the student. An interesting hybrid is the "real-time teleconference" in which the teacher is not in physical proximity to the student, but is indeed in mental proximity--that is, the teacher and student are interacting in real time over distance.

The Directive interaction produces effects in two areas previously described: content learning and affective benefits. While an instructor is frequently a primary delivery mechanism for content, an instructor serves motivational roles as well.

The instructor as dispenser of information has often taken the form of teacher as lecturer or teacher as Socratic guide. The "lecture" is often a misnomer, as (in practice) it often allows for questions, answers, side conversations, and spur-of-the-moment inclusion and elimination of topics. So, while a lecture in its most extreme form is clearly one-way preaching, in practice the lecture tends to be a more interactive activity between teacher and student. In this interactive lecture form, the instructor provides content, remediation (in the form of alternative explanations and review) and clarifies relationships with other content.

The interactive lecture can take the form of computer based training, in which the student interacts with a computer-based instructor. In this tutorial format, the software often takes on the persona of a teacher, and the language that is used is frequently modeled after live instructors.

An important contributor to content learning is the instructor interaction that provides student feedback on performance. Mager (1988) suggests three types of feedback (adequacy, diagnostic, and corrective) that can be provided systematically. It is generally acknowledged that knowledge of results is one of the more critical contributors to content learning (Schimmel, 1988).

The teacher as motivator has been documented in many educational psychology texts. It may help to substitute other terms for instructor, such as facilitator or coach. For example, few would argue that a primary function of an athletic coach is to provide motivational support for players. It is from this direction that we ascribe affective benefits to an instructor. The qualitative evidence that a good instructor is motivational, inspirational, etc, is common. It is not likely that this motivating effect is related to actual physical presence; students can get motivated at a distance even if their contact with instructors is limited to text interactions. Students may also find motivational benefits in the writing style of computer-based tutorials and textbooks that are written so as to foster motivation.

2. Experiential (learner-environment) interaction

The Experiential interaction should be thought of as a distinct type of interaction typified by a student's direct interaction with materials from the content domain. When a student works directly with the materials of the content area (or with simulations of these materials) we can say that the student is interacting directly with the *content environment*. In this type of interaction, there is not an instructor mediating the experience--that is, the feedback that the student receives comes directly from the environments (or its simulation).

Kolb (1984) called this type of world/person interaction *grasping by apprehension*. He describes this type of interactivity thusly:

> "Apprehension of experience is a personal subjective process that cannot be known by others except by the communication to them of the comprehensions that we use to describe our immediate experience." (page 105).

An analogy that might clarify the differences between Directive and Experiential interactivity. The Directive (learner-instructor) interactivity is like a guided walk through the woods--the path has been well-paved and the guide protects the hikers from danger. The Experiential (learner-content) interactivity is like a visit to the untamed wilderness--there is no path provided, and the hiker faces the risks that an explorer faces--there is no certainty of success, but there may be a bigger personal reward when complete.

In like manner, the Experiential interaction provides students with the "raw materials" of instruction and allows students to explore and construct a path. It would seem that discovery learning techniques would be natural instructional methods to be used to foster this type of instructional interactivity.

Problem-based learning (Savery & Duffy, 1996) is the current categorical space that would include Experiential interactivity. Among other interactions, Experiential interactivity might include:

* checking for understanding (working with materials to test student hypotheses) and
* organizing raw data (creating cognitive structures for student-located data).

Kolb claims that there are affective benefits associated with this form of interactivity. We can surmise that certain students would greatly enjoy this type of interaction, while others might find it to be frustrating. Our own work (Yacci, 1994) shows that some students prefer the opportunity to explore for themselves, while others prefer to be "guided." Hence, some (but certainly not all) students are likely to find that there is an accompanying affective benefit to Experiential interactivity.

3. Coordinate (learner-learner) Interactivity

Coordinate interactivity occurs when students communicate with each other. Typically, students might exchange ideas, collaborate on projects, model strategies for success, or share "war" stories. These are generally used to provide content learning to students. Coordinate interactivity can also be a great source of affective benefits for students who enjoy working with other students. The opportunity to work with others is often desirable as a means of motivating students. Coordinate interactivity also allows "unvoiced" self-comparison between students. It allows them to get closer to others who are working towards the same goals and to "size up" work habits and methods of others.

Peer tutoring is (simply put) a method in which more able students teach less able students. This type of interactivity should produce content learning for the "learning student" and might provide affective benefits (friendship, a sense of involvement, greater self worth) to the "teaching student." Less formal mechanisms for student cooperation, such as team projects and work groups often provides peer modeling of strategies. As students work together to complete such projects, they provide insight into different ways of problems solving, different mechanisms for approaching the unknown. Both the cognitive and affective benefits of work groups are often unstructured; there is no guarantee that peer modeling or friendship will occur.

When students communicate, the benefit can be seen in changes in motivation, as some students use the opportunity to compete against others as a motivator. Others students might use the communication channels for commiseration and support. Still others have subtle, hidden agendas that may exceed any given course, such as political leadership.

References

Brophy, J. (1999). Toward a model of the value aspects of motivation in education: Developing appreciation for particular learning domains and activities. *Educational Psychologist*, 34 (2), 75-85.

Gagne, R.M. & Briggs, L.J. (1979). *Principles of Instructional Design*. New York: Holt, Rinehart and Winston.

Khan, S.B. (1969). Affective correlates of academic achievement. *Journal of Educational Psychology*. 1969, 60, 216-221.

Kolb, D. A. (1984). *Experiential Learning: Experience as the source of learning and development*. Prentice-Hall.

Krathwohl, D.R., Bloom, B.S., & Masia, B.B. (1964). *Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook II: Affective Domain*. New York: David McKay Company, Inc.

Mager, R.M. (1988). *Making Instruction Work*. Belmont, CA: David S. Lake Publishers.

Merrill, M.D. (1983). Component Display Theory. In C.M. Reigeluth (Ed.), *Instructional Design Theories and Models: An Overview of their Current Status*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Merrill, M.D. (1988). Applying Component Display Theory to the Design of Courseware. In D.H Jonassen (Ed.), *Instructional Designs for Microcomputer Courseware*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Reeves, T. (1999). Keynote Address at *ED-MEDIA 1999 World Conference on Educational Multimedia, Hypermedia & Telecommunications*. Seattle, Washington.

Savery, J.S. & Duffy, T.M. (1996). Problem Based Learning: an instructional *model and its constructivist framework. In B.G. Wilson (Ed.), Constructivist* Learning Environments. Englewood Cliffs, NJ: Educational Technology Publications.

Schimmel, B. (1988). Providing meaningful feedback in courseware. In D.H Jonassen (Ed.), *Instructional Designs for Microcomputer Courseware*. Hillsdale, NJ: Lawrence Erlbaum Associates.

The Institute for Higher Education Policy. (1999). What's the difference? A review of contemporary research on the effectiveness of distance learning in higher education. Washington, D.C. available at www.ihep.com

Yacci, M. (1994). A grounded theory of student choice in information-rich learning environments. *Journal of Educational Multimedia and Hypermedia*. Vol 3, No.3. Pp 327-350.

IMS Compliant Resource Management System

Joseph Yeo Seok Hua
Temasek Polytechnic
21 Tampines Ave 1
Singapore 529757
seokhua@tp.edu.sg

Abstract: The education arena in Singapore has seen very rapid pervasion of Information Technology (IT) and the World Wide Web (WWW). With the proliferation of courseware developed for the WWW, management of courseware development becomes an important issue that needs to be addressed for maintainability, efficiency and effectiveness. Even as the volume of WWW-based courseware development under *Temasek Polytechnic's Online Learning Environment (OLE™) [3]* grows, the *Center for IT in Education and Learning [4]* set out to develop a WWW-based Resource Management System (RMS) for the effective management of courseware development in three aspects, namely Documentation, Management and Standards. The objective of this paper is to discuss the plans and effort of Temasek Polytechnic in the development of RMS. The implementation of the completed Documentation module has improved our workflow and productivity in various areas including the reduction in paperwork, elimination of redundancy, and enhancement in the presentation of Temasek Polytechnic's OLE™ courseware offerings. The expected benefits from the future development of the Management module include more effective management of courseware development in the areas of Project Tracking, Usage Tracking, and Electronic Commerce. Compliance to the *Instructional Management System [9]* from the future development of the Standards module is envisaged to make Temasek Polytechnic's courseware offerings more accessible worldwide.

1 Introduction

The education arena in Singapore has seen very rapid pervasion of Information Technology (IT) and the World Wide Web (WWW). The impetus is primarily fueled by the initiatives of the Singapore government, which has taken an aggressive and proactive approach in this area. For example, the Singapore government has various IT related masterplans, including a *Masterplan for IT in Education [1]* as a blueprint for the integration of IT in education as a strategy to meet the challenges of the 21st century.

With this backdrop, the educational institutions in Singapore, and in particular, the tertiary institutions are moving rapidly to adopt IT in teaching and learning, and to develop courseware for the WWW to harness the potential it offers. With the proliferation of courseware development for the WWW, courseware management becomes an important issue that needs to be addressed for maintainability, efficiency and effectiveness.

In *Temasek Polytechnic, Singapore [2]*, even as the volume of WWW-based courseware development under the *Online Learning Environment (*OLE™*) [3]* grows, the *Center for IT in Education and Learning (CITEL) [4]* set out to develop a WWW-based Resource Management System (RMS).

(CITEL is a support centre that facilitates academic staff in harnessing information technology effectively in the teaching and learning environment so as to make the teaching/learning experience a creative, innovative and enjoyable one. CITEL initiated OLE™ in 1997 as a service to offer computer-based learning courses for students of Temasek Polytechnic and the general public to develop work-place skills for the new millennium. It also offers useful resources for staff and students.)

The objective of RMS is to more effectively address what will be classified here as three main aspects pertaining the effective management of courseware development which is deemed important for CITEL's requirements. They are namely Documentation, Management and Standards.

The objective of this paper is to discuss the plans and effort of CITEL in the development of RMS to address the three aspects of courseware development highlighted. The RMS project is divided into three corresponding phases. The development platform used is PERL programming language and MS SQL database under the Windows NT operating system.

2 Documentation

As with MIS applications, documentation for WWW-based courseware is typically few and far between. If documentation does exist, it is usually not standardized and not kept up to date, and probably only the creator knows where to locate it. Furthermore, bits and pieces of such documentation are sometimes duplicated here and there, on an adhoc basis. This is not particularly effective, and it poses a challenge for attempts to update, as well as for maintaining information integrity.

Phase 1, the Documentation module (*Courseware Information System [5]*) designed to address these issues was completed in 1999, and is operational. Some of the objectives (features) of the Documentation module are:

1. To maintain a centralised database for online creation, updating, viewing and reporting of all courseware documentation.
2. To provide a standardised and consistent look-and-feel of all courseware documentation web pages generated on the fly.
3. To dynamically generate Temasek Polytechnic's OLE™ *User Interface [6]* links for a one-stop access to all the available courseware and their respective documentation.

3 Management

Our plans for the future development of the Management module under phase 2 of the CMS project consists of three areas, namely Project Tracking, Usage Tracking and E-commerce.

3.1 Project Tracking

Many project-tracking tools exist in the market. However, for our intent and purposes, we integrated basic project-tracking information in CMS such as the stage of development of the project, and the respective time-line. This is useful for a number of areas in our environment.

For example, some of our OLE™ projects received funding from the *Infocomm Development Authority (IDA) [7]* of Singapore. As such, we were required to update IDA on the progress of these projects on a regular basis. With basic project tracking integrated into CMS, we were able to issue IDA an access ID to CMS for real-time viewing of the summary of the projects' progress via the WWW, as and when needed, rather than manually preparing them, which can be both tedious and time-consuming.

Likewise, authorized users login to CMS to view reports on the status and progress of the courseware projects, again saving the effort for otherwise paper-based reports.

3.2 Usage Tracking

Usage tracking is typically managed by the courseware development tool itself such as CourseInfo, or programmed into the individual courseware as necessary if the tool used does not have such inherent features built-in.

Until there is a unified standard for exchanging such data among different software tools and courseware management systems, our plan for CMS at the moment is to just keep track of basic information like "when did who access or update the courseware and its documentation". This will provide some basic courseware access statistics for our internal use.

3.3 E-commerce

Currently, Temasek Polytechnic ties up with a commercial vendor for e-commerce subscription of our courseware offerings. When sufficient volume justifies, Temasek Polytechnic will examine the viability of managing this aspect by herself, with e-commerce functionality incorporated into CMS. The design and implementation will be decided upon at a later stage, depending on the state of the technology and available tools then.

4 Standards

The development and sharing of instructional courseware have been hampered by a lack of standards that enables sharing across institutions and across different technical platforms. While the World Wide Web has facilitated access to instructional contents, its effectiveness in this aspect is at best limited. Finding relevant and useful information on the web is likened unto finding a needle in a haystack because of a lack of existing structure or standards for documenting available content.

To address this, *EDUCAUSE [8]* launched an initiative called the National Learning Infrastructure Initiative in November 1994. The *Instructional Management System (IMS) [9]* was formed to address the following three obstacles for providing effective on-line materials and learning environments:

1. Lack of standards for locating and operating interactive platform-independent materials
2. Lack of support for the collaborative and dynamic nature of learning
3. Lack of incentives and structure for developing and sharing content

(The IMS Consortium is a member-supported, nonprofit, global organization that includes more than 200 campuses, university systems, tool vendors, system consultants and service providers, content developers, and U.S. and international governmental organizations committed to the development of timely, high-quality, practical open standards for interoperability of online learning and training tools, content and services.)

In collaboration with various institutions and organizations, IMS set out to address these obstacles via a set of higher-order standards and tools. These standards and tools will enable teachers, learners, software developers, content providers, and other parties involved in the learning process to create, manage and access the use of on-line learning materials and environments.

Realizing the potential merits of such an initiative, IDA of Singapore subscribed to IMS (1999) on behalf of the institutions of higher learning. Temasek Polytechnic, together with the various tertiary institutions in Singapore, and co-ordinated *by Kent Ridge Digital Labs [10]* actively worked with IMS to contribute towards the shaping of the set of standards and tools. IMS has since announced the release of various sets of specifications, namely Meta-Data, Enterprise, Content Packaging, and Question & Test specifications.

With the RMS infrastructure in place, CITEL is well positioned to adopt the standards when it takes off. Making Temasek Polytechnic's courseware IMS-compliant will be primarily what phase 3 of the RMS project targets to achieve. This will make our online courseware offerings more readily accessible globally. In addition, RMS can also be integrated with our organization's enterprise systems for greater synergy, and extended for uses with other resources such as CD-ROMs.

5 Conclusions

The development of RMS (and implementation of the completed modules so far) has significantly improved our workflow and productivity in the various areas discussed. Some of the benefits realized from the completed Documentation module include reduction in paperwork, elimination of redundancy, and enhancement in the presentation of our courseware offerings.

The expected benefits from the development of the Management module include more effective management of courseware development in the areas of Project Tracking, Usage Tracking, and E-commerce. Compliance to IMS for the Standards module is envisaged to make Temasek Polytechnic's courseware offerings more accessible worldwide.

References

[1] Masterplan for IT in Education and Learning.
http://www.moe.edu.sg/iteducation/masterplan/welcome.htm

[2] Corporate website of Temasek Polytechnic, Singapore.
http://www.tp.edu.sg

[3] On-line Learning Environment (OLE™), Temasek Polytechnic.
http://ole.tp.edu.sg

[4] Center for IT in Education and Learning (CITEL), Temasek Polytechnic.
http://www.tp.edu.sg/content/citel/

[5] Courseware Information System, CITEL.
http://ole.tp.edu.sg/ci/ci.pl

[6] OLE User Interface.
http://ole.tp.ac.sg/ci/ole.pl

[7] Infocomm Development Authority, Singapore.
http://www.ida.gov.sg

[8] EDUCAUSE.
http://www.educause.edu/

[9] Instructional Management System.
http://www.imsproject.org

[10] Kent Ridge Digital Labs (KRDL).
http://www.krdl.org.sg

The Effects of the L1 and L2 Caption Presentation Timing on Listening Comprehension

Shiho Yoshino
Department of Human Sciences
Toyo Eiwa University
Yokohama, Kanagawa, Japan
syoshino@toyoeiwa.ac.jp

Noriko Kano
Toyo Eiwa University
QYH07333@nifty.ne.jp

Abstract: Captions do not always facilitate listening comprehension; the degree of their effectiveness varies according to the amount of information that the individual can process in a limited period of time. In order to reduce the information that a learner processes at a time, the effective use of timing is considered to maximize listening comprehension. The results show that more information is memorized when L2 captions are presented before the corresponding L2 audio. It is suggested that this timing facilitates the listening comprehension of Japanese EFL students because they could concentrate on reading the captions and could prepare for the following audio. This effect was not seen with L1 captions and L2 audio; student performance was relatively independent of timing.

Introduction

Captions are used in second language (L2) classrooms as an effective aid for listening comprehension, and their effects have been examined in previous research and studies. Yoshino et al. (1997, 1998) studied Japanese university and college students with English as the foreign language (EFL), and found that both L1 and L2 captions facilitated listening comprehension. The effectiveness of the L1 and the L2 captioning varied with the difficulty level of the materials. The captions were more effective in aiding listening comprehension if the materials were relatively easy. Yoshino et al. argued that this might be due to the limitation of the student's "processing capacity" (Just & Carpenter, 1992).

L1 and L2 captions differ in terms of learning support; more information was recalled correctly if L2 captions were used than L1 captions. L2 captions provide exactly the spoken words as while L1 captions provided the same information in a different (subjects' native) language. With L1 captions, Japanese EFL students grasped the meaning by reading L1 captions, and simultaneously translated the L1 caption information for chunking the flow of L2 audio. This process of translation and chunking, if successful, allowed them to understand and recall what have been said. Because the translation process is rather difficult to manage, exceeding the learner's processing capacity, say by increasing the presentation speed or raising the difficulty level of the text, may lower the effectiveness of L1 captioning.

From this point of view, the effective use of timing was considered to reduce the information that student had to handle at any one time and so increase caption effectiveness. By showing the captions in a audio dead period before the corresponding audio, viewers may be better able to process both tasks: understand the caption and understand the audio.

Yoshino, Kano & Akahori (1999) conducted preliminary research to examine the effects of caption presentation timing. In their experiment, L1 and L2 captions were presented either earlier or later than the corresponding audio, and words and phrases recalled by the subjects were counted. The results showed that recall was highest when the captions were provided prior to the audio. These results, however, were gained from thirty-two subjects watching five different sets of materials with five different caption presentation timing arrangements.

It is presumed that the difficulty level of the materials influenced the results to some extent. We decided to examine the effect of caption presentation timing by designing an experiment that used only one set of material. Because of the limited number of subjects, the effects of L1 and L2 captioning were examined in two discrete experiments.

Experiment 1

Participants

One hundred and ten Japanese junior college students, enrolled in the course "Language Laboratory I", participated in this experiment. Based on the results of a listening comprehension test administered at the beginning of the semester, each student was assigned to one of the thirteen classes; the level of the students in each class was assumed to be equal. From these thirteen classes, five classes were selected and each class was randomly assigned to one of the five caption timing conditions.

Material

The materials used to measure the subjects' listening comprehension were developed from a TV commercial presented by the US government. The commercial presented 68 words in 30 seconds; that is, the speech speed was 136 words per minute (wpm). The captions, which exactly matched with the corresponding spoken (audio) statements, were superimposed using the video edit software *Media 100*. The captions were presented completely on the black mask which appeared under part of the screen.

Five versions were developed from the same TV commercial video: 1) the captions appear on the screen two seconds prior to the corresponding audio (-2 Time Lag condition), 2) the captions are presented one second before the corresponding audio (-1 Time Lag condition), 3) the captions and the corresponding audio are simultaneously presented (0 Time Lag condition), 4) the captions appear one second after the corresponding audio (+1 Time Lag condition) and 5) the captions appear two seconds after the corresponding audio statement (+2 Time Lag condition).

The average length of pauses in the video material was about one second; that is, between every proposition (caption), there was a second audio dead period. When the captions appeared and disappeared simultaneously with the audio (0 Time Lag condition), the viewer must have read the visual verbal information (caption) and listen to the audio verbal information. Moreover, they have to decode the visual verbal information at the spoken speed of audio. However, when the caption projected in audio dead period before the corresponding audio (-1 Time Lag condition) - the caption appeared on the screen just after the forward audio was finished, the subjects might be able to read and prepare for the forthcoming audio statements. Likewise presenting the caption in no audio statements time after the corresponding audio (+1 Time Lag condition), the subjects were compliant what have been said with the caption remained on the screen one second after the corresponding audio was finished. Two other conditions (-2 Time Lag and +2 Time Lag condition) were arranged to compare with the -1 Time Lag and +1 Time Lag conditions. As the average length of audio dead period was one second, when the captions presented two seconds before the corresponding audio (-2 time Lag), every caption were provided with the previous audio while a second. Contrary, in +2 Time Lag condition, the captions were always appeared two seconds after the corresponding audio was started. Then the captions overlapped with just after spoken statements while a second. Therefore, in these two conditions, the visual information and the verbal information were discordant. This discordance might cause the viewers' confusion for understanding the contents.

Procedure

The subjects were instructed to watch the video twice with a thirty-second break, which is a common way of viewing English videos in Japanese EFL classrooms. They were asked to recall the video's narration both in English and in Japanese after the second presentation. They were informed of the purpose of this study; that is, the experimenters were investigating the amount of information the subjects could remember with caption use. They knew that spelling and grammar would not be scored. The subjects were requested to write down every word, phrase, clause, or sentence that they could recall after each viewing.

Scoring and Data Analysis

Two measures - the number of recalled words and accuracy of recalled information - were used to examine the effect of caption presentation timing. The first, the number of recalled words, was number of words recalled correctly by the subjects. The second, accuracy of recalled information was needed since the number of recalled words does not confirm that the subjects understood the statement. The accuracy of recalled information was assessed by checking whether English (L2) recall matched Japanese (L1) recall in meaning. First, the English and Japanese statements made by the subjects were broken down into propositions; these were categorized as to either Correct (C) or Incorrect (I). Correct (C) propositions included only correct statements recalled by the subjects. Incorrect (I) propositions included both incomplete and false statements, however, the lacks of articles were disregarded. If there was no statement for a certain proposition in the statements, it was categorized as Incorrect (I). All the propositions recalled by the subjects were then categorized into four accuracy groups: 1) English-Correct and Japanese-Correct (EC-JC), 2) English-Correct and Japanese-Incorrect (EC-JI), 3) English-Incorrect and Japanese-Correct (EI-JC), and 4) English-Incorrect and Japanese-Incorrect (EI-JI). As if the subjects could listen the audio statements and understand the meanings, they could be able to recall both in English and in Japanese. In the four categories of accuracy, the number of propositions which were categorized as EC-JC was calculated for every caption presentation timing condition.

Separate one-way analyses of variance (ANOVA, 109 X 5 = subject by caption presentation timing) were utilized for the two measures. The main effect of caption timing was checked using ANOVA to test for differences among the five caption timing conditions.

Results

ANOVA results for the two measures are given below.

Number of Recalled Words

The ANOVA results showed that the caption presentation timing yielded significant effects ($F(4,105)=15.31$, $p<.001$). As shown in Figure 1, the number of recalled words decreased in the order -1 Time Lag condition, 0 Time Lag condition, +1 condition, -2 condition, and the +2 condition.

Since significant differences were found among the five conditions at the .001 level, the LSD multiple comparison method was employed to determine which conditions were statistically different. The LSD multiple comparison showed that the -1 Time Lag condition was significantly higher than the other conditions at least at the .05 level. There was a significant difference in the number of recalled words between the -1 Time Lag condition and the 0 Time Lag condition at the .05 level. In the second highest condition, the 0 Time Lag condition, the number of recalled words was significantly higher than those were in the +1, -2, and +2 conditions at the .01 level. No significant differences were found in the number of recalled words among the lowest three conditions - the +1 Time Lag, the -2 Time Lag, and the +2 Time Lag.

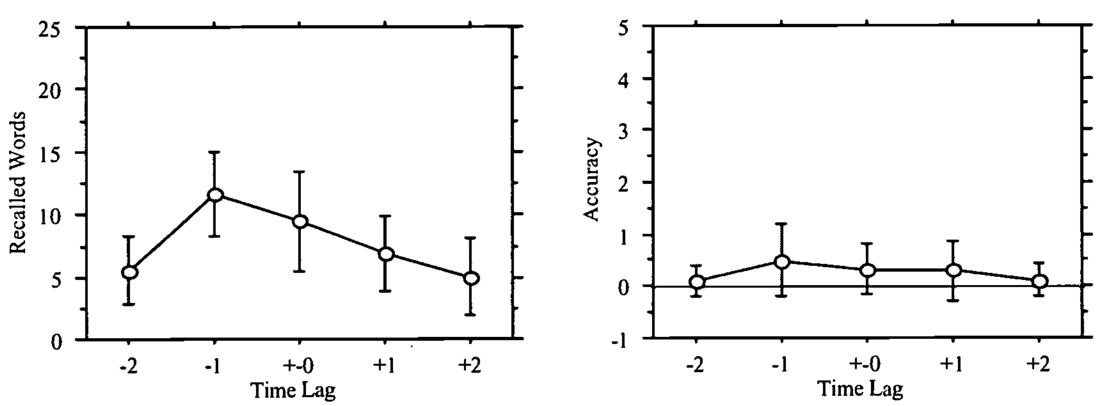


Figure 1 : Number of Recalled Words and Accuracy of Recalled Information by L2 Caption Presentation Timings

Accuracy of Recalled Information

The accuracy of recalled information showed the same tendency as the number of recalled words (Fig. 1); that is, it decreased in the order -1 Time Lag condition, 0 Time Lag condition, and +1 Time Lag condition. The results of ANOVA showed significant difference at the .05 level among the caption presentation timing conditions ($F(4,105)=2.42$, $p<.05$). Since significant differences were found among the five caption presentation timing at the .05 level, the LSD multiple comparison method was employed to determine which conditions were statistically different. The LSD multiple comparison showed that the -1 Time Lag condition was significantly higher than -2 Time Lag condition and +2 Time Lag condition at the .05 level.

Summary and Discussion

The experiment showed that the number of the recalled words and the accuracy of the recalled information were high when the captions were presented one second prior to the audio. For more words were recalled in -1 Time Lag condition than the 0 Time Lag condition, it seemed that the subjects could manage with two types of information - visual and verbal - when these information provided with time lag than presented simultaneously. When the captions appear on the screen a second before the audio, the students could concentrate on the displayed text which led to better recall. The information gained from the captions may have functioned as prior knowledge about the information provided through audio. It might have helped the subjects to recognize the spoken statements, with which most Japanese students have more difficulties than with understanding written statements. The understanding gained from the written statements reinforced the recognition of the spoken statements. In the +1 Time Lag condition, however, failure to understand the spoken statements (which is highly possible for Japanese students) made it harder for the students to focus on and be more successful at reading the captions.

In the 0 Time Lag condition, the captions and audio were presented simultaneously. As it was expected, the viewer had to read the visual verbal information (caption) and listen to the audio verbal information at the same time which might cause overflow of learners' processing capacity. Two other conditions (-2 Time Lag and +2 Time Lag condition), each caption was overlapped with the previous or the forthcoming audio for a second. That is, they have to handle two different verbal contents - one from audio and another from captions, which might cause the confusion of the subjects understanding the contents.

Experiment 2

The effects of L1 caption presentation timing was investigated. The experiment used the same procedure as Experiment 1.

Participants

Forty-three Japanese university students participated in Experiment 2. They were freshmen or sophomores, their average of TOEFL score was 444, and all were non-English major students. They were randomly assigned to one of the five caption timing conditions.

Instruments

The same material was used. Five versions, for the five caption timing conditions were developed.

Scoring and Data Analysis

The TOEFL scores of the five subject' groups were statistically different ($F(4,38)=2.77$, $p<.05$), separate one-way analyses of variance (ANCOVA, 43 X 5 = subject by caption presentation timing) were utilized for the two measures of the number of recalled words and the accuracy of recalled information. The main effect of caption timing was checked using ANCOVA to examin for differences among five caption timing conditions in the recall of EFL university students.

Results

Number of Recalled Words

The number of the recalled words and the accuracy of recalled information by the five caption presentation timings were shown in Figure 2. The results of ANCOVA presented no significant effects of the caption presentation timing (F(4,38)=2.18, p=.09).

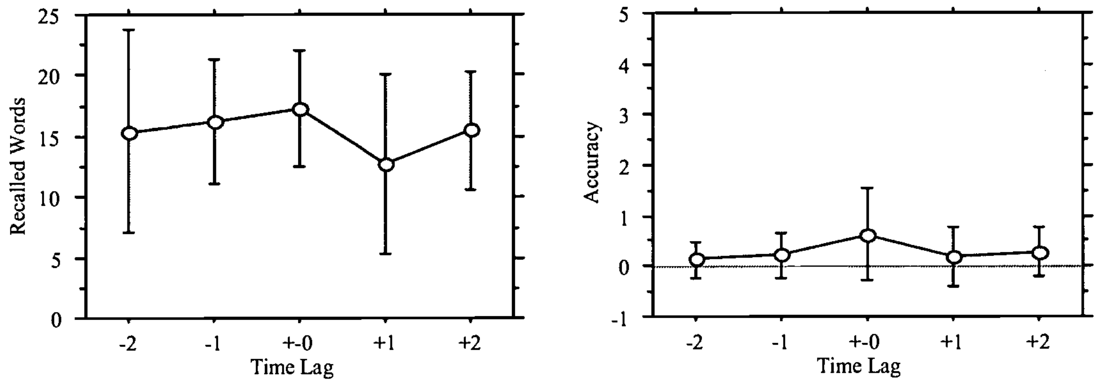


Figure 2 : Number of Recalled Words and Accuracy of Recalled Information by L1 Caption Presentation Timings

Accuracy of Recalled Information

The results of ANCOVA showed no significant difference (F(4,43)=.91, p=.47) among the caption presentation timing conditions.

Summary and Discussion

In this experiment, the result showed the L1 caption presentation timing provided no effect on both the number of recalled words and the accuracy of recalled information of the Japanese university students. This result suggested the Japanese captions information and the English audio information would be managed without overflowing individual's processing capacity.

Conclusions

The purpose of this study was to investigate the best presentation timing of L1 and L2 captions. When the information provided in a certain period of time exceeded one's capacity, there would have a possibility that the captions no longer work as an effective device for listening comprehension. In this study, therefore, the effective use of timing was considered to diminish the information presented at a time and to maximize the caption effects. It was expected that the Japanese EFL students had a difficulty to read the L2 captions presented on the screen simultaneously with the audio at the spoken speed. However, when the caption presented prior to the corresponding audio among the audio dead period, they could read the English captions and grasp the spoken words effectively. The result of the experiments followed this expectation; the L2 captions supplied one second prior to the audio contributed better listening comprehension of the Japanese EFL learners.

It was also predicted when the L1 caption which provided the same meaning in the different language presented before the audio would be more helpful because the viewers could translate the L1 caption information and prepare for the forthcoming L2 audio. The contradictory result was found from the experiment; the subjects' listening comprehension was independent of the L1 caption presentation timing. It was suggested that in this experiment, the L1 captions and the L2 audio were managed without exceeding the capacity of the Japanese university subjects even if these two different information presented simultaneously.

The result of L1 caption presentation timing is differed from the preliminary research by Yoshino et al. (1999). It was unclear what causes this contradict findings- difficulty levels of the materials or difference of the subjects including the processing capacity or translation ability. If the Japanese captions were always handle with the English audio without any difficulty by Japanese EFL students, the reason that explains the lower effects of L1 caption would not the exceeding of viewers' processing capacity by an additional process of translation. More research to conduct the L1 caption presentation timing may be needed.

Acknowledgements

This research was supported in part by the Grand-in-Aid for Encouragement of Young Researchers (No.11780129), the Ministry of Education, Science and Culture.

References

Just, M. A. & Carpenter, P. A. (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychological Review*, 99, 122-149.

Yoshino, S., Nojima, E. & Akahori, K. (1997). *Eigo-no-Kikitori bamen ni okeru Jimaku Fuka no Koka* [The Effects of Captions on Listening Comprehension] *Japan Journal of Educational Technology*, 21(*Suppl.*), 29-32.

Yoshino, S., Kano, N. & Akahori, K. (1998). *Eigo-no-Kikitori ni okeru Jimaku Fuka no Koka* [The Effects of English and Japanese Captions on Listening Comprehension] *The Proceedings of the LLA 37 th Annual Convention*, 71-74.

Yoshino, S. (1999). *Eigo-choukai ni Kouka-teki na Eigo-Jimaku, Nihongo-Jimaku no Teiji-Taiming ni kansuru Kenkyu.* [The Effective English and Japanese Caption Presentation Timing on Listening Comprehension] *Toyo Eiwa Journal of the Humanities and Social Sciences*, 16, 77-100.

Looking, Looking, Looking:
Students' search strategies using an encyclopedia CDROM program

Katina Zammit
University of Western Sydney, Macarthur
Author Address
PO Box 555
Campbelltown. NSW. AUSTRALIA
Email: k.zammit@uws.edu.au

Abstract: In elementary schools there is increasing use of computer-based environments as information sources. Information is hot-linked creating a hypertext environment. CDROM programs are closed hypertext environments with limited links between nodes and they present a unique way of locating information with no print-based equal. As students use CDROM programs they need to employ search strategies relevant to hypertext and the program. This study investigated the search patterns of 10 - 12 years old students using a commercially produced encyclopedia-based CDROM. Each group of students was given the same task, which was set in context, by the classroom teacher. Students using the encyclopedia CDROM set up mental maps and predictions based on a print equivalent. The success and search patterns across groups varied according to the search strategy employed and the user orientation to the program and the task. The effectiveness also depended on the group's knowledge of the topic, knowledge of the program and their mental map of the program's construction.

Introduction

Within the education system knowledge is gained from a variety of sources. In elementary schools computer-based technology in the form of CDROMs (Compact Disk- Read Only Memory) and the Internet are being used more often as information sources. CDROMs are closed hypertext environments; the links between nodes of information is limited. While the Internet can be considered an open hypertext environment, as there are innumerable links to be made to a large number of sites. The very nature of these resources means students have to access information from a more complex multimedia source.

CDROM programs are not as easily accessible as other resources used in classrooms. They store a large volume of information and can also be a form of entertainment - 'edutainment' or 'infotainment'. CDROM programs are non-linear, unlike books (Slatin 1990; Lawless & Kulikowich 1998). The user cannot 'see' the information contained in the program by flicking through the pages or turning to the index at the back. Users may not be aware of the extent of the information or that they are taking a wrong path (Edwards & Hardman 1989; Slatin 1990). Navigation becomes a critical tool in a student's learning. As a result, CDROM resources create a learning environment dependent on students' effective information retrieval (search) strategies.

Learning in a hypertext environment also involves a high degree of learner control. This can be seen as either beneficial to students or a constraint. Students using CD-ROMs tend to wander around, interacting with the most entertaining parts from the offerings available (Russell 1994). This wandering can be construed as developing children's metacognitive skills (McAleese 1989) or simply as an inefficient method of finding information with the learner expending a lot of time trying to find their way around (Russell 1994; Marchioninni 1989).

Studies in the use and retrieval of information from multimedia sources have found that students have little difficulty using and finding information though students' search strategies and their methods of retrieving information were restricted (Marchioninni 1989; Oliver & Perzylo 1994). The degree of success or effective use of the CDROM was influenced by the students' understandings of the system, the system itself and students' use of search strategies and retrieval techniques. However the issue of how effective students' information seeking methods were when using multimedia needs further investigation (Oliver & Oliver 1996).

Users of CDROM programs employ a variety of strategies to find information. McAleese (1989) presents a number of studies that classify these strategies, termed " browsing". Canter et al. (1985) based their categories on the way users navigated through a database, obtaining a graphic representation of their pathways. They found 5 distinct search strategies -

Scanning: covering a large area without depth
Browsing: following a path until a goal is achieved
Searching: striving to find an explicit goal
Exploring: finding out the extent of the information given
Wandering: purposeless and unstructured globetrotting. (p. 100)

Lawless & Kulikowich (1996; 1998) have proposed a different classification. Their categories incorporate the users' orientation and control over the environment, as well as addressing the range of special features within a program. They identified 3 types of common navigational profiles:

Knowledge seekers (also known as book lovers): those readers who pursue information related to the content of the hypertext; navigate to screens that contain information needed to enhance comprehension; strategic in selection of screens; acquire information in a systematic manner.

Feature explorers (also known as resource junkies): those readers who spend a lot off time interacting with the movies, graphics sound & visual effects; invest more time in understanding how the hypertext works and what kind of screens it contains than gathering important information.

Apathetic hypertext users: those readers do not appear to care about using the hypertext either to gather information or to explore its features; characterized by short intervals interacting with the text; navigation paths reveal no logical order. (Lawless & Kulikowich, 1998, p 52)

The provision of multimedia resources does not by itself increase the learning outcomes of students (Saga 1992). One has to look at the strategies employed by students, consider the construction of the multimedia programs and the teaching and learning or "training" of skills required in the classroom. Knowledge of these skills and the ability to work in a hypertext CDROM environment may also have implications for students' effective use of the Internet. As electronic and digital texts are becoming the 'new' sources of information in education and the workplace, the development of students' information retrieval skills using information technologies is critical. They will assist in providing the background for the essential literacy skills for the information age - critical literacy, visual literacy and digital literacy skills (Burbules 1997; Lankshear et al. 1997).

This paper will present preliminary findings about the search strategies used by 10-12 year old students working in cooperative groups using an encyclopedia CDROM program on a set task based on the class's current theme.

The Investigation of Students' Search Strategies

The Program

The CDROM Program was a commercially produced program entitled ENCARTA 96 (Microsoft 1993-1996). It was part of an Apple Macintosh hardware/software package purchased by the school in 1997. The program uses an encyclopedia metaphor to frame its information and the layout of the screens. However unlike a print-based encyclopedia it does not contain a range of information on a huge number of topics. The program is produced in the United States and contains limited information on Australia, in particular Australian history.

The Students

Students were aged between 10 and 12 years. They all had used the program before in a previous unit of work on "Rainforests". The majority of the students had access to a computer outside the school. The class teacher allocated the thirteen students, who took part, to a group. Each member was assigned according to their different role: recorder, reader, reporter and gopher. Groups ranged in size from 3 to 5 students. Four groups were observed using the program.

The Task

Students were asked to obtain information on the lifestyle of Australian Aborigines prior to European Settlement. The task was introduced to students by the class teacher as the initial session of a historical theme on Early Australian history. The teacher scaffolded students' investigation by having a discussion with the class about what areas to investigate, writing these as headings and sub-headings on the blackboard. This provided students with possible key words to use as students searched any of the resources.

Methodology

A naturalistic form of data gathering was employed (Oliver & Perzylo 1994). Field notes were kept as well as a video recording of each session to document the pathways taken by each group. The video-recordings provided detailed information about the interactions and pathways of each group. This has become a useful data collection technique for computer-based information-seeking studies (Oliver & Perzylo 1994; Edwards & Hardman 1989). The class teacher and students were interviewed to obtain information about students' sociocultural and computing background. During the session, students were asked to articulate the reasons they chose specific paths or navigation tools - a procedure adapted from the 'Think-aloud' technique (Afflerbach & Johnson 1984). There was no time constraint and each group pursued their searches until satisfied they had found all they could from the program.

Results

The breadth of each search, was obtained by tabulating the number of different nodes visited (NV), the number of nodes visited and the most frequently visited nodes (Tab. 1). In addition, the researcher assessed the quality of the searches in relation to location of relevant information and the types of sources used to gather information. Relevant information was defined as any source (section of written text, image, caption for image, sound) containing either specific information on Aboriginal people before the Europeans, as well as general information about Aboriginal Art or Culture, for example Didjeridu (Tab. 2).

	No. of different nodes visited (NV)	No. of total nodes visited (NS)	NV/NS: %	Most frequently visited nodes
Group 1	5	8	62.5	Find: 3 Aborigines: 2
Group 2	11	17	64.7	Main Menu: 4 Find: 2 Timeline: 2
Group 3	12	23	52.1	Find: 3 Print: 3 Find a place: 4 Tribe: 2 Map of Northern Territory: 2 Map of Azerbaijan: 2
Group 4	30	63	47.6	Find: 18 Moari: 5 Aborigines: 5 Weapons: 5 Australia: 3 Flint: 2

Table 1: Nodes (Screens) Visited

	Number located	% located *	No. of sources : Information discussed	No. of sources: notes taken	Type of source
Group 1	3	21.4	2 sound; caption	1 caption	sound caption
Group 2	2	14.2	1 sound	0	sound
Group 3	3	21.4	3 image; sound; caption	2 sound; caption	image sound caption
Group 4	5	35.7	0	0	NA

* Total number of relevant information sources =14

Table 2: Location of Relevant Information

Each group's session was graphically represented or "notated". The search patterns were compared to the visual and descriptive categories of Canter et al (1985) and the categories of Lawless & Kulikowich (1996; 1998) (see Tab. 3).

	Group 1	Group 2	Group 3	Group 4
Canter et al	*Wandering	Browsing	Scanning	Browsing
Lawless & Kulikowich	Apathetic Hypertext users	Feature Explorers	Knowledge seekers	Feature Explorers

*This session was extremely short with only 8 screens being visited. Hence, comparison with the written descriptive instead of the graphic representation was used.

Table 3: Search Strategies and User Orientation

Group 1

This group visited the least number of nodes within the program (Tab. 1) and spent the least amount of time searching for information. They found relevant information during their initial search using the FIND tool. The information was obtained from the caption under the 'Aboriginal Music of Australia' image and sound file (Tab. 2) on the 'Aborigines' screen. When unsuccessful in further searches using the same technique they chose to finish their search session. The diagrammatic representation of their search could be equated with Wandering but the group visited so few screens (nodes) and this categorization is inconclusive. They did exhibit characteristics of apathetic hypertext users.

Group 2

Group 2 chose to investigate each section of the program as listed on the Main Menu screen. They were the only group that did not begin their search using the FIND tool, choosing the LOOK & LISTEN section for their initial search. They found useful information but did not take notes on any of this information for the task, preferring to talk about the sound file accompanying the 'Aboriginal Music of Australia' image in the Media Gallery, accessed via the LOOK & LISTEN section. They visited a high number of different nodes, with a medium NV/NS score. The diagrammatic of their search and the medium NV/NS score are features of Browsing. Their user orientation can be classified as Feature Explorers.

Group 3

Group 3 visited a variety of nodes, revisiting six (half of the number of different nodes visited) more than once (Tab. 1). They located useful information on their initial search using the FIND tool and were unsuccessful with subsequent searches using the same technique. The information extracted was from the image, caption and sound file (Tab. 2) entitles 'Aboriginal Music of Australia' on the 'Aborigines' screen. They also located information about Aboriginal populations, which they deemed to be important but did not infer that this information was recent not historical data. The diagrammatic of their search was similar to Scanning. This group was the only one that exhibited behavior similar to Knowledge Seekers. Towards the end they moved into Feature Explorer behaviors.

Group 4

Group 4 visited the largest number of nodes of all the groups. They revisited 5 nodes frequently, these being the core or base nodes (Tab. 1). The FIND tool was revisited the most (18 times) as they used this node to frame their search. Hence the lower NV/NS ratio in comparison to the other groups. Although the group visited relevant nodes they did not write any useful information from any of these texts, nor did they talk about this information. They believed the information about the population of Aborigines was important and recorded notes from this. Unique was their investigation of each section of a node (Weapons) which contained only a list of hotlinked words. This group visited 2 screens not found by any of the other groups: Didgeridu[1] and Boomerang. However, they did not explore the "Related Articles" sections nor consider any of the information relevant. This may be due to locating them at the end of the session. The group lost focus and interest due to lack of success with their searches. They used hotlinked words more often than the other groups. The diagrammatic of their search demonstrated similarities to Browsing. Their orientation was equivalent to Feature Explorers.

No group located the written text with specific information about Aboriginal people prior to European settlement, which was on the 'Australia' node. Students did not use the 'View: Outline' strategy to locate this

[1]This is the spelling used in ENCARTA96 (Microsoft, 1993-1996). Students used 'didgeridoo'.

information, preferring to scroll down the text box when in the 'Australia' node. As this node is extremely long, this was not an effective method for locating this section of text. Students did not understand how to use this section of the program. This is evidenced by 3 of the four groups locating this section of the screen, 'reading' the options but not clicking on any of the alternative views.

Discussion

The information the groups found was obtained from the sound and visual texts of the program. But this was not consistent for all groups and all relevant information was not extracted. This reinforces the need for students to be given experiences on how to extract information from non-verbal texts (Oliver & Perzylo 1994). The written text was not helpful, and for some proved to be a distraction as they lost sight of the objective of the task and were consumed by the special features of the program (Russell 1994).

Effective search strategies rely heavily on the background knowledge of the topic by the searcher whether they use print-based or computer-based texts. In a computer-based environment, this knowledge becomes a crucial aspect if the user is to locate relevant information using the search tools of the program (Lawless & Kulikowich 1998). Group 4 located two information nodes (boomerang and didjeridu) at the end of their search but did not explore any of the related articles (key words), take notes or consider them important. The information did not specifically mention early Aboriginals or pre-European settlement.

The most relevant information was to be found in three sections of written text on the 'Australia' node. However, this screen contained a very long piece of text and students did not use 'View Outline' as a strategy for locating information within the screen. Students obviously did not know about this organisational feature of the program. An orientation for the user to the program, its sections, ideology, authorship, limits of information need to be covered prior to use. During the use of the programs, the imperative is to provide scaffolding for students, for example guided question proforma or key words guide (Zammit 1999).

One of the reasons for the use of the 'FIND' tool and lack of use of the 'View Outline' tool can be explained by the students' orientation to program. The first strategy is one used primarily in print-based encyclopedias; the latter is an example from a hypertext environment. Students' mental model of how to access an encyclopedia, what an encyclopedia should and would contain was based on print equivalents. As a result they did not locate all the information in the program. The construction of the program influences the strategies chosen by the user.

Even though graphical representation of navigation patterns do not seem to 'identify individual differences with the same precision as cluster analysis' (Lawless & Kulikowich 1998: 397), they do provide a visual overview of a distinguishable search pattern. When Canter et al.'s (1985) categories of browsing are used in conjunction with Lawless & Kulikowich's (1998; 1996) types of users, one can gain an indication as to why some students are more successful than others at locating information using closed hypertext CDROM programs.

Those students, who were Browsing, were also Feature Explorers and they were absorbed by the program. These students did not take notice of relevant information nor appear to know what was relevant. It is also possible they did not have the skills to extract the information when it was located or how to take notes As a result they 'lost' track of the task, being more interested in using the program's tools. Those students who were Knowledge Seekers used Scanning and covered a wide area of the program. They discussed information located, assessed the value of the information and took notes from a range of sources. This group gained some information for the task they were set. For Group 1 (the Apathetic Hypertext Users) the data is not as conclusive, given the short amount of time they spent interacting with the program. They went in, got some information and left. Their success was related to the quality of the moves made not to the quantity. (Marchioninni 1989)

From this information, two searcher orientations are proposed:

Voyeurs- they are like tourists in a new country. They have difficulty reading the visual and written signs; locate sources but have difficulty understanding what is relevant; have limited discussion of content; and are more interested in clicking and acting on the hypertext environment than negotiating meaning. They are not very successful with their search; they may locate the information but not recognize its value or use it for notes.

Investigators- they are like detectives looking for clues. They are focused in their exploration; cover a wide area within the program; discuss the value of the information located; negotiate meaning with the program; and use a range of sources for their note taking. They are successful with their search, locating information relevant to their search.

Just as two people negotiate meaning when they speak to each other, the user negotiates meanings with the computer as the other interactant. These types of negotiation or engagement are a more refined ways to consider the search strategies of users and may be more useful than the broad categories and types of users. Further research into these orientations with consideration of the types of engagement and the influence on learning in a hypertext environment is required. Perhaps certain types of users have a preference for certain types of interaction and avoid others. Some students may be better negotiators in a hypertext 'conversation' similar to those who are better talkers. In addition to this area, there is a need for more work on information retrieval using a range of commercial products in classrooms.

Conclusion

The engagement of young students during information seeking tasks is influenced by their orientation to the program and their knowledge of the topic. These in turn influences the search strategies students select when given a task and hence the effectiveness of their search. Students are drawn to the image and sound texts of a program but are not necessarily skilled in extracting information from these. In addition it is the opaqueness of the extent of programs and their construction that constrains students' effective searching. How to open up these resources for young children as effective learning environments needs conscientious efforts by educators.

References

Afflerbach,P. & Johnston, P. (1984) On the use of verbal reports in reading research. *Journal of Reading Behaviour,* 16, 307-322.

Burbules, N. C. (1997) Rhetorics of the Web: Hyperreading and Critical Literacy. In I. Snyder (Ed.) *From Page to Screen.* Sydney: Allen & Unwin.

Canter, D, Rivers, R. and Stoorrs, G. (1985) Characterizing user navigation through complex data structures. *Behaviour and Information Technology.* Vol. 2, No 4, 93-105.

Edwards, D. & Hardman, L. (1989) 'Lost in Hyperspace': Cognitive Mapping and Navigation in a Hypertext Environment. In R. McAleese (Ed.) *Hypertext: Theory into practice.* Oxford: Intellect Books.

Lankshear, C., Bigum, C., Durrant, C., Green, B., Honan, E, Morgan, W., Murray, J., Snyder, I. & Wild, M. (1997) *Digital Rhetorics. Literacies and Technologies in Education - Current Practices and Future Directions.* Canberra: Department of Employment, Education, Training and Youth Affairs.

Lawless, K.A. & Kulikowich, J.M. (1996) Understanding hypertext navigation through cluster analysis. *Journal of Educational Computing Research.* 14 (4), 385-399.

Lawless, K. A. & Kulikowich, J.M. (1998) Domain knowledge, interest, and hypertext navigation: A study of individual differences. *Journal of Educational Multimedia and Hypermedia.* 7 (1), 51-69.

McAleese, R. (1989) Navigation and Browsing in Hypertext. In R. McAleese (Ed.) *Hypertext: Theory into practice.* Oxford: Intellect Books.

Marchioninni, G. (1989) The Information-seeking strategies of novices using a full-text electronic encyclopedia. *Journal of the American Society For Information Science.* 40 (1), 54-66, 1989.

Microsoft Corporation (1993-1996) *ENCARTA 96 Encyclopedia.*

Oliver, R. & Oliver, H. (1996) Information access and retrieval with Hypermedia information systems. *British Journal of Educational Technology.* 27(1), 33-44, 1996 Jan.

Oliver, R. & Perzylo, L. (1994) Children's information skill: Making effective use of multimedia sources. *Educational & Training Technology International,* 31 (3), 219-230.

Russell, G. (1994) Frankincense or Frankenstein? Assessing the impact of CDROMs on school education. *Australian Journal of Educational Technology,* 1994, 10 (1), 41-54.

Saga, H. (1992) Are we ready enough to learn from interactive multimedia? *Educational Media International,* 29 (3), 181-188.

Slatin, J. (1990) Reading Hypertext: Order and Coherence in a New Medium. In P. Delaney & G. Landow (Eds.) *Hypermedia & Literary Studies.* Cambridge: MIT Press.

Zammit, K. (1999) Click. Click. Reading and Viewing CDROMs. In J. Callow (Ed) *Image Matters: Visual Texts in the Classroom.* Sydney: Primary English Teaching Association.

Acknowledgements

This project was funded by a University of Western Sydney, Macarthur New Researchers Grant. Thanks and appreciation to Teresa Walsh and 4/5/6Black.

Students' perceptions of learning on-line in an undergraduate education subject.

*Katina Zammit & Phil Nanlohy
Faculty of Education & Languages
University of Western Sydney
PO Box 555,
Campbelltown. NSW
AUSTRALIA. 2560
*Email: k.zammit@uws.edu.au
p.nanlohy@uws.edu.au

Abstract: On-line learning for undergraduate students is being embraced by higher education institutions as they adapt and react to the changing circumstances of student expectations, societal demands and available funding. Students' perceptions of learning on-line must be considered if their learning needs are to be met and best practice is to be achieved. Over the 1998-1999 period, an undergraduate teacher education subject, convened by the first author has included an on-line component in the delivery and assessment. Rather than replacing existing practices with on-line teaching and learning, lecturers working in this subject used mixed mode delivery to develop students' understandings and skills. They encouraged students' independent learning through on-line modules, computer based assessment tasks and presentation of subject content via the Internet, lectures and tutorials. From the students' evaluations of the subject, the mixed mode of delivery including independent learning, the use of technology, and on-line tasks were favorably received and had positive affects on the students' learning in the subject.

Changing Practices and Relationships in Universities

The advent of Information Technologies (IT) in affluent countries has changed, fundamentally, the nature of communication and learning within those societies. As a result, society is moving away from a print based to an information technology based society (Spender 1995; Negroponte 1995). The medium of exchange in society has moved from physical things represented as atoms to network based information represented as electronic bits. Higher education is especially affected by these changes and those involved in this enterprise must adapt to take advantage of the opportunities offered by the emerging technologies.

Universities will have "to change their purposes and their practices. Scholarship, knowledge, research and teaching are significantly different when done electronically" (Spender 1995, p. xxiii). Universities also operate within a political and economic climate. There is an increasing need for university qualifications in order to gain paid employment and a need for life long learning in order to maintain credentials in a rapidly changing employment environment. As a result, the numbers of students attending university has increased dramatically. These students come increasingly from a diverse population and have changing aspirations (Le Grew and Calvert 1998).

Within Australia, relatively few universities are "as yet taking a whole-of-institution approach to ... flexible delivery" (Latchem and Moran 1998, p.67). Lewis and Merton quoted in Lewis (1998) suggest that the application of technology to flexible delivery of instruction in universities has been "patchy" in that it has met with mixed results. This is especially true in the field of Initial Teacher Education (Hacker and Sova 1998).

One important dimension for university based flexible delivery is a move "from a teacher-dominated, transmission-based process to a learner centred, constructivist process" (Latchem and Moran 1998, p.67) with the use technology to maintain contact between students and tutors. Technology in flexible delivery can support students by providing;

"Information on the curriculum,
Recognition for existing achievements and advice on appropriate learning routes,
Flexible access to resources, facilities, and program content,
Opportunities to practice and apply learning." (Lewis 1998, p.27).

Innovation and change in practice comes about from what has gone before: it is not entirely 'new'. Branch and Tonkin's (1997) case study of the trial of multi-campus video on demand illustrates this principle. New learning environments grow out of old learning infrastructure when innovation has an opportunity to flourish.

Methodological Principles

Evaluation is a continuous process that is an interaction between the internal and external learning processes of students and teachers. The purpose of evaluation is to determine the value of a particular learning experience for the students who are engaged in it. There are two aspects to developing such understanding. The first is to identify what is not working for a particular student or group of students. These elements of the experience need to be changed to create the conditions for positive outcome for learners. The second aspect is to find and retain what is helping students to learn what it is they need to know.

Learning is an internal process for which learners are individually responsible. Teaching is an external process in which teachers are responsible to their students. However teachers must collect information from their students (external process) and reflect on the implications of this information (internal process) for the learning environments that they have provided for those students. Kirkpatrick, quoted in Alexander, McKenzie and Geissinger (1998), provides a four level framework for organising the collection of evaluation information. These principles have guided the examination of the subject that is the focus of this paper. The levels parallel the integrated approach suggested by Alexander and Hedberg (1994). The levels are:

"reaction to the innovation;
achievement of learning objectives;
transfer of new skills to the job or task;
impact on the organisation." (Alexander et. al. 1998 p.254).

The Subject - Curriculum Studies 6: English and Science & Technology

A site for the subject Curriculum Studies 6: English and Science & Technology (CS6) was developed containing on-line Internet resources organised around nodes, which included information and activities (Zammit, Nanlohy & Corrigan 1998; 1999). The nodes were Your Concept; Factual Genres; Learning and Teaching; Programming and Planning; Assignments and Tasks. The website demonstrated the integration of the two subject areas via hotlinks between content nodes. Each node was broken into sections; each of these varied in length depending on the content. Where a section was a long page, the parts were identified at the top and internal navigation used. It was attempted to keep the amount of information to a screen-size, but this was not always successful and different computers varied the display of the information.

The subject presentation consisted of three lectures; eight x two-hour tutorials in both the English and the Science & Technology strands interspersed with five independent study weeks. On-line tasks were developed for students to complete during independent weeks. In 1998 the Science tasks were compulsory, the English tasks were not and no grade was attached to the completion of tasks. In response to students' evaluations in 1998 and further investigation of students' completion of on-line tasks (see Alexander, McKenzie & Gessinger 1998, p.234) the 1999 tasks and the web page construction assessment item were refined.

The tasks were intended to assist students in the completion of their final assignment - an integrated program for a grade of their choice, and covered topics not addressed during lectures or tutorials. The Science tasks extended students conceptual development within a selected concept area and the use of outcomes in Science. The English tasks were designed to extend students knowledge about language, factual genres, information skills and critical literacy. In 1999, one of the tasks was the annotation of a text written in a self-selected genre relevant to the concept being investigated by students. Students had to write the text, annotate the text with the structure and 2 key language features (grammatical). In 1998, this task was part of the web page assignment. The number of overall on-line tasks decreased from eight to six. All six on-line tasks were compulsory and a pass/fail grade assigned to their completion. Students were asked to submit the tasks via email.

The Students

All the students (1998: 153 students; 1999: 126 students) were in the second year of their three-year Bachelor of Teaching (Primary) degree. Students voluntarily participated in the evaluation and hence the numbers of participants varied across evaluation forms. Most students' previous computing experience was limited to word processing. They had limited knowledge and experience of the Internet. The 1999 cohort reported an increased familiarity with the Internet. In a preliminary survey, the students' initially rated using information and receiving instructions from computers as one of their least preferred mediums.

Students Opinion of Learning in a Mixed Mode of Delivery and On-line

In both years, students mid semester completed an open-ended evaluation. The end of semester evaluation instrument combined Lickert scale responses and open-ended written replies. Students also completed a pre-subject questionnaire to ascertain their use, comfort and knowledge of computers and the Internet.

The subject's web site

The subject's site was well received by the students in both years (Tab. 1). In 1999, however it was rated more highly than in 1998. This may be because students have become more comfortable with the Internet and learning with computers than they perceived themselves to be in the preliminary survey. It may also be because students had to access the site to locate tasks, to complete tasks and find information to assist with tasks and assignments. A few students completed the subject on-line and did not attend classes. These were mainly students who were repeating the subject.

	1998	1999
Extremely helpful	11[1]	21
Quite helpful	38	51
Adequate	32	23
A little	17	3
Not at all	2	2

Table 1: Rating of subject website: end of semester

	1998	1999
A lot	13	15
Often	38	38
Sometimes	29	26
A little	14	18
Never	0	3
No comment	6	0

Table 2: Frequency of use of Website: end of semester

The frequency of use by students did not vary over the two years (Tab. 2). This is an interesting result given that the 1999 English and Science on-line tasks were compulsory and the content of these was not covered in tutorials or lectures. This required more independent learning by students but the results suggest that they used the site and the information more effectively than the 1998 cohort did. It is also important to note that 3% did not use the site at all. The completion of on-line tasks could be done with a partner, in a small group or individually. These people may have opted to work in with other students, who did the actual 'looking up' and using of the site, while they assisted in the completion of the tasks. They may also have been able to obtain enough information about tasks and content from students, books, journals or other sources.

In both years, the site was mostly used for accessing information. It was also used to get help with assignments, to access the lecturers and obtain clarification about the content.

On-line Tasks

Between 1998 and 1999 there has been a significant change in students opinion of the on-line tasks (Tab. 3). The on-line tasks in 1999 were more favorably rated than in 1998, in relation to increasing students' learning in the subject. The most significant change occurred for the English on-line tasks. This can be 'related' to the compulsory completion of these tasks in 1999. However it may also provide a better reflection on the quality of the on-line tasks as all students completed them and could evaluate them more effectively than the 1998 cohort.

[1] In all tables the numbers are in %, rounded to nearest whole.

	1998 - voluntary: English	1998 - compulsory: Science	1999- compulsory + graded: English	1999- compulsory + graded: Science
Extremely helpful	0	0	8	5
Quite helpful	19	31	35	30
Adequate	21	22	41	38
A little	25	24	13	21
Not at all	35	22	3	7

Table 3: Rating of on-line tasks: end of semester

In 1998, students who did not attempt the English on-line tasks may have rated them of no or little help in their learning because they didn't have to complete them. Students in 1999 also rated the Science on-line tasks higher than in 1998. This may be due to the decreased number of on-line tasks in Science. It may also reflect on the different learning styles, perceptions of the 1999 cohort of students, and their increasing familiarity and comfort in learning independently and in learning with this medium (Tab. 4).

Presentation Mode

	1998	1999
Extremely helpful	32	33
Quite helpful	28	46
Adequate	19	13
A little	9	3
Not at all	11	5

Table 4: Influence of Independent study weeks on learning in subject: end of semester

	1998	1999
Excellent	4	2
Good	25	56
Some value	21	8
Interesting	2	3
Boring/unhelpful	2	3
Other	-	7
No comment	41	20

Table 5: Presentation mode: end of semester

Students found the presentation mode of the subject useful to their learning (Tab. 4 & Tab. 5). In 1998 this subject was the only undergraduate subject with a different pattern of attendance and on-line tasks. For 1998 cohort it was a unique and challenging experience. In 1999, the subject is only one of a number of undergraduate subjects with unusual attendance patterns, combining a range of delivery modes. Hence 1999 students may have had previous experience or other subjects where they had to keep track of their attendance for other subjects as well as Curriculum Studies 6. When read in conjunction with Table 4, the results also show that students can learn and appreciate learning from a range of mediums and modes, including an on-line medium and an independent mode.

Using Computers

Students developed a lot of confidence in using computers as a result of this subject (Tab. 6). Their experiences working with computers were commented on favorably mid-semester and at the end of semester (Tab. 7). Again the difference between 1998 and 1999 cohorts' negative opinion may be due to the changing nature of the student population in regards to use and exposure to computers. The more negative comments in 1999 about 'using computers' were related to lack access.

	1998	1999
Positive experience/ good or great	51	53
Some value/ getting better/more confident	15	33
Negative experience/ difficult or hard	28	8
Other	0	5
No comment	6	2

Table 6: Working with computers: end of semester

Technical difficulties and access to computers were the most frequently reported problems students encountered. The authoring software, although different in each year, was a problem and the problems with email preferences in the computing laboratories meant students in 1999 couldn't email directly from the Internet browser. This required students to print out or send tasks as attachments using their personal email accounts.

Students' opinion of the construction of a web page assignment changed over the 2 years (see Tab. 7). The 1999 cohort commented most favorably about this assignment in the formative mid-semester evaluation. There is also a decrease in the negative comments about this assignment in 1999. Students' comfort at using computers may account for this. Also students can see the benefit in learning about web page construction as future educators of children living in a digital world.

	Positive Comments		Negative Comments	
	1998	1999	1998	1999
Web page construction	10	24	15	10
Using computers	23	22	0	11
Course structure	20	13	10	9
Face-to-face Content	23	13	34	37
Other	0	10	0	7
On-line tasks	2	3	13	7
Technical problems	0	0	11	14
CS6 website	4	0	0	0
Assignments	10	0	6	0

Table 7: Mid-semester evaluation

Face-to-Face Content

The largest number of mid-semester negative comments related to the face-to-face content (Tab. 7). What was remarkable was one of the two content areas received the majority of unfavorable comments over both years. Even with changes made to the Science subject content, it was still not well received.

Discussion

Two trends are clear from the CS6 initiative. The first is that students are increasingly comfortable with on-line delivery of aspects of undergraduate subjects. The second is that, the on-line component of a subject can become increasingly supportive of students' learning given appropriate evaluation and subject design changes.

Simply participating in a university course increases students' experiences with Information Technologies (IT). They need to use IT for research, information collection and production of assignments. In this subject, the use of IT was required for participation and for the production of assessment items. A third dimension was added in that this subject also studied the place of IT in children's learning. Thus the use of the on-line resources were linked to the students' future professional roles. Significant assistance was given to students by their peers, by the lecturers and by the technical staff of the computing center.

It is important to note that comfort increased in the second year of the subject when there was a grade attached to the completion of on-line tasks. This is a form of compulsion and as such needs to be backed by support for those students who find the use of IT a challenge. From the student evaluations obtained it seems that the central importance of the tasks and the support provided mitigated the compulsory nature of the on-line tasks.

The second trend that these evaluations highlight is the need for continuous monitoring and improvement in the on-line learning experiences offered to the students. The lecturers responsible for the delivery of this subject responded to students' evaluations by redesigning the number and nature of the on-line tasks. They made changes that were designed to assist students to be more independent in their learning.

In addition, the responses to the face-to-face delivery indicate that lecturers also need to evaluate the content and presentation of the face-to-face lessons if using a mixed-mode presentation for a subject. It is essential to meet the needs of students, consider what they have learnt before the subject and extend this knowledge.

Conclusion

The design of the subject and the improvements made were part of an attempt to develop a more "learner centred constructivist" learning environment (Latchem & Moran 1998, p.67). The students approved this philosophical approach.

The success if this subject is a significant component of organisational change within the Faculty's pre-service teacher education program. Indicators of organisational change since the inception of this initiative has been the interest of other lecturers in doing on-line work; involvement in Flexible delivery projects funded by the university; knowledge sharing and collaborative learning of lecturers; the use of an integration approach to on-line learning in subjects; and the modification of subject presentation formats.

References

Alexander, S. and Hedberg, J. (1994). Evaluating Technology-Based Learning: Which Model? In Beatie, K., McNaught, C. & Wills, S. (Eds.), *Interactive Multimedia in University Education: Designing for Change in Teaching and Learning.* Amsterdam: North Holland, Elsevier, pp. 233-244.

Alexander, S., McKenzie, J. and Geissinger, H. (1998) *An Evaluation of Information Technology Projects for University Learning.* Canberra: CUTSD.

Branch, P. & Tonkin, B., (1997). Multicampus video on demand at Monash University, *Australian Journal of Educational Technology,* 13(2), 85-97.

Hacker, R. & Sova, B. (1998) Initial teacher education: A study of the efficacy of computer mediated courseware delivery in a partnership context. *British Journal of Educational Technology,* 29(4), 333-341.

Kemp, J.E., Morrison, G.R. & Ross, S.M. (1998) *Designing Effective Instruction*, Upper Saddle River NJ, Prentice Hall.

Latchem, C. and Moran, L. (1998) Staff Development Issues in Dual-Mode Institutions: The Australian experience. In C. Latchem, & F. Lockwood, (Eds.). *Staff Development in Open and Flexible Learning.* London: Routledge. pp. 65-74.

Le Grew, D & Calvert, J. (1998) Leadership for Open and Flexible Learning in Higher Education. In C. Latchem, & F. Lockwood, (Eds.). *Staff Development in Open and Flexible Learning*. London: Routledge, pp. 3-12

Lewis, R. (1998). Staff Development in Conventional Institutions Moving Towards Open Learning in C. Latchem, & F. Lockwood, (Eds.). *Staff Development in Open and Flexible Learning*. London: Routledge, pp. 23-32.

Negroponte, N. (1995) *Being Digital.* Sydney: Hodder & Stoughton.

Spender, D. (1995) *Nattering on the Net Women, Power and Cyberspace*, Melbourne: Spinifex.

Zammit, K, Nanlohy, P. & Corrigan, G. (1998) Learning to learn with technology. *Proceedings of the AARE conference, Adelaide,* Dec. 1998 http://www/swin.edu.au/aare/welcome.html

Zammit, K, Nanlohy, P. & Corrigan, G. (1999) Integrating on-line learning: A first attempt to integrate the Internet into a teacher education core curriculum subject. *UltiBASE*: http://ultibase.eu.rmit.edu.au/develop/Articles/Zammit1.htm

Acknowledgements

Acknowledgement and thanks go to our colleagues Gerry Corrigan, Jon Callow and Gordon Brown for their commitment to the initiatives introduced in the subject. The development of the subject was assisted by funds from a University of Western Sydney, Macarthur Teaching Incentive Grant.

Authoring Computer-Based Instruction for Teaching Procedural Knowledge Using Instructional Event Shells

Jianping Zhang And Jin Cao
Department of Computer Science
Utah State University
Logan, UT 84322-4205 USA
jianping@zhang.cs.usu.edu

Jin Cao
Citrix Systems, Inc.
Salt Lake City, UT USA
jin.cao@citrix.com

Abstract This paper reports our work towards the development of an authoring system for automating the instructional design for teaching procedural knowledge. The core of our work is the design of a set of instructional events for teaching procedural knowledge, *Introduction, Presentation, Demonstration, Exploration, Practice*, and *Test*, and the development of corresponding instructional event shells and an instructional simulation tool. An instructional event shell is a piece of program code that executes an instructional event. *Demonstration, Exploration, Practice,* and *Test* event shells are built upon the instructional simulation tool. The instructional simulation tool provides an environment for creating simulations of procedural knowledge. These simulations may be used for *Demonstration, Exploration, Practice,* or *Test* The focus of this paper is a description of these instructional events and the instructional simulation tool.

Introduction

With the rapid advances of computer network and multimedia technologies, the use of interactive instructional technologies has been experiencing a dramatic increase in recent years. However, development of high quality computer-based courseware is both time consuming and labor intensive. Therefore, only the best funded training programs can afford to be computer-based. Many organizations that are attracted to the concept of computer-based training have to give up when they discover the cost and the time to implement computer-based courseware.

A traditional computer-based courseware development team involves subject matter experts, instructional designers, and programmers. The subject matter expert determines what to teach and provides subject matter knowledge. The instructional designer together with the subject matter expert determines how to teach and designs the instructional treatments for subject matter knowledge to be taught. The programmer generates computer code to implement the instructional treatments for the delivery of the instructional material. The development processes of both instructional design and programming are very long and labor intensive even for some simple training programs.

To reduce the time and cost spent in programming, authoring systems have been developed and used widely. The goal of existing authoring systems is to eliminate programming in the courseware development process and lift the expensive burden from the course developer's shoulders. Solving the programming problem for course developers with authoring systems has greatly influenced the productivity of development of computer-based instruction, and the number of interactive instructional software products has increased geometrically.

However, the current conception of authoring systems has not solved the cost and time problem to a sufficient degree. The quality of many current instructional products still appears to be far below the potential promised by the current computer technology. Even though the expensive programming burden has been lifted from the course developer's shoulders, there remains a equally cost and unnecessarily repetitive instructional design process burden which still rests on the developer (Merrill, 1985).

Merrill and his colleagues (Merrill, Li, & Jones, 1991) introduced the instructional transaction theory that maintains that the basic building block of instruction should be the instructional transaction. This principle applies particularly to the highly interactive medium of computer-based instruction, in which the most powerful vehicle for learning is the pattern of interactions between the student and the computer. Based on the instructional transaction theory, a simple prototype named ID Expert (Merrill & Li, 1989) was developed. ID Expert was intended for use by both novice subject matter experts and experienced instructional designers and provides instructional design and templates for courseware developers. The instructional transaction theory provides a theoretical foundation for the development of authoring systems that automate the instructional design of computer-based instruction (Zhang, et al., 1997). Recently, a few commercial authoring systems such as ToolBook and Authorware included some templates or widgets that speed up the courseware development process.

Instructional simulation is an important instructional design technology, especially for teaching procedural knowledge. A simulation is any attempt to mimic a real or imaginary environment or system (Alessi, & Trollip, 1991; Reigeluth & Schwartz, 1989; Thurman, 1993). A simulation is often used for one of two purposes: scientific or instructional. The reasons for using simulations instead of real systems are cost, danger, inaccessibility, or time. Instructional simulations are designed to teach the student about the system by observing the effects of actions or decisions. Instructional simulations are different from scientific simulations in that it should provide guidance, explanations, hints, and feedback for actions, decisions, or results.

Computer-based simulation has been recognized as having cost benefits, safety benefits and security advantages in teaching procedural knowledge. Three barriers to the effective use of simulations in education and training have been identified (Leston Drake, 1997). First, developing simulations is extremely expensive. Second, once a simulation is completed, maintenance and modifications to the simulation are difficult and costly. Finally, not all simulations are instructional.

This paper reports our work towards the development of an authoring system for automating the instructional design for teaching procedural knowledge. The core of our work is the design of a set of instructional events for procedural knowledge teaching, *Introduction, Presentation, Demonstration, Exploration, Practice, and Test*, (Merrill, et al., 1992) and the development of corresponding instructional event shells and an instructional simulation tool. An instructional event shell is a piece of program code that executes an instructional event. The ideas introduced in this paper have been implemented in a prototype named PKAuthor using Visual C++ and the Access database system.

Teaching Procedural Knowledge

Course Structure

Authoring a course using KPAuthor is to create a course structure, provide content material, and create instructional simulations. The course structure, the content materials, and simulations are stored in a database.

A course structure is a tree of course units. The root of the tree is the course and the leaves are instructional events. A course may consist of a set of events and a set of lessons. Instructional events of a course may be a pre-test, a post-test, a course introduction, a course summary, and a comprehensive practice.

A lesson may be composed of a lesson introduction, a lesson summary, a comprehensive practice, a test, and one or more instructional sessions. An instructional session may consist of a set of instructional events and zero or more other instructional sessions. A session may teach one or more procedures.

Instructional Events

Procedural knowledge may be taught using six instructional events: *Introduction*, *Presentation, Demonstration*, *exploration, Practice*, and *Test* (Merill, et al., 1992). These six instructional events may be used repeatedly. In PKAuthor, six corresponding instructional event shells are implemented to execute these six events.

Introduction. It informs the student of the learning objective: what the student can do after he/she completes the learning of the procedural knowledge. In addition to the learning objective, the student is also informed of the prerequisites: what the student must know before he/she can start learning the procedural knowledge. It also briefly describes the tasks to be completed and the goal to be achieved. All materials may be presented using different media such as text (rich text format), pictures, still images, animations, audio, and videos. All materials may be presented in one or more pages. Hyperlinks are allowed.

Presentation. It displays all the material for mastery of the procedural knowledge to be taught. Presentation presents the task to be accomplished with a text or audio description of all steps to be performed in order to complete the task.

Demonstration. It uses examples to illustrate the material presented in *presentation* in a simulated environment. Each step is demonstrated by showing the student how to perform the step. The consequence of each step is also demonstrated by showing the student the state of the device or system following the execution of each step.

Exploration. It provides the student with an opportunity to "play with" in a simulated environment. This "play" allows the student to explore "what happens if ..." type questions by actually trying out a variety of actions and observing the consequences of these actions. Exploration is the mode of learning by discovery.

Practice. It assigns some problems to the student and then the student solves these problems in a simulated environment. Problems can be solved with or without guidance. With guidance, the system shows the student what to do at each step. Without guidance, the student solves problems on his/her own. Hints for solving a problem are always available upon the request of the student. Both intrinsic feedback, observing the consequences of a given action or set of actions, and extrinsic feedback, informing the student about the appropriateness of a given action or set of actions, are available.

Test. It checks the level of mastery the student has attained and determines if the student passes a session/a lesson/a course. *Test* questions may be performance questions or concept questions. A performance question is similar to the problem in *practice*. Neither hints nor feedback is provided in *test*. Only the score is given to the student. Concept questions are multiple questions, true/false questions, matching questions, sequencing questions, and fill-in-blank questions. The student is informed if he/she passes or not.

Instructional Simulation Tool

A simulation provides a controlled learning environment that attempts to replicate key elements of the real world. Simulations allow the learner to act and then provide appropriate outcomes or consequences. Simulations can best serve procedural knowledge teaching. Four of the six instructional events for procedural knowledge teaching need to use simulations.

Simulation Components

Components of an instructional simulation are objects, states, actions, tasks, and rules. Creating a simulation is to create these components. A simulation of a system consists of a space of states, a set of actions, and a set of tasks.

Objects. Simulation objects represent entities in the real world. They can be physical objects or conceptual objects. They are the basic components of a simulation. A simulation object is composed of two parts: internal and external representations. The internal representation is a set of attribute value pairs, which represents the internal status of an object. The external representation is a set of graphic images.

States. State is one of the most important components used in the instructional simulation. A state represents the status of the current world. A state consists of a set of objects and relationships between these objects. A change of an attribute value of a state or a change of a relationship between two objects changes the current state to a new state.

Actions. An action changes the state of current world whenever it is executed. Teaching procedural knowledge is to teach how to choose a sequence of actions under various conditions in order to achieve a goal state from an initial state. An action consists of three parts: precondition, consequence, and an external action. The precondition of an action specifies the conditions under which the action can be executed, the consequence specifies the effect of the action. The external actions specify how to execute the actions and include mouse and keyboard actions. An action moves one state to another by changing some attribute values of some objects or some relationships between objects. Each action is also associated with some instructional materials. The instructional materials teach the student what is the action, when to apply the action, how to perform the action, and what is the effect of the action. An action may be taught explicitly or taught implicitly using the *exploration* instructional event.

Tasks. A task defines a problem. A task may be used as a demonstration example, a practice problem, or a test problem. A task contains one initial state, one goal state, and sequences of actions. The problem is how to apply actions to achieve the goal state from the initial state. The sequences of actions are the solutions of the problem.

A complex task may be divided into a few subtasks, each of which has its own initial and goal states. It makes the complex task easier to learn.

Each task is associated with some instructional materials. The instructional materials include instructions for the student how to solve the problem, hints at each step, and feedback at each step. The feedback can be simply right or wrong for an action or detailed explanations of why the action is correct or incorrect. Feedback may be immediate feedback or delayed feedback. Immediate feedback is given immediately after each action. Delayed feedback is given after a sequence of actions is performed.

Rules. Rules are represented as IF-THEN rules. The IF part is a conjunction of conditions and the THEN part is a conjunction of consequences. A condition is either an attribute value pair or a relationship and a consequence is either an attribute value pair or a relationship. Whenever all conditions in the IF part are satisfied, all consequences in the THEN part become true.

An action changes the state of the world. These changes may cause a sequence of changes of states. Rules are used to determine this kind of changes of states.

Creating A Simulation

Creating a simulation is to construct objects, states, actions, tasks, and rules. The simulation authoring tool is composed of a set of editors: Property Editor, Object Editor, Attribute Editor, Action Editor, State Editor, Task Editor, and Rule Editor. Fig. 1 show the screen of the dialog box of Action Editor, respectively.

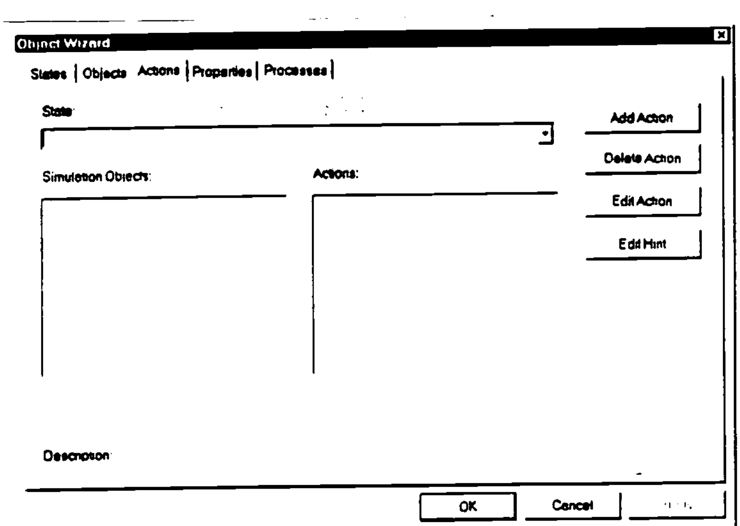


Fig. 1. Action Editor Dialog Box

Property Editor. A property is an attribute. The Property Editor is used to define properties of objects and relationships among objects. A property may have four types of values: enumerated, numeric, set, or string. To define a property, one needs to specify the name of the property, the value type, and the legal values. Fig. 2 shows the screen of the dialog box for editing value type and values of a property.

Object Editor. The Object Editor is used to collect the necessary information for creating an object. The information includes the name of the object, the type of the object, the list of properties, and the media representation.

Action Editor. The author defines actions through Action Editor. Action Editor allows the author to specify the name of an action, the preconditions, the consequence, and the mouse and keyboard action.

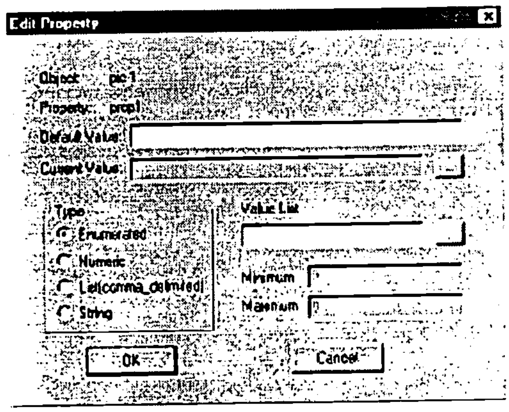


Fig. 2 Dialog box for editing value type and values of a property

State Editor. The author creates, renames, and removes states using the State Editor. To create a state, the author only needs to give a name to the new state, specifies the property values of objects, the relationships among objects.

Task Editor. The author makes use of the Task Editor to create and edit tasks. A task is one of the most complicated simulation components. The author defines initial and goal states using the state editor. A graphic editor is provided for the author to specify the solutions (sequences of actions). Detailed feedback may be constructed using the graphic editor.

Rule Editor (Process Editor). Rule Editor allows the author to define the conditions and consequences of a rule. It consists of a condition editor and a consequence editor. Fig. 3 is the screen of the dialog box of the condition editor.

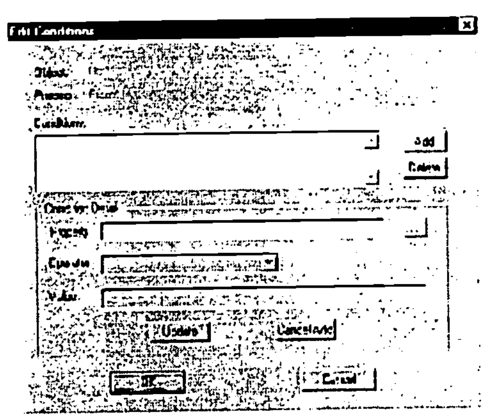


Fig.3. Dialog box of condition editor.

Authoring A Course Using Instructional Event Shells

Authoring a course using PKAuthor consists of the following three phases.

- Content Knowledge Acquisition

- Simulation Development
- Course structure construction
- Instructional event configuration

Content knowledge acquisition is to create instructional materials for courses, lessons, sessions, and instructional events.

Simulation development is to construct one or more simulations. A simulation consists of a set of tasks for *demonstration*, *practice*, and *test* and/or an exploration environment for *exploration*.

Course structure construction is to create the tree structure of a course and define all course units including instructional events.

Instructional event configuration is to associate instructional event with the content knowledge, simulation tasks, and simulated exploration environments.

Conclusion

In this paper, we reported the work we conducted in development of a procedural knowledge teaching authoring system, PKAuthor. This work is a part of a larger project. One of the major objectives of development of PKAuthor is to explore the methods for developing authoring systems to support automated instructional design. PKAuthor is implemented on Windows 95 in Visual C++ and the Access database system.

In the current version of PKAuthor, only a subset of the features described above has been implemented. In the future, we will add more features into the system. PKAuthor has only been tested on computer literacy courseware. PKAuthor needs to be tested on more applications. A more user friendly GUI interface needs to be designed and implemented in PKAuthor. In the future, we plan to implement a web-based version of PKAuthor.

References

Alessi, S. M., & Trollip, S. R. (1991). Computer-based instruction: Methods and development. (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Reigeluth, C., & Schwartz, E. (1989). An instructional theory for the design of computer-based simulations.

Thurman, R.A.(1993). Instructional simulation from a cognitive psychology viewpoint. Journal of Computer-based Instruction, 16(1), 1-10. Educational Technology Research & Development, 41(4), 75-79.

Leston Drake, (1997). Design and Development of a Computer-based Simulation Authoring System for Problem Solving Instruction. IT/EDUC Utah State University.

Merrill, M. D. (1985). Peter Dean Lecture: Where is the authoring in authoring systems? *Journal of Computer-based Instruction*, 12(4), 90-96.

Merrill, M. D., and Li, Z. (1989). An instructional design expert system. *Journal of computer-based instruction*, 16(3), 95-101.

Merrill, M. D., Li, Z., and Jones, M. K. (1991). Instructional transaction theory: An introduction. *Educational Technology*. 31(6), 7-12.

Merrill, M.D., Tennyson, R.D., & Posey, L.O. (1992) *Teaching Concept: an instructional design guide.* Educational Technology Publications, Englewood Cliffs, New Jersy.

Zhang, J., Gibbons, A.S., Merrill, M.D. (1997). Automating the design of Adaptive and self-improving instruction. In *Instructional Development Paradigms* (Eds Dills & Romiszowski). Educational Technology Publications, Englewood Cliffs, New Jersy.

SHORT PAPERS

Creation of a Simple Intranet for University Educational Use

Dr. Hassan Ahmadi Torshizi,
Faculty Member, Computer Science Department,
Islamic Azad University, Mashhad, Iran

Mr. Bagher Azghandi,
Faculty Member, Computer Science Department,
Islamic Azad University, Mashhad, Iran

Abstract: This article describes and presents the results of an 18 month project by faculty members and students of the Computer Science Department of the Azad University in Mashhad, Iran, at an approximate cost of $10,000. The result was the creation of a simple Intranet which employs eight phone lines and makes it possible for faculty members, students, and university employees to access information by only dialing up. Although not complex, this Intranet does provide information services through the use of Microsoft Information Internet Services (Internet Information Server - IIS) and NT Information Systems support software packages (such as Back Office), which offer users ready pages in static or dynamic form via ASP (Active Server Page). This Intranet system also features E-mail service to facilitate the communication between and among students and faculty. In addition, users may conduct direct conversations on Web pages (Net chatting) and participate in network conferences (Net meetings) while conveniently using the local language, Farsi.

Introduction

Today there is no doubt that information systems play an important role in the development of the remote education culture. From remote sites, via telephone lines and satellites, computer users can now access different kinds of hypertext information data bases that specialize in scientific, commercial, artistic and other areas with multimedia user friendly formats. Actually, this scenario is the basic working principle of remote education. However, the problem remains that information is too widely scattered, with no dedicated organization, fixed protocol or rules, for guiding the user in efficiently locating and utilizing these valuable educational resources in an optimum way and format. This is indeed a universal problem, not just isolated to the specialized academic environment. One possible solution for resolving this dilemma is the creation of local Intranets in educational institutions and their departments. With proper planning and organization, direct and indirect communication between users and access to the data they need can be realized. This would also make possible scientific conferences and other direct and indirect means of conversation between educators and students, information providers and searchers. However, because of the high expense and technical expertise entailed in establishing a comprehensive information system with state-of-the-art information technology, Intranet systems such as these are not yet common. This simple Intranet provides the following services:

1. Access to data about different university departments, including information on:

   1.1. University departments: Campus locations and addresses, the geographical and historical development of the departments, their academic goals, along with related pictures.

   1.2 Class schedules: Current semester schedule along with instructors' names, class times, classroom locations and other information.

   1.3 Faculty members: Campus addresses, phone numbers, E-mail addresses, academic experience, qualifications, classes taught and now teaching ,research work, scientific articles and books published.

1.4 Students: Majors, E-mail addresses, projects interested in.

1.5 Academic courses: Curriculum, university departments, number of units, pre-requisites, course resources and references, short descriptions of how the course will be conducted including laboratory requirements, projects, exam materials, dates and locations of exams. If possible, a description of exercises related to each course is provided.

1.6 Laboratories, workshops, practical courses, hardware and software workshops: Along with a calendar showing schedules and work to be accomplished, suggestions are included on how these special classes can be taken advantage of.

1.7 Publications: Articles published by faculty and students and where the abstracts are kept.

1.8 Books: List of existing books within the different university departments.

2. E-mail, on-line conversations and Net Meetings:

Provided are E-mail access, on-line conversations through the Web (Web chatting), and network conferences (Net Meetings). All of these facilities are available for those having User I.D.'s and E-mail accounts. In on-line conversations , it is possible for users to communicate in either English or the local language, Farsi. In the case where users have a CCD camera and sound card connected to their computers, they will also be able to see and hear each other.

3. Software bank at the university computer center and the possibility of transferring files to and from remote sites (File Transfer Protocol, FTP).

Study and Investigations Performed in this Project

This project's main functions covered six areas:

1. Design and implementation of hypertext pages along with the scripts needed in the database. This was accomplished using software packages such as Home Site, Front Page, VB and Java.

2. Design and implementation of Access software for university departments which store information obtained from the University Information and Statistics Center and which is updated by the Computer Service Department of the university.

3. Creation of dynamic Web pages (ASP) for accessing related information on departments, students and the software information bank. With the help of these pages, users can access databases of the server environment.

4. Creation and use of E-mail by users from within the internal pages of the database with the help of the software called Exchange Server.

5. Creation of Net chatting with the use of Web pages.

6. Creation of Net conferences through the server with the use of Net Meeting software.

Conclusion

The development of a simple Intranet can provide essential information for faculty and students, plus the advantages of electronic communication in the forms of correspondence, conversation and network conferencing. The use of the Intranet offers endless possibilities in the development and progress of the remote education culture.

This article outlines the conditions, requirements and actions that were taken to establish a simple Intranet. One must consider that the work was performed under limited conditions, by faculty members and students from the Computer Science Department at an overall low cost. This should be compared to the unlimited current and future possibilities in the development of remote education that the Intranet and the use of computers provide to the University. It naturally follows that, as a result of this project, university departments will take more advantage of this and related projects.

The following outlines other areas that can be explored to make this Intranet more profitable and successful:

1. Separation of E-mail servers and the transferring of files from other system information servers so as to increase the number of users and the speed of services.

2. Preparation of electronic news magazines by different departments which students can access from remote sites.

3. Creation and development of Telecourses in CD form which can be accessed by students on-line from remote sources or off-line.

References

1. A Model for Intelligent Computer-Aided Education Systems (February 1995). *Computers and Education*, 24 (2).

2. Duff, J.M. (1997). *Web Page Design.* Swadley, R.K.: Sams Publishing.

3. From Bulletin Boards to Electronic Universities: Distance Education, Computer Mediated Communication and On-line Education (1992). *ACSDE Research Monograph*, 7.

4. Sones, D., & Randall, N. (1997). *Special Edition Using Microsoft, Front Page 97.*:Que ® Corporation.

5. Swadley, R.K. (1997). *Java and Java Script.*:Sams Publishing.

6. Swadley, R.K. (1997). *Windows NT and Back Office Integration.*:Sams Publishing,.

7. Swadley, R.K. (1997). *Windows NT Internet and Internet Administration.*:Sams Publishing.

What Tools for Adaptative Multimedia Telelearning

AJHOUN Rachida,
TALA, IERA, Morocco,
ajhoun@emi.ac.ma

BENKIRAN Amine,
département informatique, EMI, Morocco,
benkiran@emi.ac.ma

Abstract: In this paper we are mainly interested to present briefly a telelearning system where the learner is able to attend courses to his own rhythm and accesses only the elements of the course which relates to him. The power of our system is the use of widely available tools. This availability will guaranty a large opening and a larger audience. Our objective is to produce one generic course, which will be used to generate several specific courses according to the learner profiles.

Several telelearning applications were carried out to provide courses on the Internet (Harasim, 1999) (Padhye &al., 1999). Generally, the courses are hypertext documents. In this approach, a learner can access any sequence of a course without order constraints on these sequences and without having the necessary knowledge. Consequently, the teaching objectives (specialty, type of training...) aimed by the access to the course will not be reached. In our view and to ensure a pedagogical learning, the course must take account of the learner profile (capacities of training, previous knowledge, language...) and the learner evolution (prerequisite, speed...) (Fleury M.) (Bloom &al.).

In this paper, we are mainly interested to present techniques of adaptability of the courses in the SMART-Learning (System for Multimedia Adaptative and coopeRative Telelearning) project. The goal of our system is to allow a reliable adaptability of the courses to learners based on tools that are of a great availability and easy to use.

Functional model

The fundamental goal of SMART-Learning is to provide the learner with the sequences from the course which are adapted to his profile and according to the progress in the course. The profile changes are dynamically processed by the system. The author produces only one *generic course* and at the learning time, our system generates an individual course for each learner [Ajhoun & al. 2000].

To adapt a course to a given profile will recommend the author to take into account all various types of profiles as well as the pedagogic path to follow for each profile. To simplify the task of the course production, our system is conceived to guide the author by proposing some courses production models.

To make the courses evolutionary, the author uses the interactions of learners (questions, remarks, badly understood sequences...) with the system to improve his course. Using this feedback effect, the author will have the possibility of modifying the contents and improve its teaching techniques if necessary. This significant aspect is translated in the architecture of our system by a tight dependence between the phase of production and that of learning

At the learning time, the profile changes with the advancement of the course. Every pedagogical sequence of the course should be generated in real time to take account of the new calculated profile. For this reason, our system proposes techniques of generation of the courses, based on the generic course produced by the author and the calculated profile of the learner.

Methodology of adaptability

In order to respect the adaptability objective, we have designed a model for the production of generic courses. This model provides the general structure of the course in accordance with the profiles of learners and the objectives aimed by this course. Our system integrates in the generated course the mechanisms to take account of the dynamic evolution of the profile during the learning (Benkiran & al. 2000).

At the end of each pedagogical sequence and if necessary, the learner make a self-evaluation test to control the knowledge obtained during this sequence. According to the test result, as well as other parameters based on the interaction with the system (e.g.: speed, spent time) and based on the *educational graph*, the system chooses the next pedagogical sequence to present to the learner. The educational graph represents the whole of the learning rules which control the succession of the different course sequences in order to achieve a teaching goal.

We applied this model using XML language, reputed by its facility to exchange complex document on the Internet, for courses production. This brings a double advantage:

1. The simplicity of production and updating of courses;
2. The ability to force the course structure and the links between the elements of the course.

To solve the problem of adaptability in its practical phase, we have defined an approach based on some XML specific tools (XSL, DOM...).

Why the Web

Make our system accessible to a large users require the choice of means and tools, which are available and known by great number of users. In our view, to provide courses to learners anywhere in the world, the use of Internet, is impossible to circumvent. Indeed, the number of users of Internet increases continuously (Bosak, 1997).

Designing software for the World Wide Web poses particular challenges to the design of user interfaces due in part to the limitation of bandwidth, and to the very nature of hypertext transfer protocol (HTTP) browsers as document retrieval systems.

The main disadvantages of the Web are bad interactivity, non-guaranteed quality of service, the difficult synchronization between the media and especially the structure of the HTML are opposed to some educational principles. This led us to find solutions at the design in order to avoid these problems.

The flow rate and the response time of the access to the Internet network depend mainly on the time and the place of access and can lead to bad performances to transfer the elements of the course which are multimedia documents, in particular in southern countries. To avoid this disadvantage, we propose several access modes to the courses. One of them, the off line mode consists in storing all the media elements of the course locally (e.g.: CD-ROM or disk). All the learning process is done remotely. To show a media element of the course to the learner the access is done locally instead of transferring the information from the server. This makes it possible to improve the quickness of the presentation and the interactivity with the system.

Conclusion

A prototype of our system was carried out and tested at our research unit with a great success and satisfaction. Furthermore, we underline the simplicity of the use of XML to provide adaptable courses on the Internet. Our approach has several advantages. We will mention its simplicity, the small data transfer between the learner and the course server – because only profile related data are transferred - as well as the negligible processing to adapt a course to each learner.

References

Ajhoun R., Benkiran A. Mahamane A. (2000) *A framework for adaptative and cooperative learning for Internet: the SMART-Learning*, proceedings of INET2000, the 10th Annual Internet Society Conference, Yokohama, Japan, July 2000.

Benkiran A., Ajhoun R., Belqasmi Y. (2000) *Adaptability of Multimédia Courses using Intelligent Hypertexts,* proceedings of TechEd2000 - Technology in Education International Conference, Palm Springs, California, March 2000.

Bloom B.S, Krathwohl D.R,.Masia B.B(1970). *Taxonomie des objectifs pédagogiques. Tome 2. domaine affectif* Education nouvelle, Inc. 1970

Bosak J. (1997) *XML, Java, and the future of the Web* Sun Microsystems, 1997

Fleury M. *Implications de certains principes de design pour le concepteur des systèmes multimédias interactifs* Faculté des sciences de l'éducation, Université Laval.

Harasim L. (1999) A framework for online Learning: the Virtual-U *IEEE Computer* September 1999

Padhye J., Kurose J. (1999) Continuous-Media Courseware Server: A Study of Client Interactions , *IEEE Internet Computing,* Vol.3, No.2, March/April 1999.

The Cosmos Web-based Explanatory Library (CosWbEL)

Saleh S H Al-Shidhani
School of Cognitive and Computer Sciences
University of Sussex, Falmer, Brighton, BN1 9QH, UK
+44 (0) 1273 678061 , mapc0@sussex.ac.uk

Abstract: The Cosmic Explorer is a simulation-based interactive exploratory system aimed to provide an interactive means of simulating, exploring and studying cosmological models of the universe. This paper presents the web-based explanatory library of the system that takes into account the learner's difficulties in envisaging the cosmological concepts and adaptively presents the domain knowledge to match the learner's demands.

The Cosmic Explorer

Modern cosmology is an example of a complex dynamic conceptional domain and is best described by the General Theory of Einstein. The Cosmological Principle (CP) implies a homogenous and isotropic distribution of the matter in the Universe without giving an explicit definition nor sufficient distinctive description of what this mean in practice. Therefore, students face difficulties in grasping these concepts and their representations because their imaginary picture of the "big bang" event is often based on firework metaphor (Odenwald & Fienberg, 1993).

To tackle this situation we are developing the Cosmic Explorer that uses an N-body hydrodynamic cosmological simulator (namely Hydra by Couchman, et al. 1995) and a research-specific visualization utility (namely Tipsy by Katz and Quinn) to produce a realistic simulation of the real Universe and to provide scientific-class analysis tools. The system is aimed to promote conceptual understanding of the cosmological principle and confront several misconceptions associated with the expansion of the universe.

The practical goal of the CosWbEL is to support self-driven/distance learning, and to complement traditional learning settings. Here we adopt the view that Science teaching should reduce the emphasis on problem solving in favour of a clear and deeper understanding. One way to achieve this is by a heavy usage of visual illustrations of the concepts as well as comprehending its implication before concentrating on relevant problem solving skills. Consolidating the proper understanding can be helped by extracting several visual representations from real or simulated world(s) so the de-abstraction process will be easier. For example, the students can be shown visually the data form which the descriptive properties were extracted. Consequently, reversing the process will be easier for them, since they have visual images that go side-be-side with the description rather than purely theoretical imaginative thoughts.

During the process of refining the design, a preliminary study was devised to probe students understanding of a few key concepts. The study indicated a lack of proper understanding and incomplete background. The lack varied from one subject to another and seemed to depend on the speciality of the subject and on the relevance of his research project to the expansion of the universe and the large scale structure. Although this domain is addressed nicely in most of the recent astronomy introductory textbooks, a deeper understanding was not achieved probably because the students have taken few courses that cover the topic.

This situation set the rational for developing a web-based explanatory library tuned towards filling learners' understanding gaps. Providing the necessary coherent background is crucial since it is believed that this process is the most effective and efficient way to rectify several misconcepts specially naïve ones. Another valuable gain is comprehension of the current concepts as the next pivotal step towards providing a strong unfragmented foundation on which new concepts can be built. The ultimate goal of the research is "How the system can model the learner's reflections and provide dynamically generated meaningful choices.". The next section outlines the proposed library resources and the categorisation as initial attempt to grasp the nature of the problem and possible effective solution.

The Library Resources

The CosWbEL will consist of a comprehensive and structured database of the domain knowledge and a mapping of the relevant local and global resources. The knowledge database will consist of the following:

Explanatory Text	Illustrative Figures	Interactive Diagrams
Conceptual Maps	Comparative Tables	Associated Misconceptions
Formula Sheets	Units Listing Sheets	Glossary Of Terminology.

As the above listing suggests, this section of the library will consist of online documents that present the cosmological concepts and their implications. The library will make use of a lot of visual illustrations that qualitatively show how these concepts apply in given situations as well as how they fit together as part of the whole picture. Furthermore, it will present examples of possible homogenous distributions and check for understanding and go deeper if necessary as a way of adaptive to the learner. Conceptual representations of the influencing factors have been prepared for five key concepts that are best supported by the simulation outputs.

Learners will be encouraged to adopt an exploratory learning methodology (Cox, 1992; al-Shidhani, 1999) since the dynamically constructed knowledge will be presented in a structured network. This mode focuses on synthesizing the applications of a certain concept from previously introduced cases. In addition, it emphasizes the generality by showing how linking between the concept abstractions and the specific cases has the same theme. The assumption here is that exploring such a conceptual network increases the understanding of the dynamics and the factors' interdependency. This approach adds elements of clarity to any explanatory text as well, it shows some implications of the concepts that are taught. In this way, the less complicated misconceptions can be pointed out and addressed easily at the appropriate place within the text, so building of new concepts goes step-by-step with comprehending and clarifying the current ones.

The mapping of relevant local and global resources will be aimed to associate the related resources to the constructed knowledge representation. The resources are classified as web resources, searchable databases and online discursive resources. This component will be an attempt to enrich the library resources by providing classified map to the diverse and vast resources available via the WWW and put the learners in control of their exploration and acquisition. The main distinction here is that learners are unlikely to get confused or lost in the huge web resources because most irrelevant pages are filtered out. The detail of the searching and filtering codes will be presented at the conference.

Conclusion

The CosWbEL is expected to facilitate the learning of complex and dynamic domains such as modern cosmology. The complementary approach of the knowledge representation has the potential to aid learners to build a coherent well structured conceptual understanding of the domain and enrich the subject teaching/learning experience and take advantage of the valuable www resources. Evaluation of its effectiveness helps to clarify the optimum utilization of the web in designing 21st century education.

References

Al-Shidhani, S. (1999), Exploratory Learning Environments (ELE) and the Demanded Interactivity: The Cosmic Explore Case, in the proceeding of The 3rd HCT Workshop: Interacting through/with Technology, Ed. Retkowsky, Fabrice. COGS, University of Sussex. Brighton,UK.

Couchman, H. M. P.; Thomas P. A.& ,Pearce F. R.;1995, "Hydra: An Adaptive-mesh Implementation Of PPPM-SPH", MNRAS, 452, 797.

Cox, R.J. (1992). Issues in Guided Exploratory Learning from Computer-Based Systems. DAI Research paper No. 589. Dept. of AI, University of Edinburgh.

Katz N. and Quinn, T., Tipsy software downloadable from FTP Directory: ftp://ftp.astro.washington.edu/pub/hpcc/.

Odenwald, S.; and Fienberg, R. T. (1993) Galaxy redshifts reconsidered, Sky & Telescope, vol. 85, no. 2, p. 31-35.

Interactive Fiction: Model Development and an Example Created with DHTML and Microsoft Agent

Alan Amory and Devandran Govender
School of Life and Environmental Sciences
University of Natal
Durban 4041, South Africa
amory@nu.ac.za

Introduction

Interactive fiction (IF) appears to include both the adventure and role-playing games genres. However, Desilets (1999) defined interactive fiction as a "computer-based form of literature in which the reader plays the part of an important character, deciding, within limits, what action that character will take". That author argues that IF promotes student motivation, develops insights into elements of conventional literature, problem-solving skills, critical thinking and problem identification, and can be inexpensive to develop. McKee (1992) and Rieber (1996) agree that games can affect cognitive functions and motivation, and inherently stimulate curiosity (Thomas and Macredia, 1994) by including challenges and elements of fantasy, novelty and complexity (Malone, 1984; Malone and Lepper, 1987; Rivers, 1990). Educational researchers have investigated mainly two game types, simulation and adventure, as viable educational tools (Quinn, 1994, 1997; Roberts, 1976). Quinn (1994) proposed a model for the development of educationally sound games that attempted to integrate cognitive science, interface design and models of instruction. However, that theoretical model offers little practical help to guide game developers. In an attempt to formalize the relationship between educational theory, game design, play and development, we developed the Game Object Model (GOM) (Amory *et al.*, 1999) (Fig. 1). While this model includes interfaces that create the ambiance of the game, Harrigan (1999) argues that dramatic theories (Laban, 1975; Stanislavski, 1976) could be incorporated into the design of educational software to heighten game play.

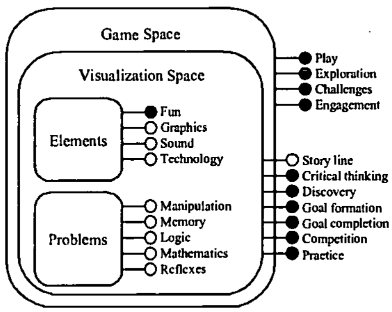


Figure 1. Game object model [●- abstract interfaces, ○ - concrete interfaces]. (From Amory *et al.*, 1999)

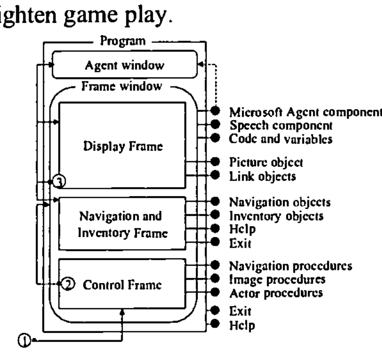


Figure 2. Design of interactive book to show relationships between the frame windows, child frames and objects within frames.

The primary objective of this study was to develop an interactive fiction prototype to evaluate the use of GOM and to extend this model to include an interactive actor. Secondary objectives were to teach young people basic astronomy and to evaluate the use of Dynamic Hypertext Markup Language (DHTML) as a viable authoring tool.

Materials and Methods

The basis of the interactive book is a story by Jenny Marais, a South African author of the book series for young people, *Learning with Granny.* Her stories attempt to integrate scientific knowledge into stories that stimulate and encourage scientific discovery in the reader. Two Microsoft® technologies were used to create the learning resource: Internet Explorer DHTML version 5 and Agent version 2 (http://msdn.microsoft.com/workshop/c-frame.htm#/workshop/imedia/agent/default.asp). The character selected for this project was Peedy, an animated parrot. While the development of the user-interface relied on VBScript, the puzzles were coded in JavaScript. Graphics were designed using Bryce (MetaCreations) and Photoshop (Adobe). The interactive book was created using DHTML embedded in a number of HTML frames (see Fig. 2). The pilot software was tested on two young people (a 10 year old girl and an 11 year old boy). An informal interview was held before and after the game was played.

Results and Discussion

Both participants were computer literate and had access to a computer at home that they used for recreation (playing games, drawing) and for school projects. They reported that they liked playing 'shoot-em-up' games and were familiar with Microsoft's Encarta, WordPad, Paint and CorelDraw. Both reported that they used the Internet to find information, downloading computer games and looking at wildlife pictures and cartoons. Analyses of video recordings showed that participants used the interactive book in different ways: the girl spent more time carefully exploring and reading the information than did the boy, who spent more time solving puzzles. Klawe and Phillips (1995) reported similar results. Both players described Peedy as "cute" and commented on his friendliness and bright colours. However, they felt that younger children (8 year old) might find Peedy more appealing. When asked what type of a character they would have preferred, both agreed that an alien character or a parrot with a surfboard would have been better. The players enjoyed the interactions, collecting items and puzzle solving but did not enjoy reading all the text. They found the puzzle that required "matching the zodiac sign with its constellation" difficult and suggested that Peedy should help the user in such puzzle by providing clues about what to do. The participants thought that the story was a bit too simple, lacked a climax and did not support the complex ideas presented in the puzzles. At the end of the interview they commented that the interactive story was both fun and educational and would prefer other literature presented in this medium. Using DHTML to create an interactive story was fairly difficult to code but cheap to implement. The Common Object Model of Internet Explorer provided a framework for the development of this resource. The Agent and Speech components enriched the environment in that the inclusion of an interactive actor provided a focus for the player and made the interactions with the computer more meaningful. The inclusion of a virtual actor also adds an additional element of drama to the story and creates a more meaningful interaction with the player. Gestures made by the actor support the story line and provided additional information to the player. The Game Object Model and inclusion of virtual actors proved useful in the creation of the interactive story. However, DHTML is too difficult to use, as there are no software tools available to help in adding complex scripts to dynamic Web pages. The young players enjoyed interacting with the software and puzzles but thought that the story line should be more complex and felt that the interactive character was a bit too childish.

References

Amory, A., Naicker, K., Vincent, J. and Adams, C. (1999). The use of Computer Games as an Educational Tool: 1. Identification of Appropriate Game Types and Game Elements. British Journal of Educational Technology 30: 311-322.

Desilets, B. (1999). Interactive Fiction vs. the Pause That Distresses: How Computer-Based Literature Interrupts the Reading Process Without Stopping the Fun. Currents in Electronic Literacy 1 (http://www.cwrl.utexas.edu/currents/spr99/desilets.html)

Ju, E. and Wagner, C. (1997) Personal computer adventure games: their structure, principles and applicability for training. Data Base for Advances in Information Systems 28 78-92.

Klawe, M.M. & Phillips, E. (1995) A classroom Study: Electronic games engage children and researchers. Proceedings of Computer Support for Collaborative Learning, 95 (CSCL) Bloomington, Indiana.

Laban, R. (1975). The mastery of movement. Macdonald and Evans Limited.

Malone, T.W. (1984). Heuristics for design enjoyable user Interfaces: Lessons from computer games in Thomas JC, and Schneider, M.L. (eds) Human factors in computer systems pp. 1-12 Ablex, Norwood NJ.

Malone, T.W. and Lepper, M.R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning in Snow, R.E. and Farr, M.J. (eds) Aptitude, learning and instruction III: Cognitive and affective process analysis, Erlbaum, Hillsdale, NJ.

McKee, V. (1992). Out of sight - and out of mind? Life and Times, The Times 22 September.

Quinn, C.N. (1994) Designing educational computer games in Beattie, K., McNaught, C. and Wills, S. (eds) Interactive multimedia in University Education: Designing for change in teaching and learning pp. 45 – 57, Elsevier Science B.V, Amsterdam.

Quinn, C.N. (1997). Engaging Learning. Instructional Technology Forum. (itforum@uga.cc.uga.edu)

Rieber, L.P. (1996). Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. Educational Technology, Research and Development 44: 43-58.

Roberts, N. (1976). Simulation gaming: A critical review. ERIC Document No. ED 137165

Stanislavski, C. (1976). Creating a role. Theatre Arts Books.

Thomas, P. and Macredie, R. (1994). Games and the design of human-computer interfaces. Educational Technology 31: 134-142.

Conceptual Visualization in a Task-Based Information Support System

Lora Aroyo
Faculty of Education Science and Technology, Division of Educational Instrumentation
University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands
aroyo@edte.utwente.nl

Darina Dicheva
Department of Computer Science, Winston-Salem State University, N.C. 27110, USA
dichevad@wssumits.wssu.edu

Ivan Velev
Faculty of Mathematics and Informatics, Department of Information Technologies
Sofia University, Bulgaria
ivan@pcs.bg

Abstract: This paper reports on the latest design updates and implementations of the task-based information and performance support system AIMS. It emphasizes the visualization issues related to the overall system construction, implemented in the latest version of the AIMS prototype.

Background

AIMS stands for Agent-based Information Management System that aims at providing combined adaptive information support for students and instructors within the context of on-line course environments. AIMS helps students to get an overall conceptual view over the subject domain in which they work and to make a direct link with the course goals and assignments. They are also able to search for reference information and materials needed to perform a task as well as to explore the subject domain for better comprehension [Aroyo, Dicheva 99]. AIMS is built as an agent-oriented architecture, where agents' behavior is modeled in correspondence to the main activities involved in the process of task-based information retrieval. As a result of agents collaborative intelligent behavior, the system provides an intelligent user-oriented information support for learners and instructors.

What Do We Visualize and How Do We Realize it?

Main visualization target in AIMS is the presentation of the subject domain structure and the overlaying structures of the course and of the user model. As part of the supporting information search functionality AIMS proposes combined visualization of the search results. As the basic underlying mechanism for information structuring and presentation we use the concept mapping approach. Concept mapping allows the learners to connect new ideas to knowledge that they already have and to organize them in a logical structure. This way it allows them to see more complex relationships between ideas than just sequence and hierarchy. It is simple and intuitive visual form of knowledge representation well applicable for subject domain structuring and course tasks presentation. In this specific educational context, concept mapping appears to be a very useful technique for visual presentation of search results, domain and course structures. It is also used for course task and subtasks. The user model is build as an overlay model of the domain concept map. Search results are also partly presented with this graphical approach. The result documents are related to a result concept map of domain terms used in those documents. Documents are still organized in the traditional way of textual list-based presentation. Some metadata is also applied in order to support a better and quicker overall search result comprehension. Metadata in the form of short descriptive information and structured tags is also used in order to describe the context of the domain terms and links.

The visualization and domain navigation facilities help students to get orientated within the subject domain and to build up their own understanding and conceptual associations. It supports their visual thinking and imagination.

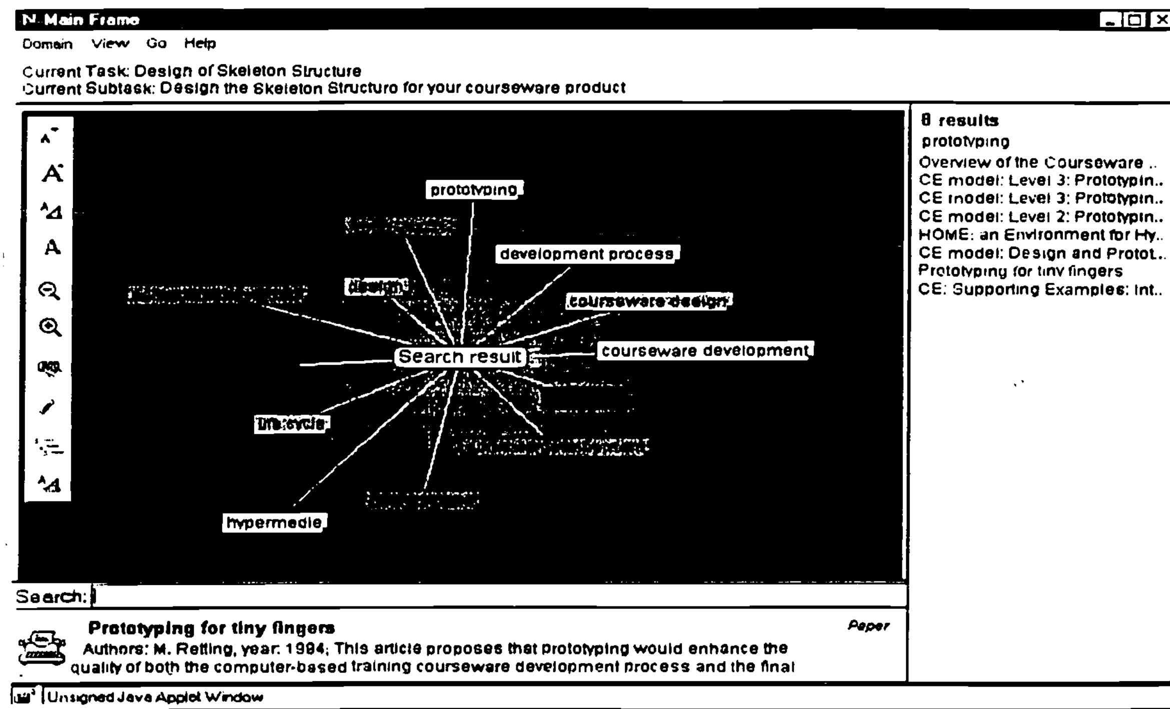


Figure 1: AIMS Information Search and Browsing Environment

The GUI Issues in AIMS

Student Support. The student environment consists of a search facilitated with domain concept browser aimed at providing support to the student in the context of information search, domain exploration, and task comprehension. When the student logs in he or she can choose between working on a course assignment or exploring the subject domain and performing task independent search queries. The browser component visualizes a Concept Map of a set of domain terms and links in the context of the overall domain structure presentation, search results and course task presentation. Its functionality includes navigating (by shortcuts, history), bookmarking (terms, tasks, search results) and screen editing. The main AIMS functionality - searching for course related material is combined together with several options for refining search query and search results.

Instructor Support. Instructor support tools consist of domain, course, and library editors. The domain editor is aimed at providing support for the instructors to build and maintain the AIMS domain knowledge. Its functions cover building a new domain structure, that is, the domain concept map and the documents related to it, as well as editing and updating the existing domain structure, including terms, links, and documents. The concept map representing the subject domain knowledge is presented to the students to explore and is used to support their information search activities. The course editor is aimed at facilitating the instructor to build the structure of a specific course and organize along going tasks, course materials, and reference documents. Since the main goal of AIMS is to provide a task-based information support, a series of tasks are associated with each course. The main idea is that the system uses a task to constrain the information provided to the learner in support of his or her efforts to complete this task. Each course task is associated with a list of domain terms, which the student must know to perform successfully the task. Tasks are related also to course topics, which are automatically associated with the whole collection of domain terms included in each related task.

References

Aroyo, L. & Dicheva, D. (1999). *Information Retrieval and Visualization within the Context of an Agent-based Information Management System*. In Proceeding of Ed-Media'99 Conference, Seattle, USA.

Understanding of Adults` Metacognitive Knowledge about Information Seeking Skills via Internet

Petek A kar
Department of Computer Education and Instructional Technology
Hacettepe University
Ankara, 06532 Turkey
paskar@hacettepe.edu.tr

Serpil Yalç nalp
Information Technologies and Electronics Research Institute
ODTU TÜB TAK Ankara 06531 Turkey
serpil.yalcinalp@bilten.metu.edu.tr

Abstract: The purpose of this study is to understand the metacognitive awareness of variables that influence information seeking skills via internet among a group of university staff at Middle East Technical University, Turkey. Nine professors were answered the questions related to personal, task, and strategy categories. Most of the interviewers perceive the basic computer usage competence as a component of information seeking via Internet. Most of them complained about the bulk of search results, most of them are irrelevant which takes too much time. They indicated that goal and task definition is more important than to navigate through Internet. All of the interviewers indicated the importance of planning before starting to information seeking.

Metacognitive Knowledge

The general knowledge that guides effective selection and of task relevant skills has been referred as metacognition (Flavell, 1977, in Paris . & Myres II, 1978). Metacognition has been used to describe our knowledge about how we perceive, remember, think, and act - that is, what we know about what we know. (Melcalfe & Shimamura, 1994)

Metacognitive knowledge consists primarily of knowledge or beliefs about what factors or variables act and interact in what ways to affect the course and outcome of cognitive enterprises (Nelson, 1992). There are three major categories of these factors or variables -person, task, and strategy. The personal category encompasses everything that you could come to believe about the nature of yourself and other people as cognitive processors. The task category concerns the information available to you during a cognitive enterprise. It could be abundant or meager, familiar or unfamiliar, redundant or densely packed, well or poorly organized, delivered in that manner or at that pace, interesting or dull, trustworthy or untrustworthy, and so on. The metacognitive knowledge in this category is an understanding of what such variations imply for how the cognitive enterprise should best be managed and how successful you are likely to be in achieving its goal. As for the strategy category, there is a great deal of knowledge that could be acquired concerning what strategies are likely to be effective in achieving what subclass and goals in what sorts of cognitive undertakings.

Information seeking is a kind of problem solving, which requires goal identification, task definition, search strategies, use of information, synthesis and evaluation. Internet and World Wide Web are changing our conceptions of information systems, which requires new search skills compared to the traditional environments, such as books and references. Open Ended Information Systems- OEISs differ from traditional systems in several aspects (Hill, J. R, 1999) which can be categorized as i. User orientation ii. System form and iii. Type of information retrieved. The user actively engages navigating and searching the system playing a primary role in processing the information retrieved. On the other hand, there are knowledge and skills, which are necessary for problem solving and research independent of information system environment. In this study the metacognitive awareness about information seeking skills for Internet were investigated with respect to person, task and strategy variables.

Personal Variables

One relevant aspect of information seeking skills via Internet is the individuals` s perception of the characteristics of good information searcher. All of the interviewers described the person who is good at information seeking via Internet as the person having information seeking skills that were gained at classic environments. Most of the interviewers perceive the basic computer usage competence as a component of information seeking via Internet. They indicated that the person who is good at using computers is the person who possesses the necessary skills for actualizing his purpose, is patient and knows the limitations of computers. More than half of them stressed the importance of using package programs. Interestingly, one interviewer responded that the person who's good at computers knows when to stop. On the other hand, two of them reported the importance of knowing English; since most of the information available on the Internet is English. Most of the interviewers reported that there is no difference on using computers regarding the gender. Persons stating the no differences, also proposed that success is related to the metacognitive skills. Two of the interviewers indicated that males are more successful while other two proposed that females are more successful. One of the interviewers stated that females are more successful since they are more patient.

Task Variables

Most of the interviewers complained about the bulk of search results, most of them are irrelevant which takes too much time. They indicated that goal and task definition is more important than to navigate through Internet. Therefore a person who will start to search on something need the necessary background and knowledge on the topic. In addition most of them indicated that open information systems don't provide them the articles that they need for their research study. However they responded that because of the interaction between the colleagues on the WEB, it is easy to access recent studies on one-to-one basis. One of the interviewers stressed the importance of how to perceive information on the Internet. He said, " If you perceive and regard the information as raw data which should be treated with suspicion and to be elaborated and validated then it will cause no problem. " One of the difficulties with the task environment shared by most of the interviewers is the difficulty to follow and read the information on the screen. One of the problem that most of the interviewers stated that in open information environments it is not possible to see the whole and also it is not possible to see how much portion that you reach. This yields a very uncomfortable situation.

Strategy Variables

All of the interviewers indicated the importance of planning before starting to information seeking. More than half of them stressed the organization for efficient search. It is interested that interviewers from social sciences prefer to access reliable and well-known institutions, such as government bodies, universities and research institutions. On the other hand interviewers form science departments prefer keyword and author search using search engines. Most of the interviewers stated they prefer to read and analyze the material on paper rather than on screen. In addition more than half of the interviewers indicated that the people who are completing the search through shorter links are more successful than the others. This response is related to the planning and organization, which is stressed by most of them.

References

Hill J.R. (1999) A Conceptual Framework for Understanding Information Seeking in Open-Ended Information Systems *ETR &D*, 47 (1), 5-27.

Myers M. and Paris G. (1978) In Children's Metacognitive Knowledge About Reading. Journal of Educational Psychology 70 (5), 680-690.

«Darwin's World»: Hypermedia Technology to Enhance Scientific Thinking in the Kids

Michel Aubé
Université de Sherbrooke
2500 Boulevard Université
Sherbrooke, Québec, Canada, J1K 2R1
maube@courrier.usherb.ca

Robert David
Université de Sherbrooke
2500 Boulevard Université
Sherbrooke, Québec, Canada, J1K 2R1
robert.david@cyberscol.qc.ca

Abstract: Scientific training requires much more than simply communicating content matter. In adult scientists, research activities involve complex collaborative work through which scientific rigor is achieved. This suggests that kids should best be trained into critical thinking by being immersed into real scientific communities wherein they could produce relevant knowledge and pursue significant exchanges with «real» experts. Hypermedia technologies now permit creating learning activities that meet such requirements.

Introduction

Within the typical school curriculum, scientific training is usually achieved through presenting the kids with the normative content of the discipline. More active and involving formulas also include laboratory work, field observations and personal research projects, yet most often rigorous and critical thinking still rely upon conformity with traditional material and examples, and upon applying logical or methodological rules. Moreover, even among scientists of the cognitivist tradition, there is still a clear emphasis on learning as basically an *individual* process, resting upon the learner's past knowledge and acquired cognitive skills. But should this epistemological view be applied within the scientific community, not much progress could be made. Among «real researchers», *collaborative* work and mutual dependence are rather the rule: it is not just a matter of sharing knowledge and data, it is probably the essential way through which scientific rigor is achieved. Theories and data are thus compared and confronted, imaginative and provocative new ideas are generated and edited, and consensus in spite of the diversity of data sources and viewpoints provides the basis for critical thinking and solid theorizing. The question is then to engineer scientific curricula for the kids that would put them into the role of «real» researchers, interacting with «real» members of the scientific community, through activities that make sense for them. Moreover, these projects should constitute «real» knowledge contributions, and should by the same token attract expert scientists to interact imaginatively with the kids.

A Social Constructivist Perspective

«Darwin's World» (Aubé, de la Chevrotière & David, 1999 – http://darwin.cyberscol.qc.ca) is an educational project using hypermedia technology so as to meet these goals with children from elementary and secondary schools all over the world. It is part of a larger project, «CyberScol» (http://cyberscol.qc.ca), aimed at providing school teachers with powerful tools, developed on the Internet, to help them meet the objectives stated within the governmental programs. Many disciplines are covered in CyberScol, from language skills to humanities, to physical sciences. Although more specifically concerned with activities from Biology and the natural sciences, «Darwin's World» has been developed so as to foster and enhance rigorous thinking, along with the skills required to apply the scientific method. Hypermedia technology is used to enable and sustain articulate production and communication, and for inserting the youngsters into real scientific communities, as responsible peer researchers, interacting through electronic mail with a community of Biologists who act as consulting experts.

One typical example of a learning activity found in «Darwin's World» consists in the *adoption*, by a whole classroom, of an animal species from the local surroundings. This choice has to be approved by the project team, and it involves a commitment to produce, on the project's web site, the best card-file describing the identity and the ecology of the species. Only one class in the whole world could adopt a given animal, so as to promote responsible expertise for the research done. The scientific content has to be validated by at least one expert Biologist, most preferably a specialist on the adopted species. Moreover, all the texts written have to be validated as to their linguistic quality (composition as well as spelling). The kids' commitment also includes constantly updating the card-file, and behaving as experts in case of public (or even expert) questions coming through the electronic mail. Computer forms are available on the web site, to guide the children into researching and selecting the relevant data, and the results are saved within a growing animal data base. The web site posting the card-file is automatically generated from these forms, and various multimedia elements (sounds, pictures, animations, hyperlinks...) could be inserted to enrich the ongoing description.

Two main objectives are characteristic of «Darwin's World». First, kids have to *build up* their own knowledge, but this process has to be achieved through *collaborative work*, among the children themselves, but also with a large diversity of resources (books, web sites, CD, TV programs...), and with a few knowledgeable experts. They thus have to compare data, elucidate contradictions, raise new questions, and by doing so, to develop articulate thinking. Second, they have to become *responsible* for whatever knowledge they produce. Their work is to be posted on the web site; with the help of experts, they have to guarantee the scientific content of their research; they have to raise new, relevant and stimulating questions; their names and class photograph clearly associate them with their contribution. The approach advocated here stems from a socio-cognitive approach, and is strongly based upon empirical results about collaborative learning, the transfer of knowledge, science teaching and computer applications in education (Campione, Shapiro, & Brown, 1995; Palincsar, 1998). One central idea is that scientific attitudes might be acquired in a way similar to language skills, provided that the kids could be involved, as adult researchers most frequently are, in significant communication and exchange with other researchers. They could thus participate into building knew knowledge, for the value and utility of which they could truly be held responsible. Hypermedia technologies now permit such feats by combining many resources at once: accessing complex information distributed over a variety of web sites, producing and publishing complex information of high quality content, and communicating quickly with a community of experts, for discussion and validation.

Conclusion

Many objectives are reached by the same token. The kids are deeply motivated into serious work and rigorous verification of all kind of information to be posted. By requiring constant interaction with computers, the activity fosters computer literacy, yet it also incites to look for various sources of information, including books, journals, films, and other people. The complexity of the task also naturally leads to cooperation: individuals are not in competition and they need each other, which creates a positive climate in the classroom. The quality of the site also incites collaboration from the experts, and their comments motivate further the kids' work. Finally, the approach is clearly project-based, creating learning opportunities through complex problem solving.

References

Aubé, M., de la Chevrotière, P. & David, R. (1999). «Le Monde de Darwin»: une application socio-cognitive des TIC pour la formation des jeunes à la rigueur et à l'esprit scientifiques. Communication présentée au *67e Congrès annuel de l'ACFAS*, Ottawa, 10 mai 1999.

Campione, J. C., Shapiro, A. M. & Brown, A. L. (1995). Forms of transfer in a Community of learners: Flexible learning and understanding. In A. McKeough, J. Lupart et A. Marini (Eds.), *Teaching for transfer: Fostering generalization in learning* (pp. 1-19). Mahwah, NJ: Erlbaum.

Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology, 49,* 345-375.

Training Students to Become Web Authors: Evaluation of a Training Methodology

Patricia Ryaby Backer
San Jose State University
Department of Technology, 1 Washington Square
San Jose, CA 95192-0061
pabacker@email.sjsu.edu

Abstract: This paper describes the development and evaluation of a training methodology to teach students how to create web pages. The training methodology evolved over two years and involved three stages of testing. The data from 1999 (current model) reveals two contradictory results. Approximately one-third of the student teams did worse than students from 1998 but half of the class received a better score than the previous year. Due to the small sample sizes and the results, it is impossible to state whether the new training model is superior to the previous two models.

Introduction

This research project built upon previous work on the nature of student use of computers for instruction (Backer 97). Backer (1997) analyzed student learning in constructing an electronic portfolio using computer-based multimedia development tools. The development of portfolios by students was not a cursory process. In order to be effective, portfolios require students to become self-reflective and view their work as a whole rather than as unrelated pieces. Electronic resumes, as natural technological outgrowths of portfolios, can expand this active process further by encouraging students to express themselves visually as well as in written form. In addition, this study showed that the use of electronic portfolios brought learning that is interactive and socially based.

The question then evolved for the investigation in this current project. Since students approach the design of multimedia in diverse ways and with varying results, how do they approach and learn how to create web pages? This question formed the basis of this qualitative study where the focus was on attempting to determine how students learn to use new tools rather than on the final projects.

Evolution of the WWW Training Methodology

The goal of the training was to teach students how to design web pages. The actual training methodology has evolved over the past two years. In Stage One (1998), the training model for web authoring was simplistic. The instructor made the assumption that the students, since they had experience in developing multimedia, would have little trouble developing their first web page. The training consisted of a presentation on HTML, a class exercise on HTML, and a demonstration of HTML editors.

Based upon the results of Stage One (see Backer 98), the training methodology was expanded in Stage Two and was more elaborate. Stage Two was done as a part of summer 1998 workshops on incorporating multimedia in education for K-12 teachers (see Backer & Saltmarch 99). These training workshops were organized by the Mathematics And Science Teacher Education Program (MASTEP), a five year NSF sponsered consortium to improve mathematics and science in the greater San Francisco Bay Area. The first two steps were the same as in Stage One, however, after these steps there were additions to the training methodology. The students were given a six-lesson, self-paced tutorial on how to complete a web page that they were required to complete. After the tutorial on HTML, there was a demonstration of Adobe Pagemill followed by a self-paced tutorial on Pagemill. Pagemill was used as the web editor as it had been donated to MASTEP by Adobe Systems as part of a software package for the students.

The quality of the web sites produced by students in Stage Two was significantly better than the quality of those produced in spring 1998 (Stage One). The simplistic error problems found in the first investigation were virtually absent this time. In addition, the students appear to have the better grasp of the nature of web authoring than did the students in spring 1998.

The Stage Three model built upon the results of the previous two stages. For the Spring 1999 class, the training methodology differed slightly from stage two and was enhanced. Instead of starting the instruction by discussing HTML, a section on web design and web structure was added. In addition, the first day's lecture focused on design criteria for effective web pages. The next three steps were the same as in stage one and two. After this section, additional days were added to specifically address graphics, JAVA, and complicated HTML tags. The training model for Stage Three was as follows:

1. The instructor gave a web-based presentation on web structure and design criteria for effective web pages. This was done on day one.
2. The instructor gave a computer-based presentation on the structure of a web document and the basics of HTML. Then, the students were given handouts on basic HTML tags. This presentation was followed by a class exercise on coding a web page. For this exercise, students were given a screen shot of a web page along with the text present on the page. They were asked to add the correct HTML tags to make the basic text have the same format as the screen shot. After they finished, they were given a handout with the correct HTML code so they could compare it to their own coding. These steps were done on day two.
3. Next, the students were given a self-paced tutorial on how to complete a web page. The students were required to complete the six-part tutorial. The students were given the diskettes and asked to return them on day three.
4. Because of the problems with graphics evidenced in the summer workshops, one day was added to focus on using graphics on the web.
5. At this point, the instructor gave a computer-based presentation on Microsoft FrontPage to construct Web pages. After the presentation, the students were given self-paced tutorials on Microsoft FrontPage. They were required to complete this tutorial before beginning their own web design.
6. Three additional days were used to address specific web issues. The topics covered in these presentations included links, lists, tables, JAVA applets, and frames.

Results

The analysis of the outcomes (i.e., the web pages provided by the students) was done by reviewing the errors in the final web pages submitted by the student teams. The average grade for the final web project in 1999 was 75%; this compares to a class average of 77% from 1998. A t-test of the data shows there were no differences in the results from the two years although the variance for the second year was much higher than in 1998 (105.17 for 1999 versus 39.53 for 1998). More student teams received higher scores (50 and above) in 1999 as compared to 1998. However, in both years, there were some students who received very low scores: two students in 1998 received scores of 36/50 and three student teams received scores of 30/50 in 1999.

The data from 1999 reveals two contradictory results. Approximately one-third of the student teams did worse than students from 1998 but half of the class received a better score than the previous year. Due to the small sample sizes and the results, it is impossible to state whether the new training model is superior to the previous two models. The researcher is currently re-testing the third training model during the Spring 2000 semester in order to determine whether it provides a more effective method of training students to develop WWW materials.

References

Backer, P.R. (1997). *The use of portfolios in professional education: A multimedia model of instructional methodology.* Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL. (ERIC Document No. ED 408 356)

Backer, P.R. (1998). *Student WWW Pages: An Investigation into How Students Learn to Create Web Pages.* Paper presented at the 1998 WebNet conference, Orlando, FL.

Backer, P.R., & Saltmarch, M. (1999). *Evaluation of a multimedia workshop model: Training instructors to use technology in the classroom.* Paper to be presented at the 1999 Ed-Media conference, Seattle, Washington.

Complete paper available at http://www.engr.sjsu.edu/pabacker/Backer_EDMEDIA2000.pdf

Relationship Between Academics' Educational Beliefs and Their Design and Use of Computer Facilitated Learning

John D Bain, Colleen Mills
School of Curriculum, Teaching and Learning, Griffith University, Australia.
J.Bain@mailbox.gu.edu.au

Carmel McNaught
Professional Development, Learning Technology Services, RMIT University, Australia
Carmel.McNaught@rmit.edu.au

Gillian Lueckenhausen
Academic Development Unit, La Trobe University, Australia
g.lueckenhausen@latrobe.edu.au

Abstract: The leaders of 24 computer facilitated learning projects in higher education were interviewed about their educational beliefs and practices, and the transcripts and associated documents were coded on 16 belief and 16 practice dimensions. Shared patterns of beliefs and practices were sought by clustering the projects with the aid of hierarchical methods. Three example profiles are provide to illustrate the belief/practice connections which, although apparent, are not simply defined. Subsequent analyses will be based upon project narratives.

The impetus for the present work came from recent interest in the beliefs and understandings that academics bring to their teaching (Kember, 1997; Samuelowicz & Bain, 1992) including their use of educational technology (Bain & McNaught, 1996). There is some research suggesting that academics' educational beliefs and practices are closely coupled (Bain 1998; Quinlan, 1999), but more work is needed to uncover the details of the relationships involved, particularly in relation to educational technology (Reeves 1992).

For this study we selected 24 university projects incorporating computer facilitated learning (CFL), based on documentary material provided by an Australian competitive granting agency. We conducted two detailed interviews with each project leader, each of about two hours duration. The first interview sought information about the academics' development and implementation of CFL, and the second probed their epistemological and educational beliefs. The semi-structured interviews were audio recorded and transcribed. Two interrelated analyses are being undertaken, one to result in detailed narratives of the cases, the other to provide an analysis of the patterns of belief and practice. A preliminary version of the second analysis is reported here.

The transcripts and documentary material were used to code academics/projects on 16 belief and 16 practice dimensions, with coding based on the full weight of evidence rather than localised interview comments or archival details. Some of the dimensions were drawn from published sources (Bain et al., 1998; Samuelowicz & Bain, 1992; Reeves 1992) and others from preliminary examination of the interview transcripts and project documentation. Most dimensions were five point bipolar rating scales (c.f., Reeves, 1992), but others involved qualitative differences that could be ordered from less to more sophisticated. Examples are presented in (Fig. 1).

A preliminary analysis of the data was undertaken by applying hierarchical clustering (using several methods and distance measures) to the full set of dimensions. The aim was to find similarities in the belief/practice profiles of the participants. Six clusters were tentatively identified, three of which are illustrated with individual cases in (Fig. 1), using 15 of the 32 dimensions. What is evident from (Fig. 1) is that, although relationships between belief and practice profiles can be discerned, they are not simply defincd. Some beliefs and practices seem to be interconnected in ways anticipated by Reeves (1992) and Bain et al. (1998) (e.g., *beliefs* concerning the origin of knowledge, the type of understanding and the role of discussion, and *practices* such as learning control, learning process and learning framework), but others are not.

Although this profiling approach is useful as a preliminary way to compare and contrast projects, we are convinced that a full understanding of the connections between beliefs and practices awaits the writing of the academics' narratives, based on their detailed commentaries and our rich descriptions of the CFL and its educational context (c.f., Bain, 1998; Quinlan, 1999). We anticipate that, once the narratives are to hand, we will be able to group like projects more convincingly than the profiling and clustering methods allow.

BELIEFS					
Origin of Knowledge	Academic/ discipline	2	3	4	Student/ collaboration
Pedagogical Philosophy	Instructivist	2	3	4	Constructivist
Type of Understanding	Knowing more	2	3	4	Knowing differently
Role of Discussion	Incidental	2	3	4	Central
Accommodation of Students' Conceptions	Absent	Pre-emptive	Conversational-Assimilative		Conversational-Accommodative
Curriculum Progression	Linear/ Hierarchical		Jigsaw		Spiral
Curriculum Focus	Knowledge + Understanding		Disciplinary ways of knowing		Professional/ Artistic performing
PRACTICES					
Accommodation of Individual Differences	Non-existent	2	3	4	Multifaceted
Task Structure	High	2	3	4	Low
Interactivity	Navigational	2	3	4	Manipulative/ Constructive
Learning Control	Teacher managed	2	3	4	Student managed
Metacognitive support	Unsupported	2	3	4	Integrated
Learning Process	Reproduction	2	3	4	Construction
Learning Framework	Structured		Guided		Facilitated
Learning Focus	Knowledge		Reasoning		Performance

Figure 1: Profiles of three CFL projects on seven belief and eight practice dimensions

References

Bain, J. D. (1998). *Celebrating good teaching in higher education: Putting beliefs into practice.* Keynote address to the 1998 Conference of the Higher Education Research and Development Society of Australasia, Queensland Branch, held at the Sunshine Coast University College, Sippy Downs, June 20-21, 1998.

Bain, J. & McNaught, C. (1996). Academics' educational conceptions and the design and impact of computer software in higher education. In McBeath, C., & Atkinson, R. (eds.) *The learning superhighway. New world? New worries?* Proceedings of the Third International Interactive Multimedia Symposium, Perth: Promaco Conventions, pp. 56-59.

Bain, J. D., McNaught, C., Mills, C. & Lueckenhausen, G. (1998). Describing computer facilitated learning environments in higher education. *Learning Environments Research*, 1 (2), 163- 180.

Kember, D. (1997). A reconceptualisation of the research into university academics' conceptions of teaching, *Learning and Instruction*, 7 (1) 225-275.

Quinlan, K. M. (1999). Commonalities and controversy in context: A study of academic historians' educational beliefs. *Teaching and Teacher Education*, 15, 447-463.

Reeves, T.C. (1992). Effective dimensions of interactive learning systems. *Information Technology for Training and Education Conference (ITTE '92),* (pp. 99-113). St Lucia, Brisbane: University of Queensland.

Samuelowicz, K. & Bain, J. D. (1992). Conceptions of teaching held by academic teachers. *Higher Education*, 24, 93-111.

Acknowledgements

The research reported in this paper was supported by grant A79601676 from the Australian Research Council for the period 1996-1998. We are grateful to the Committee for the Advancement of University Teaching secretariat for access to project applications and final reports. We also wish to thank the academics involved for permission to include their projects in our research analyses and publications.

The Supporting Collaborative Community Model: Implications for Online Learning

Julene Bassett
Instructional Psychology and Technology Department
Brigham Young University
USA
jbass@wiley.byu.edu

Joanne Hall
Department of Instructional Technology
Utah State University
USA
KIWI@cc.usu.edu

Abstract: The Supporting Collaborative Community (SCC) model of instruction restructures learning environments to access the strengths of both individuals and the class as a whole by overtly emphasizing those moral relationships that define true community interaction. The SCC model creates this enriched environment through emphasis of four main features: support of clearly-articulated purposes or tasks, regard for each individual's unique worth and diversity, acknowledgment of one's responsibility to others, and a sense of obligation to share. Allowing students to "own" their experience and enabling the group to benefit from each individual's strengths and assets fosters a supportive community where members feel safe to take risks and collaboratively explore new learning experiences. The SCC model lends itself well to the dynamic nature of online/distance learning when diverse members must establish their learning environment without the usual interaction that occurs in traditional face-to-face settings. Because online/distance learning so often occurs asynchronously amid other priorities and commitments, a community providing dynamic social and collaborative support can motivate learners while providing the reinforcement necessary to take full advantage of the learning experience.

Introduction

The Supporting Collaborative Community (SCC) model of instruction restructures learning environments to access the strengths of both individuals and the class as a whole by overtly emphasizing those moral relationships that define true community interaction. Where traditional classroom models focus mainly on the relationship between the learner and instructor and test only individual accomplishment, the SCC model overtly emphasizes the positive dynamics created through community interaction. This model actively seeks to establish an environment with three elements: one, encouragement of exploration without ridicule for mistakes or shortcomings (support); two, emphasis on sharing previously and newly acquired knowledge (collaboration); three, a sense of belonging through participation and interaction with others (community). Within this environment learners are encouraged to take responsibility for creating and "owning" their educational experiences. In doing so they become co-instructors interested in making the experience valuable for themselves as well as others. Attainment of the group goals then becomes worthwhile to each individual.

The SCC model enhances learning in situations where there are multiple learners, where there is enough opportunity and time to establish a connected community, where interaction between participants is encouraged, and where learning is more than memorization and recall of facts. Although the specific structure of the model will be different for every instantiation, the appropriateness of using this model is not restricted by course content, type of knowledge, learners' ages, or proximity to other group members.

The SCC Model

The SCC model enriches learning by emphasizing four main features. The first is *support of clearly-articulated purposes or tasks* which help orient the learners and define the community. These must be considered important both to the community and its individuals so each group member will support them. The goals or tasks should address something the community sees as valuable rather than unimportant exercises. Learners must understand the purpose for any learning in which they engage. The second feature is *regard for each individual's unique worth and diversity*. Each member needs to feel that they are esteemed by others as a valuable person with individual skills and perspectives to contribute to the whole. Likewise, they must sincerely learn to perceive others as such. Establishing a pattern of valuing diverse opinions and perspectives encourages the community to seek participation from all members, including those who are infrequent contributors in more traditional settings. Though diversity often requires compromise and a willingness to think differently, articulating this as a group goal and explicitly emphasizing its importance helps alleviate some of the frictions that naturally occur when diverse opinions are expressed.

Third, community members need to *acknowledge a responsibility to others*, which is, fundamentally, a commitment of accountability to and for each other. This responsibility creates a relationship of support. When members agree to learn with and from each other they strengthen the power of their interaction. Fourth, when learners feel *the obligation to share*, they are prompted to enter into interchange and interaction with others. Sharing is an essential component that makes collaboration so effective. Without it, a community cannot determine its goals or come to know each other through anything but superficial stereotypes. Sharing, even when doing so may put one in a vulnerable position, provides both opportunities to define oneself and allows bonding relationships to form. Sharing also benefits the community by giving it access to everyone's resources.

Online Learning Implications

The SCC model lends itself well to the dynamic nature of online/distance learning where diverse members must create an environment with online's own unique methods of interactions. Lacking a well-known schema often supplied in traditional settings (classroom structure, nature of the instructor, etc.), purposes, tasks and even roles are often negotiated and must be clearly defined online. While virtual environments naturally allow participants the freedom to define themselves without as many physical or other identifying features affecting others' perceptions, care and sensitivity must be exercised so that exchange between learners fosters true relationships of trust where each individual's worth and diversity can safely be shared. Acknowledging a responsibility to others helps to ensure honest interaction takes place. It also encourages all learners to contribute what they can to the experience.

Additionally, a sense of community commitment helps bond its members. Online/distance learning often occurs asynchronously around other priorities, commitments, and time constraints. The SCC model of instruction can help form a community providing dynamic social and collaborative support that motivates learners while providing the reinforcement necessary to take full advantage of a rich learning experience.

References

Faulconer, J. (1999). Postmodernism. Personal website. Retrieved September 1999 from the World Wide Web: http://JamesFaulconer.byu.edu/

Holeton, R. (1997). Composing Cyberspace: Identity, Community, and Knowledge in the Electronic Age. McGraw-Hill College Division.

Lewis, C., Watson M., & Schaps E. (1999). Recapturing education's full mission: Educating for social, ethical, and intellectual development. In Reigeluth, C. (Ed.), Instructional-design theories and models: A new paradigm of instructional theory volume II. (pp. 511-536) Lawrence Erlbaum Associates, Publishers.

Wallace, P. M. (1999). The Psychology of the Internet. Cambridge University Press.

Trends in Multimedia; Hypermedia & Telecommunication – Development of a Methodological Design for an Empirical Study

Prof.Dr.Peter Baumgartner, PhD, BEng
Institute for Organisation and Learning (IOL) , Innsbruck University, Austria
peter.baumgartner@uibk.ac.at

Dr.Andreas Holzinger, PhD, MSc, MPh, BEng, DipEd
Institute of Medical Informatics, Statistics and Documentation (IMI), Graz University, Austria
andreas.holzinger@kfunigraz.ac.at

Gig Searle, BSc
Institute of Medical Informatics, Statistics and Documentation (IMI), Graz University, Austria
searleg@email.kfunigraz.ac.at

Abstract: Rapid development in the field of Multimedia, Hypermedia and Telecommunication (MH&T) is continually providing new work, study and research areas. The authors are of the opinion that these trends have found their expression within the ED-MEDIA (EM), which has meanwhile become the most important conference in this field, and intend to prove this hypothesis by the evaluation and classification of the published papers presented at the conference. The study is based on the assessment and analysis of theme structures, technological backgrounds and questions of contents, beginning with the clarification of methodological questions. Due to this rapid development, prefabricated categories cannot encompass a change in trend, rather, the categories must be developed on the basis of the information at hand. The authors present the argument that the "grounded theory", a procedure developed in social science, is a suitable methodical tool for the building of these categories.

1. Methodological Approach

In 1999, 600 submissions from almost 50 different countries were presented in Seattle. For the purpose of our trend analysis, a methodological approach should include all papers submitted, since our analysis will only include the papers accepted for publication in Proceedings of EM 99, the discrepancy may be considered a significant intervening variable. We feel that exploring the trends in MH&T in detail could lead to a more active and therefore influential implementation. Previous studies of this subject were mainly cursory, the evaluation being based solely on the subject of the paper. In 1996, Jim Devines' (NDEC) evaluation of the EM papers from 1993-95 into didactic sub-categories showed an increase in the instructionist approach (cf. Devine (1996)). We intend a more rigorous evaluation of the texts contributed during 1999. Pre-definition of categories, which fails to recognize the continual fluctuation within the media, is unsuitable for our undertaking. We believe that the papers' contents are equally relevant to this study, not just the subject of the paper. It is of greater importance to explore the relationship between the two main reference points: Education and Media, is this instrumental or are there other connections to be considered - *social, organizational or political?*

In Montreal, we intent to exemplify our proposed Hypothesis and operationalize the resulting category construction. Using the material of the EM 99 in Seattle as a *temporal slice* we shall demonstrate and discuss the proportional distribution of the individual categories (representation in percentages).

After this presentation, we intend to implement our theory with data from the complete volumes of the EM, for the EM 2001 in Amsterdam. The extensive data mining and evaluation will be carried out by students of Business Education, Innsbruck University, Austria. In spite of the relatively extensive effort required in this research we believe that the results are relevant to the scientific community - understanding the direction of the research in this comparatively new field is almost as important as the research itself.

2. Tools: The Grounded Theory

From the viewpoint of Constructivism it is appropriate to place emphasis on the fact that truth and reality does not have an existence independent of the subject. This should not be misunderstood as solipsism. If we arrange the available data according to pre-developed categories our preconceptions appear to be confirmed. Our failure to reflect the process of assignation, and our methods, preclude our awareness of the blocking and changing done to the material. These considerations caused us to choose an alternative: The Grounded Theory (cf. Glaser & Strauss (1967), Strauss (1987)), which aims at overcoming this methodological circular reasoning. In a iterative research process the universal should emerge from the individual through induction.
Also in the Grounded Theory, inductive conclusions are not used for logical argumentation and, currently, have no empirical validity. They are merely heuristic instruments for the development of a theory. None the less, the validity of the inductive assumptions constructed still have to be checked.
The theoretical assumptions still cannot be proved (verified) but only disproved (falsified). This falsification, as well as questions of actual data distribution, does not lie in the scope of the Grounded Theory, whose aim is the generation of new ideas, categories etc., but of other – more traditional – empirical research methods. To discover a theory from data systematically obtained from research means to "ground" the theory into empirical research, because the construction of the hypothesis is not based on the researchers preconceived ideas but on the data and material itself, the supporting, objective structures can be made visible. Examining the actual data, we designate codes as nominators for the incidencies of every interesting case to be investigated further (indicies), reducing the endless complexity of the reality (lateral coding). Next, we compare the different nominators, the defining rule for this method is: "While coding an incident for a category, compare it with the previous incidents in the same and different groups coded in the same category (Glaser & Strauss 1967, p.106)". Slowly, the idea of a new concept emerges, which is able to catch the different features of some of the indices: A new category has appeared and is developed by the researcher.
Whether the constructed category is actually relevant (theoretically "good") can only be confirmed by searching the data for further indications of the new category (axial coding). Closer consideration of the characteristics (dimensions) of the category indicate the suitability of further subdivision, or of generalization (construction of meta-categories). With this step we have arrived at the level of core categories. The description of the relation of these meta-categories will generate a special kind of theory called "Substantive Theory". In contrast to "Formal Theory" (Glaser/Strauss), this has a very close connection to the subject field. It is a kind of "thick description" as Clifford Geertz calls the construction of meaning in an anthropological description (Geertz 1973). Insert the Picture here: http://www-ang.kfunigraz.ac.at/~holzinge/edmedia/proposal.html

3. Theoretical Sampling:

Every category which has emerged is just a tentative, and temporary, hypotheses. It is therefore possible that for a specific category no appropriate passage can be found. In order to find the reason, we must investigate that section of our original data input that caused the construction of the new category and to look for other possibilities of building categories; the sample is extracted according to factors dictated by theory. This "Theoretical Sampling" (Glaser & Strauss) is not concerned either with chance or with statistically representative samples, since a single case is sufficient for both the construction and the interconnection. A research completed in the Grounded Theory style is therefore not concerned with the quantitative distribution of particular proportions but rather the discovery of categories where we can put the data in. We have to repeat this process from data to category and back, following a cyclic procedure until all our categories fit to the data and no further categories emerge. Glaser & Strauss call this the saturation of the sample.

4. References

Blumer, Herbert (1969). *Symbolic Interactionism: Perspective and Method.* Berkeley: University of California Press.
Devine, Jim (1996). How INTER – How ACTIVE: Do We Really Know? Concern about Positions and Priorities for Action. *ED-MEDIA, 1996,* Association for the Advancement of Computing in Education, Boston, MA. 333-338.
Geertz, Clifford (1973). *The Interpretation of Cultures.* New York: Basic Books.

Glaser, Barney G., Strauss, Anselm L. (1967). *The Discovery of Grounded Theory. Strategies for Qualitative Research.* New York: Aldine de Gruyter.
Strauss, Anselm L. (1987). *Qualitative Analysis for Social Scientists.* Cambridge: Cambridge University Press.
Strauss, Anselm L., Corbin Juliet (1990). *Basics of qualitative research: grounded theory procedures and techniques.* Newbury Park (CA): Sage.

Help in the Search for Information in Hypermedia Documents

Alain Beaufils, Francois-Marie Blondel
Institut National de Recherche Pedagogique, Departement Tecne
91, rue Gabriel Peri
92120 Montrouge France
alain.beaufils@inrp.fr, francois-marie.blondel@inrp.fr

Abstract: This paper presents a system of help for the exploitation of hypermedia documents. It was derived from a common type of educational CD-ROM in which we added search and note-taking tools. The evolving note-taking system interacts continuously with the document being explored, and allows the user to keep the explored sections in mind. A study on usability of the search tools showed that the students prefer the index or the table of contents and neglected the cross-reference links. The activity of note-taking at every stage of their search favored their planning of the search.

Introduction

The consultation of hypermedia documents can be easy and satisfying when it is simply a question of discovering an individual item of content, it can prove to be more complex when it is a question of in-depth research in the context of one particular project. In a previous study (Beaufils, 1998), we sought to identify certain difficulties encountered by secondary school students using a typical hypermedia (the CD-Rom encyclopedia which deals with ancient Greece) in order to respond to a series of questions on larger themes.

In this paper, we describe a prototype which includes specific tools for information seeking in a hypermedia; then we discuss the results of several investigations on the usability and the usage of these tools.

A prototype for information seeking

Although it conserved the content, the structure and the index of the original CD-ROM, the prototype includes several new tools for searching, selecting and note-taking.

The search tools, such as the index or semantic cross-references, function by interacting with the table of contents. Colored highlighting allows the student to use these tools in order to situate the pages that have been found within the hierarchical plan. Users also have the option of placing the headings of all the pages which interest them in their own personal area. The personal area can be divided into several compartments, allowing the students to organize the material they had selected into such categories as: pages to visit, pages already visited, pages corresponding to themes existing in the document, or pages corresponding to themes resulting from their personal research plans.

This workspace is intended to function by interacting with the selection system. Several different types of notes can feature on it: preparatory notes (clues, bookmarks, personal knowledge), personal comments and pieces of information gathered during the consultation. The notepad is structured by topics defined by the user. She can put together the heading of a page, some excerpts of a page and also personal comments, arrange them under a named topic or move them to another topic.

The usage of the search and note-taking tools

The study involved six students, all volunteers aged 16 and 17 coming from a high school in the suburb of Paris. Students spent three sessions working on three questions: (1) the image and place of women in Greece, (2) the importance of the body in Greek civilization, (3) the good and bad aspects of Athenian democracy.

In numerous cases, the students only used one search tool during any one session. They were tempted to repeat, in a somewhat systematic fashion, the strategies that had already succeeded, as Weyer has previously noticed about dynamic books (Weyer 1982). The index and the table of contents were the most commonly used tools. The index was often selected as the first tool and generally enabled a highly exhaustive search. The readability of the table of contents ensures the fruitfulness of searches conducted using this tool (Dee-Lucas, 1996). Few attempts to extend the search using semantic cross-references were noted, mostly during the last session. Linear exploration was only used by students as a complement of other consultation methods. The number of pertinent pages found during the three sessions was high (85% or higher) which shows the effectiveness of the strategies followed, whatever tools were used.

All the students used the selection tool but they usually inserted the page headings in a single compartment, limiting this tool to its "storage" function. The putting aside of page headings helped in consulting these pages and reduced the risk of forgetting about them. The loss of pertinent pages was moderate (less than 30% for the two first questions), which attests to a satisfactory command of the operations of consultation and exploitation. In few cases, the possibility of creating categories within the selection gave rise to diverse strategies: planning which sections to consult or structuring those categories that had already been consulted.

The number of notes produced by the students at the beginning of the session ranged between three and around ten. These notes essentially designated sections to explore. We noticed the strong influence the preliminary planning had on the search for information and on the organization of the final response. The production of an initial structured plan led to a precise but inflexible representation of the goal to be attained. During their consultations, students may discover pieces of information that do not figure in their preliminary evaluation of the question. Such discoveries can lead to modifications in the final plan with respect to the initial plan. Over the course of 75 operations of note-taking recorded, 17 corresponded to an event leading to a noticeable modification of the final plan. Our observations show that in the majority of cases, the representation of the response did not develop in any notable fashion. One might suppose that the more elaborate the representation, the harder the subject will try to preserve it intact (Rouet & Tricot, 1998).

Closing remarks

We observed that the activity of note-taking performed by the students at every stage of their search for information (evaluation, selection and treatment) unquestionably favored how they managed the search and the planning: (1) the initial notes stimulate the process of evaluating the task, giving the students points of reference and freeing their memories from certain work; (2) the workspace the students are able to use must be unified but with the constant possibility of being reorganized; its function is to put three types of notes in relation with each other: the preliminary search plan, a selection of pertinent pages, and a selection of information gathered from these pages; (3) some aspects of the process of note-taking are neither spontaneous nor common, thus it is desirable to give the students specific advice at the beginning of the session or to expose them to some prior training.

By using search mechanisms that are relatively independent of content, associated with an open, flexible and evolving note-taking system, students can have the possibility of constructing a personalized hypermedia system within the document they are exploring. We are now studying how such tools can be adapted to facilitate similar activities with web resources.

References

Beaufils, A. (1998). Aide à l'exploitation de bases hypermédias. Tricot A.& Rouet J.-F. (eds). *Les hypermédias, approches cognitives et ergonomiques*, Paris, France: Hermès. 191-209.

Dee-Lucas, D. (1996). Effects of overview structure on study strategies and text representations for instructional hypertext. *Hypertext and Cognition*. Rouet J.-F., Levonen J.J., Dillon A.P., Spiro R.J. (eds). Mahwah, NJ: Lawrence Erlbaum. 73-108

Rouet, J.-F. & Tricot, A. (1998). Chercher de l'information dans un hypertexte : vers un modèle des processus cognitifs. *Les hypermédias, approches cognitives et ergonomiques*, Tricot A.& Rouet J.-F. (eds). Paris, France: Hermès. 57-74.

Weyer, S.A. (1982). The design of a dynamic book for information search. *International Journal of Man-Machine Studies*, 17, 87-107.

Assessing the Use of Technology to Enhance Learning in Higher Education.

Karen Belfer
Technical University of British Columbia
Belfer@techbc.ca

Abstract: The present paper reports on the development of an instrument called "The Use of Technology in thc Classroom", that assesses the use, application and quality of technology to enhance education. A brief summary of statistical analysis of the reliability and validity of the instrument is presented.

Introduction

The process of integrating technology to enhance learning implies a change in the curriculum, which means a shift on the philosophy of teaching, every day classroom practices and reassessing the way we learn.

One of the responsibilities of the Academic Computing department in Mexico's Anahuac University is to work together with the faculty in determining needs and opportunities to introduce technology to enhance the curriculum or course content, and to facilitate the research, development and training to support educational technology.

A proposal was advanced to formally assess the projects that where generated and supported by the department.

The use of technology in higher education

With the arrival of the new Millennium the use of technology in higher education has become a "must have" rather than a "nice to have". And "... any institution that is not able to integrate elements of technology into their current offerings will find themselves at a competitive disadvantage with the virtual universities" (Rao & Rao, 1999).

The rapid changes in technology, the constant demand from the working environment to prepare professionals capable of using the new technology, the institutional to make decisions related to the acquisition of hardware and software, are some of the reasons that make the introduction of the use of technology so important in higher education.

Bennet (1987) described three different roles computers have in education: education with the computer, education about the computer and management of instruction.

The use of technology in education has advantages (Russell, 1999) and the diversity of ways it can be integrated and applied is immense.

Evaluation of the use and quality of educational technology has always been problematic because of the inherent diversity and complexity of the possible applications e.g. (Biermann, 1994; Doll 1987) created check lists that help teachers and administrators, assess different options for educational systems. Those lists are practical to evaluate independently of the classroom learning context. They are simple to use to assess if the system is user friendly, well designed, has no bugs and is well documented.

However more complete require an empirical evaluation, that may be time consuming and costly. Comparing a group of students with control groups is one way of doing this.

Both methods of evaluation reduce the learning process specific factors: list of criteria to assess a systems like if was never going to be used by students, and students that are consider like only receptors of knowledge.

The use of technology in education can be regarded as a social process in at least two ways (Baumgartner, Payr (1995):

a) It takes place in a social situation (classroom, work, home).
b) The goal of a learning process is to help us adapt with prevailing social conditions.

This report purposes the evaluation of the use of technology to enhance learning through the three social dimensions that the student perceives:

a) The Teaching Quality
b) The Classroom Climate
c) The Integration of Technology in the classroom.

Process:

The idea was to create an instrument that experiment the level of satisfaction that the students perceive from the integration of the technology (basically software) with the course content.

Based on the idea that student's satisfaction would derive from having a good instructor, being in a comfortable learning environment (climate) and good application of the technology.

Scales of the Instrument

Table 1. Descriptive information for each scale.

Scales	Description	Sample Item
Teaching Quality (Climate)(TQ-C)	The instructor of the course knowledge of the content, clarity of explanation, fair assessment, and is interested in students needs and opinions.	The tcacher's explanations keep me focused.
System as a Medium to Enhance Learning (SM)	Extent to which the technology used on the course is effective.	The use of the system enhances my learning
Equipment (E)	The technology provided at the laboratories is of good quality, under good working conditions.	The systems work properly on the lab equipment
Satisfaction (S)	To what extent the students feel that what they are learning is worth while.	Students enjoy coming to this class
System Characteristics (SC)	Extent to which the technology used on the course is task focused and user friendly.	This system is easy to use
Use of the System in the Professional Field (PU)	Extent to which the technology used on the course is updated based on the needs of the field.	This systems and similar ones are used on the professional field

Method

An exploratory study of the psychometric properties of the instrument was carried out with students of undergraduate courses where using technology to enhance learning.

There were 490 participants from 34 courses, 224 male, 266 female; from the schools of Architecture, Social Communications, Design, Business & Economy, Engineering, Pedagogy and Psychology.

38% were in year one, 14% were in year two, 29% were in year three and 19% were in year four.

Procedure:

The project was an internal evaluation, created and applied by staff of the university.

One person, the author carried out the administration of the instrument giving any additional instructions needed beyond those printed on the questionnaire.

Results:

The following statistical treatments were applied:

A) To validate the internal structure of the instrument a factorial analysis: with a varimax rotation.
B) To validate the internal consistency of each scale a Cronbachs' alpha coefficient was calculated for each item and scale. Alpha of the instrument = 0.9604
C) Discriminant validity of the scales was indicated by correlation analysis between scales: (using the mean correlation of a scale with the other five scales as a convenient index). All values are small enough to demonstrate that each scale has adequate discriminant validity, but the conceptual distinctions among scales are important enough to retain the six dimensions within the instrument.
d) W conducted an Analysis of Variance for items for each scale to demonstrate that there is significant difference between items within each scale. All values have $p<0.001$.

e) Differences between classes were identified using an analysis of variance between different measures of groups, using the groups as the unit of analysis. The results showed that the instrument did significantly differentiate between the perceptions of the students of the classes.
f) A final ANOVA was calculated to demonstrate the independence of the scale. With an $F= 64.55$ $p<0.001$.
g) Multiple regression analysis was conducted to determine the relationships between variables.
h) Structural Analysis.

Conclusions

The instrument has proven to be reliable and valid.

The structural analysis showed the Teaching Quality (F1) as the center of the use of technology to enhance learning.

This means that the instructor has an influence in the way the student perceives the Equipment (F2), Use of the System in the Working Environment (F3), System as a Medium to Enhance Learning (F4), System Characteristics (F6) and all of this factors affect the students Satisfaction (F5). As a teacher or as a facilitator he has a great influence in the classroom climate, students satisfaction and the way they perceive the use and application of the technology.

The technology has advanced so much in the last two years since the data was gathered that some adjustments may be necessary especially integrating items related to the more advanced ways of using technology in education and considering some adaptation for online learning.

This instrument was created in Spanish and validation was based on the Spanish version. Future research has been done with translation and validation of the instrument in English.

References

Baumgartner, P., & Sabine, P. (1995). Problems of Educational Software Evaluation (*Paper sent in for ED-MEDIA 96, Topic: Evaluation of Multimedia/Hypermedia Systems*).
"Academic Software"
<academic-software-l@edvz-nov.uibk.ac.at> Date: Mon, 6 Nov.

Biermann, H. (1994). Lehren und Lernen mit Computern. *Lehren und Lernen im Umfeld neuer Technologien.* Reflexionen vor Ort, edited by J. Petersen and G. B., Reiner, (pp. 123-141). Frankfurt/Main: Peter Lang.

Bennett, R. E. (1987). *Planning and evaluating Computer Education Programs.* Merrill Publishing Co. U.S.A. pp. 25-31.

Doll, C. A. (1987). *Evaluating Educational Software.* American Library Association, Chicago/London.

Harasim, L., Hiltz, S. R., Teles, L., Turoff, M. (1995). *Learning Networks: A Field Guide to Teaching and Learning* Online. The MIT Press.

Mateo G., M. A.; Fernández S. J. (1992). Análisis confirmatorio de la estructura dimensional de un cuestionario para la evaluación de la calidad de la enseñanza. *Investigaciones Psicológicas.* No. 11, Editorial Complutense, Madrid. (pp. 73 - 80).

Fraser, B. J., Treagust, D. F. (1986). Validity and Use of an Instrument for Assessing Classroom Psychosocial Environment in Higher Education. Higher Education, 15.(pp. 37-57).

Fraser, B. J., Wilkinson, W. J. (1993). Science Laboratory Classroom Climate in British Schools and Universities. *Research in Science & Technological Education*, Vol. 11, No. 1. (pp. 49- 70).

Rao, P., Rao, L. (1999). Highlights from Syllabus Magazine Volume 12, No. 7. *Curriculum and Productivity Software.* March.
http://www.syllabus.com/mar99_mag.html

Russell, T. L. (1999). *Significant Difference.*
http://cuda.teleeducation.nb.ca/significantdifference/

TILT Project (1995). University of Glasgow. *Conclusions Emerging from TILT.*
http://www.elec.gla.ac.uk:80/TILT/conclude. html
Last Update: March , 1995.
Written by: Gordon Doughty.

TILT Project (1996). University of Glasgow. *Issues*
http://www.elec.gla.ac.uk:80/TILT/issues.html
Last Update: January , 1996.
Written by: Gordon Doughty.

Treuhaft, Jack (1995). *Academic Computing*, Algonquin College of Applied Arts and Technology.
http://www.algoquinc.on.ca/edtech/acadcomp.html

Zwaiman, K. (1996). *Evaluación del Area de Afectación Curricular Tecnológica.* Final paper for the "Institutional Evaluation" and "Climate Evaluation" courses.

A Learner Centred Assessment of Quality for Online Education: Course Climate

Karen Belfer
Technical University of British Columbia
belfer@techbc.ca

Abstract: The Technical University of British Columbia is committed to de development and delivery learner centered courses that have an online component an emphasis on collaborative learning. Assessing the quality of these courses requires a new approach. The TQM theory suggests that providing the client with a high quality product at all times is a very important constituent of quality. The social environment "climate" has a positive effect on students satisfaction. This paper describes the development and adaptation of an instrument that measures climate for online courses and the importance of using the results of the applications as an important stage of the of the overall TQM process that includes an ongoing monitoring and modification of the learning environment based on climate assessment.

Introduction

The Technical University of British Columbia (TechBC), the newest university in Canada, has been created as a unique learning environment to educate the work force needed for high-growth advanced technology industries.

Recognizing the rapid growth in information and knowledge, TechBC's programs will emphasize not only the acquisition of knowledge, but also the ability to utilize and apply knowledge appropriately, critically and creatively.

The university is implementing a learner-centered education (Bonk & Cummings, 1998), where students' cognitive, metacognitive, motivational, affective, developmental, and social needs are met. Although perhaps not unique, the creation of a new institution affords opportunity to more fully realize this approach in the learning process. All courses have an online component, and most courses (with the exception of the flexible learning) have an emphasis on collaborative learning.

Assessing the quality of courses delivered in a team-based, online learning environment

Total Quality Management for Education: Climate

In the last two decades there has been an emphasis on the importance of quality in higher education, with attention focusing first on the definition of quality and, more recently, on how to evaluate and measure it (Harvey, Green, Burrows, 1993; Brindley, 1995, Municio, 1995, Williams, Watson, 1995).

The increasing number, and demand for, distance education programs is prompting researchers to ask what constitutes a good distance learning course from the perspectives of both the institutions and client. Some, like Scriven (1995), have even provided indicators such as policy development and management, staff development, service provision, and processes of open learning. Certain levels on these indicators have been suggested as benchmarks for measuring quality in distance education.

Municio (1995), William & Watson (1995), Scriven (1995), and Brindley (1995) all mention that providing the client with a high quality product at all times is a very important constituent of quality. From the assertion by authors like Fernandez (1995) and Lampikoski (1995) that client satisfaction is a good indicator of quality, it follows that student satisfaction is a key criterion for institutions to determine quality in distance education.

Many researchers have talked about students' satisfaction, and the effect it has on academic achievement (Fraser & Deer, 1983; Fraser, Seddon & Eagleson, 1982; Muñoz, 1996). Peterson, et al. (1986) established that a good social environment or "climate" has a positive effect on students' satisfaction.

In Canada, the Ontario Ministry of Colleges and Universities prepared Vision 2000: Quality and Opportunity (1990) that emphasized the challenge of developing well-educated citizens for a culturally diverse society. As one possible answer to that challenge, Evans-Harvey (1995) proposed that administrators and teachers promote and develop of positive learning environments in which culturally diverse students work in harmony while meeting their personal aspirations.

Climate has an influence on behavior, and can determine educational outcomes such as cognitive achievement, satisfaction, motivation, and personal development (Fernández, Asensio, 1989, p. 2).

The definition of climate is abstract and its measurement is typically based on subjective self-reports. Mainly what we see is that the definitions of climate are limited to the instrument used to measure it (Anderson, 1982).

There have been many instruments created to measure classroom climate in higher education for a face-to-face environment. These include the Classroom Climate Scale (CES) (Moos & Trickett, 1974), the College and University Classroom Environmental Inventory (CUCEI) (Fraser & Treagust, 1986), the Science Laboratory Environmental Inventory (SLEI) (Fraser & Wilkinson, 1993), The College Classroom Environment Scales (CCES) (Winston, Vahala, Nichols, & Gillis, 1989). However, only the Distance and Open Learning Environment Scale (DOLES) has been created for the specific purpose of assessing climate in distance education.

Procedure

After reviewing the DOLES literature where the authors describe the choice of assessment method, criteria for method development and validation used, it was judged to be effective in assessing most aspects of climate for online learning.

For this instrument to work in our university the measure of climate has to integrate both online and face to face components, so we developed an adapted and augmented version of DOLES that consists of 8 scales. The descriptions of each scale are presented in Table 1.

Table 1. Scale description

Scales	**Description**	**Sample Item**
Students Cohesiveness	Extend to which students know, help, work together and are friendly towards each other.	It is easy to organize a group for a project.
Teacher support	Extent to which the instructor befriends, trusts and is interested in students.	The instructor sends me comprehensive feedback on my assignment
Personal Involvement / Flexibility	Extend to which the students participate and independently decide individual ways to approach course discussions and activities	I get a chance to discuss my relevant personal experiences
Task Orientation / Material Environment	Extent to which activities are clear and well organized	Expectations of assignments are clear in this course.
Interaction	Extent to which the students interacts with the instructor, other students and the content.	The interaction between all participants is high
Learner centered	Extent to which the cognitive, motivational, developmental and individual needs of the students are satisfied	The course offers a variety of activities
Technology Resources	Extent to which the technology is used to enhance learning	The technology resources in this course allow interaction between instructor and student.

Conclusion

Revisiting connection between TQM and climate, the five areas of focus for the theory of TQM, suggested by Sherr and Lozier (1999), were mission and customer focus, systematic approach to operations, vigorous development of human resources, long-term thinking, commitment. These five points form a complete theoretical system, and one cannot fully understand any one point without the other four. Creating the instrument that measures climate in online learning was just the first stage of a larger process that includes an ongoing monitoring and modification of the learning environment based on climate assessment.

References

Brindley, J. (1995). Measuring quality in learner services: building towards the future. Conference paper, project description in D. Sewart (ed.) One world many voices: quality in open and distance learning. *Selected papers from the 17th World Conference of the International Council for Distance Education*, Birmingham, United Kingdom, June 26-30. Vol. 1, 49-52.

Bonk, C. J. & Cummings, J. A. (1998). A Dozen Recommendations for Placing the Student at the Center of Web-Based Learning. *Educational Media International*, 35 (2), (pp. 82-89).

Evans-Harvey, C. (1995). Creating a Positive Climate for Learning in Higher Eduaction. *CSSHE Professional File*, No. 13. Fall. 9p.

Fernández Diaz, M. J., Asensio I. I. (1989). Concepto de Clima Institucional. *Apuntes de Educación, Dirección y Administración*. No. 32, (pp. 2-4).

Fraser, B. J., Treagust, D. F. (1986). Validity and Use of an Instrument for Assessing Classroom Psychosocial Environment in Higher Education. *Higher Education*, 15.(pp. 37-57).

Fraser, B. J., Wilkinson, W. J. (1993). Science Laboratory Classroom Climate in British Schools and Universities. *Research in Science & Technological Education*, Vol. 11, No. 1.(pp. 49- 70)

Harvey, L., Green, D., Burrows, A. (1993). Assessing Quality in Higher Education: a transbinary research project. *Assessment & Evaluation*, Vol. 18, No. 2, (pp. 43-148).

Lampikoski, K. (1995) " Who determines quality in distance education?" Conference paper, project description in D. Sewart (ed.) One world many voices: quality in open and distance learning. *Selected papers from the 17th World Conference of the International Council for Distance Education*, Birmingham, United Kingdom, June 26-30. Vol. 1, (pp.117-120).

Moos, R. H. & Trickett, E. J. (1974). *Classroom Environment Scale manual*. Palo Alto, Calif. Consulting Psychologist Press.

Municio, P. (1995). Calidad Total. *Organización y Gestión Educativa*, No. 3, (pp. 3-7).

Muñoz de Bustillo, C. (1996). Improving Classroom Climate. *Education Resources Information Center (ERIC)*, No.ED396381. (pp. 21).

Jegede, O., Fraser, B. J & Fisher, D. L. (1998) *Development, Validation and Use of a Learning Environment Instrument for University Distance Education Settings*. Unpublished.

Peterson, M., et al. (1986). *The Organizational Context for Teaching: A Review of Literature*. (pp.32).

Scriven, B. (1995). Indicators of quality in open learning. Conference paper, project description in D. Sewart (ed.) One world many voices: quality in open and distance learning. *Selected papers from the 17th World Conference of the International Council for Distance Education*, Birmingham, United Kingdom, June 26-30. Vol. 1. (pp. 219-222).

Sherr, L. A. & Lozier, G. G. (1999) *Total Quality Management in Higher Education*. http://www.umr.edu/~assess/tqm/tqmhed.html

Williams, J., Watson, L. (1995). Gestión de la Calidad Total (TQM) en Educación. *Organización y Gestión Educativa*. No. 3, (pp.8-13).

Winston, R. B., Jr., Vahala, M. E., Nichols, E. C., & Gillis, M. E. (1989) *College Classroom Environment Scales* (version 2). Unpublished instrument.

Assessing the Potential of Electronic Discussion Groups to Enhance Learning in a Classroom-based Course

John F. Bennett, Associate Professor of Marketing
School of Business and Professional Studies
Stephens College, Columbia, MO., USA
Jbennett@wc.stephens.edu

Abstract:
Internet communication tools like Web sites, listservs, e-mail, newsgroups, bulletin boards, and real-time chat programs have been embraced by many educators for their potential to enhance traditional classroom instruction. Specifically, the use of these tools is believed to enhance the three major activities of all teachers: to counsel students individually, to deliver information, and to encourage classroom discussion. This paper reviews the findings from a study conducted by the author that measures the effectiveness of using electronic discussion groups to enhance teaching and learning.

Survey

Convinced of the value of electronic discussion groups in enhancing traditional classroom instruction, the author has been requiring each of the students in an upper-level, undergraduate marketing course to subscribe to a listserv set up specifically for the class. Students used the listserv to argue pro and con positions on statements posted to the discussion list by the instructor. Half of the students on the list argue the pro position and the other half argue the con position. Their responses are then posted to the list and critiqued by other students. A different statement is sent to the list every two weeks and is often related to a current news event related to the concepts being studied. When possible, students are sent links to Web sites that provide additional information about the topic being discussed.

To assess whether the electronic discussion groups were producing the desired student outcomes, the author conducted a survey of all students that had participated in the electronic discussion groups over a two semester time period. A total of 52 students were included in the survey and all responded.

Data were gathered from the students by means of a questionnaire that was distributed both by e-mail and in class. The evaluation instrument measured 1) the extent to which students had used or participated in e-mail discussions; 2) their opinions on the effect that the listserv assignments had on their learning of course content; 3) a self-assessment of their level of computer experience prior to the course; 4) a self-assessment of their level computer experience after the course; 5) their assessment of the negative features of electronic discussion groups, and 6) their assessment of the positive features of electronic discussion groups.

The results indicated that approximately 67% of the students surveyed participated in e-mail discussions on a weekly basis, 13% on a daily basis, and 7% on a monthly basis. 13% of the respondents reported that they did not participate in the e-mail discussions at all. Among those that participated in the electronic discussion groups on a weekly, daily or monthly basis, the majority, 70%, reported that e-mail discussions had a moderate influence on learning the course content. 15% reported that the e-mail discussions had very little influence on learning the course content with the remaining 15% indicating that e-mail discussions had a substantial influence on learning.

Among those students who participated in the e-mail discussions on a weekly basis, the majority, 70%, reported that the discussions had a moderate influence on learning. 20% reported that the discussions had a substantial influence on learning with the remaining 10% indicating that the discussions had very little influence on learning.

Among those students who participated in e-mail discussions on a daily basis, 50% indicated that the discussions had a substantial influence on learning the course content. The remaining 50% indicated that the discussions had a moderate influence on learning. In other words, all of the students in this group indicated that the discussions had at least a moderate degree of influence on learning.

All of the students who participated on a monthly basis indicated that the discussions had a moderate influence on learning the course content.

The students were asked some open-ended questions to assess their perceptions of the advantages and disadvantages of electronic discussion groups in the classroom. Inconvenient access to computers with Internet connections was the least liked aspect of using e-mail. Students also indicated that they felt overwhelmed by the number of e-mail messages they were receiving each week. This was particularly true among those students who were on several class lists. Some students noted that there was too little discussion of the pedagogical benefits of electronic discussion groups. Consequently, at the beginning of the semester they failed to understand why in-class discussions were being supplemented with e-mail discussions. It was only after participating in the electronic discussions for a few weeks that the students began to understand and appreciate their value. Finally, some students lacked experience using a listserv and expressed a fear of this technology. The students noted that their participation in e-mail discussions would have been greater if they had received some remedial assistance with the technology being used.

One benefit mentioned by several of the students was that electronic discussions provided a convenient means of interacting with peers as well as the instructor. They appreciated being able to send and reply to an e-mail message at a time of their choosing. Students also noted that it was easier to collaborate with their peers on group projects. The frustration caused by trying to arrange convenient meeting times for a group of students to physically meet and work on a project are largely eliminated with electronic discussion groups.

A few of the students commented that they were more comfortable with written rather than oral discourse. They stated that they felt more willing to make provocative assertions during e-mail discussions and to challenge the views of their peers and the instructor. In short, they felt liberated by this new medium. However, a couple of students did indicate that had they been able to maintain their anonymity they would have been more willing to challenge the viewpoints of their peers. This is consistent with research showing that people are more daring and confrontational regarding the expression of ideas when allowed to remain anonymous (Lauzon, 1992).

Conclusion

Based on the survey results, electronic discussion groups do appear to enhance learning of course content. This is especially true among those students who reported that they participated in e-mail discussions on a daily basis. Therefore, instructors should consider incorporating electronic discussion groups in their classes and using strategies for encouraging students to participate in the discussions on a regular basis. To avoid the problem of students feeling overwhelmed by the number of postings made to the list, a limit should be placed on the size of the discussion group. In large classes, several discussion groups could be used.

Critical to getting students to be active participants in electronic discussions is to provide them with an understanding of the pedagogical benefits of this learning tool. A few of the students surveyed indicated that they did not understand the need for the listserv, which may have resulted in a lower level of participation.

Consideration should be given to the students' level of expertise with communication technologies. The survey found that several students were unfamiliar with listservs and would have appreciated some training in their use. Providing this training at the beginning of the course would help ease these students' fear of these technologies and increase their level of participation in the electronic discussions.

Those considering incorporating communication technologies in their courses should also be mindful of the difficulty students may have getting access to computers connected to the Internet. Ideally, all students would have their own computers that would provide access to the Internet. However, it is more realistic to assume that at least a few students will be wholly dependent on the institution's computer resources. Should access to computers on campus be a problem for students, it may not be possible to make participation in electronic discussions a requirement in the course.

Finally, in deciding whether to use electronic discussion groups it is important to: 1) identify the best teaching and learning strategies for the class, especially those that would not be feasible without electronic discussion groups, and 2) identify which technologies are best for supporting those strategies. It may be found that electronic discussion groups would be poorly suited to support the teaching strategies being used. There may be other technologies, even conventional ones, that would are better suited for carrying out a particular teaching task.

Weaving the World into the Curriculum: Using Technology to Internationalize the Art, Music and Social Studies Curriculum

Linda Bennett, Ed.D.
Curriculum & Instruction
University of Missouri-Columbia
United States
lb@missouri.edu

Jonathan Pye, Ph.D.
Curriculum & Instruction
University of Missouri-Columbia
United States
pyej@coe.missouri.edu

Introduction

"Emerging approaches to developing rich learning environments combine multimedia, computer mediated communication, and a host of interactive strategies to connect people in varied and robust ways." (Schwier, 1999)

The virtual learning community can be the key to opening the door to the world for the learner. Instructional technology is a powerful tool for students to communicate within a global community and develop knowledge, skills and attitudes about the world. Students can electronic communication tools, Internet resources, and multimedia documents to research information, develop inquiry skills, or discuss diverse viewpoints. Communication tools can link professionals, educators, and students interested in social studies, art or music. Projects can be developed for students in different settings to work collaboratively and internationalize the curriculum. Designing global multimedia projects can enrich the art, music and social studies knowledge base and broaden their global perspective. Through global methods such as these and regular integration of technology a community of learners can be developed (White, 1996).

The Model

This web-based project was initiated in the fall of 1997 to meet the Principles and practices of the Undergraduate Teacher Development Center in the College of Education at the University of Missouri-Columbia framework for diversity and technology (1995). The technology benchmark is: "Effective teachers use technology to participate in a community for professional development, to engage in personally meaningful inquiry, and to support teaching, learning, and assessment." The diversity benchmark is: "Effective teachers encourage students to value commonalties and differences of our pluralistic world."

The project emphases promoting and facilitating internationalizing the curriculum and uses technology as an integral component in the learning process. This project is an effort to implement the college's framework by designing undergraduate curriculum to increase global perspectives and technology as they relate to art, music and social studies. Each term approximately sixty prospective elementary teachers are enrolled in the elementary art, music, and social studies methods block in which this model is implemented.

The framework for the model includes:

- Using technology is an integrated component in internationalizing of the curriculum of art, music and social studies
- Developing Internet resources for internationalizing the in art, music and social studies curriculum
- Accessing electronic communication tools to discuss internationalizing the curriculum
- Infusing technology into internationalizing the assignments, class experiences and electronic portfolio in art, music and social studies

The performance expectations for students in the project are:

- Use their e-mail, a class discussion group, a newsgroup, and online forms. Each of these forums for communication, inquiry, and reflection support the articulation of ideas, diverse viewpoints, and creative problem solving.
- Design interdisciplinary units of study, lessons and children's museums, which infuses technology into the internationalized curriculum. Within these assignments the students are designing multimedia projects and using interactive strategies for learning.
- Building a model for discovering quality Internet resources for internationalizing the art, music and social studies curriculum
- Disseminating the projects in local elementary schools

This report is on the development of the program and the delivery systems for the infusion of technology into the internationalizing of the curriculum. As an ongoing project, the curriculum is being refined based on feedback each semester from instructors and students.

Conclusions

This model will stimulate an awareness of possible means for delivering an integrated internationalized curriculum through technology. The world is at the fingertips of any learner when quality Internet sites are woven into the curriculum. In a virtual learning environment the learner can build a model of discovery to find exemplary resources. Students can develop international attitudes and views through online communication tools, collaborate with students around the world on projects, research new bodies of knowledge, and design global multimedia projects.

One student's response represents an example of how students in the project make the transfer from the integration of technology and meeting the needs of diversity in an elementary school.

"I think as future teachers we need to know how to use the technology because many of our future students will be more knowledgeable about technology than me. Technology communication allows students to correspond with other children around the world. With the ever increasing diversity, children need to be able to talk with other students that are not exactly like themselves."

As instructors and prospective teachers make use of technology as an integrated component of their daily life, then we can discover new methods for combining the art, music and social studies and infusing diversity and technology. The shift in the pedagogical infusion of technology and diversity are key to the success of teacher education.

References

Schwier, R. (1999). Turning learning environments into learning communities: Expanding the notion of interaction in multimedia. *Proceedings of the 1999 Ed-Media Conference*, 282-286.

Undergraduate Teacher Development Center. (1995). *Principles and practices.* College of Education, University of Missouri-Columbia, Columbia, MO.

White, C. (1996). Relevant social studies education: Integrating technology and constructivism. *Journal of Technology and Teacher Education* 4(1), 69-76.

Experiences with *The Universal Machine: A Multimedia Introduction to Computing*

Glenn D. Blank, EECS Department, Lehigh University, USA, glenn.blank@lehigh.edu
Robert F. Barnes, EECS Department, Lehigh University, USA, rfb1@lehigh.edu
(http://www.eecs.lehigh.edu/~glennb/um)

Abstract: There are a great many books introducing computer science, yet few use the computer itself as a dynamic instructional tool. Interactive multimedia opens a door for students whose learning styles lean more to the concrete, participative approach, rather than the typically more abstract, reflexive approach of most computer science textbooks. Our experience confirms our approach, by way of significantly improving final examination scores. We also introduce our plans for a more constructive, inquiry-based approach to multimedia education.

We have written yet another textbook for the first semester course on computer science (CS0 or CS1), which WCB/McGraw-Hill published in 1998. It is accompanied by a multimedia CD-ROM. Media-rich material makes computer science accessible to a broader audience and stretches what an introductory course can cover. There are still relatively few CS1 books that emphasize the breadth of computing as an *intellectual discipline*, rather than as just programming. Nevertheless, CS1 also requires programming in languages such as C++. Our multimedia presents the dynamic aspects of program structure and provides online help driven by a student's errors. Though C++ is now the most popular language for introductory courses, its complexity poses certain disadvantages as well. We have therefore focused on a subset of C++ (which we call C++--), together with a integrated programming environment catering to beginners. Finally, we believe it is essential to teach problem-solving strategies *before* taking up programming--especially before the student dives into a programming language as complex as C++! The multimedia helps students visualize and experiment with analytical and analogical problem solving strategies. *The Universal Machine* therefore has three major goals, followed in the structure of both book and multimedia:

1. To emphasize the breadth of computing as a discipline. A narrow concentration on programming can lead to a misconception that computer science is little more than programming. True, computer scientists use programming as an experimental tool, but like other scientists, they emphasize *abstraction*. They also use mathematical techniques to study computing *theory* as well as engineering techniques to improve the *design* of effective systems. (Denning 1988 emphasized these three approaches to the study of computing: abstraction, theory, and design.) We follow the recommendations of Tucker 1991 by introducing a broad treatment of computing as an intellectual discipline, with topics ranging from computer architecture to artificial intelligence.
2. To encourage students to think about and practice programming as systematic problem solving. An early chapter examines three alternative approaches to problem solving: hacking (illustrating the difference between blind and informed hacking with the well-known fox-goose-corn problem), analytical (which includes top-down decompositon), and analogical (ranging from copy and paste to object-oriented reuse and inheritance). Early on, students practice these approaches with a simple programming environment called *Knobby's World*. "Knobby the Knowbot" is a simple agent that moves and picks up objects in a microworld. Using a graphical simulation program, students first learn to program Knobby by issuing simple commands, then by progressing to defining and calling macro-instructions, and finally by writing programs. Knobby is a relative of Karel the Robot (Pattis 1981). The purpose of Knobby is in part much the same as that of Karel--to serve as a "gentle introduction to the art of programming," though Knobby is more oriented to teaching C++ than LISP. Later chapters studying the software life cycle emphasize the systematic use and reuse of functions and classes.
3. To provide an introduction to computer programming that gives an adequate background for a continuation to a second-semester course suitable for computer science majors, without disenfranchising those students without previous computer experience. Because C++ (unlike Pascal, BASIC or LOGO) was not intended as instructional language, it can be rather daunting for beginners. We therefore concentrate on a subset of this very rich language, which we dub C++--. The multimedia CD-ROM includes a tool called LOOKOUT which will "look out" for errors in C++-- programs. Beginners typically have difficulty understanding the error

messages that modern compilers emit. LOOKOUT provides detailed explanations of error messages. Moreover, the multimedia, after presenting expository and interactive material on C++, invites the student to invoke LOOKOUT to study sample programs and develop simple programs. Thus the student learns abstract presentation (in both text and audio mode) interactive exercises in the multimedia itself, then by example and problem solving in the integrated LOOKOUT environment. LOOKOUT also supports a small library of software "classes" which lets students solve a variety of problems (especially non-numerical ones) using simple graphical shapes, musical notes, external files, and strings and arrays that catch "out of bounds" errors. For those who want to go beyond the C++-- subset, there are optional "Beyond C++--" sections at the end of C++ chapters in the book.

Creating *The Universal Machine*, was, to put it mildly, a challenge. Early on, while writing proposals to publishers, talking to people with more experience than we then had in developing multimedia, we began to talk about our "Greek chorus." They warned us gloomily about the inevitable pitfalls and problems we would encounter and advised us to increase our budget. Sure enough, we did encounter many snafus, personnel changes, miscommunications, conflicting priorities, and learning curve issues. It took two and a half years to bring out the first edition of the book with multimedia. A year and a half later we released a second version of the CD-ROM, cleaning up many bugs, adding multimedia material for two chapters which we were not able to include in the first edition, and giving the user more control over the interface.

The initial user interface put the user at the console of a space ship and navigated into one of three galaxies (the three major themes) and thence into star systems or planets (chapters). The analogy of this interface is that exploring outer space is like exploring abstract problem space. As we expected, many beginning students enjoy this interface. However, many sophisticated students, instructors (who make textbook decisions) and our publisher's marketing staff (alas!) thought it was "juvenile," unfortunately misleading them about the level of most of the content. So we have developed an alternative interface, presenting themes and chapters in text rather than galactic graphics, with rollovers bringing up summaries of each chapters. The user can choose between either interface at installation and switch between them. The user can also choose to disable sound, have the presentation stop after each screen (by default it advances automatically, which most of our students seem to prefer), skip the opening and credit sequences, etc.

While developing *The Universal Machine*, the lead author taught CS1 (to a mixed audience of majors and non-majors) at Lehigh University, about 70-80 students each year. From the first year, for which only the manuscript of the book was available, to the second, in which an incomplete version of the multimedia was introduced, mean final examination scores improved about six points. Improvements were especially notable in coverage of breadth topics. In the third year, once the complete first edition was available, the mean final examination scores improved another seven points. This time there was significant improvement in the programming problems, suggesting that integration of LOOKOUT with the multimedia was indeed crucial. We expect further improvement this year, with the introduction of two new chapters and many bug fixes.

We now envision an avatar-based model of learning, in which students would interact with multimedia personae modeling the experience of learning at different levels. *The Universal Machine* features a narrator, who speaks text in a professional voice, but otherwise has no identifiable persona, and also a cartoon-like character named "Knobby" who pops up from a pedestal to ask the user to do exercises or to dialog with the narrator in the role of a learner. A lesson learned from this first attempt is that while less sophisticated users enjoy interacting with Knobby, more sophisticated students find him juvenile. We envision designing several different characters, representing learners with whom a wider range of students can identify, as well as different teachers, such as a professor, graduate teaching assistant and undergraduate apprentice teachers. These avatars would model students and teachers studying expository multimedia material together, as well as guiding students though interactive exercises, ranging from point-and-click quizzes to exploratory research using online information, such as Compendex and INSPEC.

References:

Denning, P. et al. (1991). *Report of the ACM Task Force on the Core of Computer Science.* New York: ACM Press.
Pattis, R. (1981, 1995). *Karel the Robot*. New York: John Wiley Press.
Tucker, A., et al. (1991). *Computing Curricula 1991--Report of the ACM/IEEE-Computer Society Joint Curriculum Task Force*. New York: ACM Press.

Meta Groupware Design for CSCL Environments

Grégory Bourguin, Alain Derycke
Laboratoire TRIGONE, Institut CUEEP,
University of Lille 59650, Villeneuve d'Ascq, France
gregory.bourguin@univ-lille1.fr

Abstract: In the last few years, many different research areas have raised from CSCW. However, we can notice a general goal shared by all of those domains: create more user centered groupware, i.e. design system better responding to user's needs. Our experience in CSCL system design teaches us that those needs cannot be totally pre-defined but seem to emerge from user's activity. This involves reformulating the problem: we have to design CSCL systems supporting non pre-defined but emerging user needs. Work based on Activity Theory helped us in creating a new CSCL environment called DARE (Distributed Activities in a Reflective Environment) designed for this dare.

Introduction

The observation of the evolution of real uses by advanced educational actors (pedagogical designers, tutors) shows that they have a light planning of the activities: they start with a pattern of proposed activities but, during the process, they have an opportunistic behavior, revising and evolving their instructional strategies and learning activities according to the learner population reactions and progresses. It appears clearly that they need more evolving CSCL systems. Below, we present the design properties of DARE (Distributed Activities in a Reflective Environment), an environment for groupware support. DARE emphasizes on *co-construction* and *expansiveness* (Kuutti 1991) (Bardram 1998) properties of activity. DARE is a meta groupware that takes elements coming from both social science and computer science for its design. Roots of this model are coming from Activity Theory.

Key Concepts for design

Activity Theory (AT) has been identified as a hot issue for HCI and CSCW over the 10 last years, due to contributions from (Engeström 1987), (Kuutti 1991) or (Bodkers 1991). We will not expose here all AT. However, we would like to present some elements we found essential to understand DARE's philosophy. First and according to Kuutti (Kuutti 1991), we define activity as our basic unit of analysis. Secondly, activity is mediated by artifacts and we use Engeström's *basic structure of activity* (Engeström 1987) model to create our conceptual model. Finally, we accept that elements appearing in this model are creating a situation that influences activity and that they are subjects to modification because activity always modifies its situation in a reflective fashion.

The concepts we use for our conceptual model are the object (the motive of activity), the subject (or actor), the community (a set of subjects sharing the same object), the tool (mediating the subject and object relationship ; anything used in the transformation process), the rules (mediating the subject-community relationship ; explicit and implicit laws, accepted practices...) and the division of labor (mediating the community-object relationship ; explicit and implicit organization of a community). We have decided to synthesize the two last concepts in only one named role. Rules it represents strongly influence actions that subject may perform during activity by defining an evolving set of rights. Role mediates the relationship between community and object by determining what each role existing in community has to do to reach the object of activity, this corresponding to the division of labor.

Bedny (Bedny & Meister 1997) mentions that task is the basic component of activity. According to (Leont'ev 1977), task is *"a situation requiring realization of a goal in specific conditions"*. AT argues that situation is never given in advance and is the result of interactions. Activity starts with an initial situation given in the task. This situation is shared by all subjects involved in activity; it is transformed by task performance and concludes with a final situation. For our design, we accept that activity is created according to a given task defining the object of activity, the tools to be used and the roles. However, activity tends to modify its task until the end.

Open Implementation

Usually, CSCW systems implement a specific task that has been constructed thanks to a task analysis. Unfortunately, breakdowns often appear generally due to a shift between system's embedded task and user's one (or the representation he has constructed). If user is unable to understand the task the system really implements, or to adapt it to its one, then appropriation does not happen. Our meaning is then to allow users to access to the task in order to help in understanding the real task behind the system and, if needed, to modify it. This corresponds to the *Open Implementation* approach described by (Kiczales 1996). An existing technique for Open Implementation is *Meta Object Protocol* (MOP) (Kiczales et al. 1991) that helps in providing system interfaces for examination and modification, in other words, providing a meta interface. We have used MOP technique to implement DARE. MOP defines a meta level description of the system that is accessible to users. It allows, through a meta application, the examination (*introspection*) and manipulation (*intercession)* of the system during its own execution while maintaining a causal connection between this execution and its meta level. Our meaning is to apply those concepts in order to create a reflective system based on task and activity.

In languages implementing MOP, the meta level corresponds to the classes and the execution to their instances. In DARE, that is realized in Distributed Smalltalk & Java, everything concerning task is traduced in term of class, and activity in term of instance. This correspondence takes advantages of reusing the reflective properties of the languages that are used. This allows to modify the task during the corresponding activity's execution. Task itself is an artifact manipulated by subjects according to their role. Task is part of and is modified by activity it defines in a causally connection. Accessing to task is a meta activity in which subjects may modify their working situation in a cooperative way. This offers a support for activity implementing concepts and mechanisms as described in AT.

Conclusion

This paper has briefly presented how we have used a simple model and mechanisms coming from Activity Theory to design a meta groupware that helps users to define their own activities. This meta groupware is named DARE. However, Activity Theory teaches us that activity is reflective in the sense that it is co-constructed and expansive. This is why DARE is more than a meta groupware but a reflective groupware allowing users to access the meta level of their activity during its execution.

During the following months, DARE is going to be used for experimentation in CSCL domain. The main idea is to provide to users (students and teachers) a bootstrap CSCL activity and to study how they use DARE reflective properties to adapt, evolve and co-construct this CSCL environment. This possibility to allow self-organization inside a learner group and co-construction of the collaborative learning activities is seen for us as an important contribution to self reflection activities.

References

Bardram, J. (1998). Designing for the dynamics of cooperative work activities. *Proceedings of the ACM CSCW'98 conference.* ACM Press, 89-98.

Bedny G., Meister D. (1997). *The Russian theory of activity, Current Applications to Design and Learning.* Lawrence Erlbaum Associates, Publishers.

Bodkers, S. (1991). Activity Theory as a challenge to system design. *Information systems Research: Contemporary Approaches and Emergent Traditions*", Nissen, H; Klein, H. Hirschheim, R. (eds), Elesevier Science Publishers, BV (North Holland), 551-564.

Engeström, Y. (1987). *Learning by expanding: an activity-theoretical approach to developmental research.* Orienta-Konsultit Oy, Helsinki.

Kiczales G. (1996). Beyond the black box: open implementation, IEEE Software, January, 8-11.

Kiczales G., Bobrow D.G., Des Rivieres J. (1991). *The Art of the Metaobject Protocol*, MIT Press.

Kuutti, K. (1991). The concept of activity as a basic unit of analysis for CSCW research. *Proceeding of the second ECSCW'91 conference*, Kluwers Academics Publishers, 249-264.

Leont'ev, A. N. (1977). *Activity, Consciousness and Personality.* Moscow : Political Publishers.

HAPTIC VIRTUAL REALITY FOR TRAINING VETERINARY STUDENTS

Stephen Brewster, Michelle Montgomery Masters, Aidan Glendye
Glasgow Interactive Systems Group, Department of Computing Science, University of Glasgow,
email : stephen@dcs.gla.ac.uk, michelle@dcs.gla.ac.uk

Stuart Reid, Nik Kriz
Faculty of Veterinary Science, University of Glasgow

Abstract: This paper reports on an initial and on-going study into the use of haptic (Schiff & Foulke, 1982) technology in veterinary education. The University of Glasgow has a commitment to the implementation of non-invasive procedures for diagnostic and education purposes in Veterinary Medicine, wherever possible. As part of the continued development in the use of technology in veterinary education, Virtual Reality is now being explored as a possible aid to teaching and in particular to replace invasive examination procedures.

THE PROBLEMS

One major problem in the education of veterinary students is the danger faced by animals when being examined by inexperienced students. The students need to gain experience in internal examinations (a key method for diagnosing problems and diseases) but it can be dangerous. The animals may become stressed, be injured or may even die because of unskilled internal examinations. Large classes of students mean that each person may only get a very limited amount to time learn the practical examination skills required. Another problem is that the students must learn about a whole range of diseases and problems as part of their education. At the time during their training when they are learning about a particular disease there may be no animal available with the particular disease in question. This means that students may not be able to consolidate their learning with practical experience.

THE SOLUTIONS

We are investigating ways to solve these problems by using haptic devices that allow users to feel virtual objects. There are three main benefits from our solution:
Safety: The use of haptic models to simulate problems allows the students to learn in a safe environment. They can learn on the models without endangering any animals. Once they have gained sufficient skills on the models they can then move on to the live animals with much less chance of doing harm.
Cost: The cost of education is also reduced. A large number of students can interact with the haptic models very quickly and cheaply. They can also do this much more frequently than would be possible with live animals.
Flexibility: The flexibility of the models is great. It is possible to simulate a range of diseases that the students would not normally experience. Different stages in the progress of a disease or condition can also be simulated. This can be done at the time the students are learning, allowing them to try out their theoretical knowledge immediately in a practical setting.

THE TECHNOLOGY

The technology to feel virtual objects is just now becoming available (Massie & Salisbury, 1994, Bryson, 1995). It was first developed so that users could feel objects in virtual environments. Minsky (in Blattner & Dannenberg, 1992) describes the technology thus: "Force display technology works by using mechanical actuators to apply forces to the user. By simulating the physics of the user's virtual world, we can compute these forces in real-time, and then send them to the actuators so that the user feels them". The device used for the work described is a PHANToM. This is a very high resolution, six degrees-of-freedom device in which the user puts his/her finger in a thimble or holds a pen at the end of a motor-controlled, jointed arm. It provides a programmable sense of touch that allows users to feel textures and shapes of virtual objects, modulate and deform objects.

THE HAPTIC MODELS

As mentioned, we are developing haptic software models that will simulate the feel of parts of a horse under examination. This shows two horse ovaries. The ovaries feel correct and they move in appropriate ways (if pressure is applied they can be moved in three dimensions in a realistic way). Both ovaries have very smooth, taut surfaces. The left ovary is softer and slightly smaller than the right one. A follicle can be seen on the left ovary (indicating ovulation is about to take place). This sticks out from and is much softer than the rest of the surface. The visual representation of the ovaries is built in OpenGL. The haptic representation is built using the GHoST software toolkit from SensAble. When vets are doing internal examinations they cannot see the ovaries, so the visual images are mainly for illustrative purposes. However, a visual representation is beneficial when learning to use the system. Our software allows the visual representation to be removed as required. The PHANToM device only allows the user to feel with one finger, not the whole hand. This, however, is not a limitation as vets will only use their thumb when feeling the ovary in a real examination.

EVALUATION

The development of the models has been performed using an iterative, participatory approach. Computing scientists have been working closely with vets to ensure that the models are correct. This has involved the building of initial prototype models and their continual refinement via expert user evaluation. The next stage in our work is to carry out evaluations with vet students. We will discover if the models are usable: can the vet students interact with them, use the device, etc. We will also be able to find out how effective they are: can students correctly identify the particular diseases and conditions we have simulated in our models.

CONCLUSIONS

One problem in veterinary education is that students must learn how to do internal examinations of animals but in doing so can be dangerous for the animals. Another difficulty is that there may not be an animal available with a particular disease when the students are studying it. The availability of haptic devices means that these problems can now be overcome. We have developed a set of haptic models of horse ovaries that will allow students to learn in a safe, cheap and flexible environment. Once they have learned the necessary skills they can move to working with live animals with much less risk of danger.

References

Schiff, W. & Foulke, E., Eds. (1982). *Tactual perception: A sourcebook.* Cambridge University Press, Cambridge.
Massie, T. & Salisbury, K. (1994). The PHANToM Haptic Interface: A Device for Probing Virtual Objects. *In Proceedings of the ASME winter annual meeting, symposium on haptic interfaces for virtual environments and teleoperator systems* ,Chicago, IL.
Bryson, S. (1996). Virtual reality in scientific visualisation. *Communications of the ACM*, 39, 5, 62-71.
Blattner, M. & Dannenburg, R.B., Eds. (1992). *Multimedia Interface Design*, ACM Press, Addison-Wesley, New York.
Vince, J. (1995). *Virtual reality systems*, Addison-Wesley, Wokingham, UK.

Hinckley, K., Pausch, R., Goble, J., and Kassell, N. (1994). Passive Real-World Interface Props for Neurosurgical Visualization Interacting in 3-D. *In Proceedings of ACM CHI'94,* ACM Press, Addision-Wesley, 452-458.

Online Education in Schools: Expectations, Facts, and Fiction

Peter A. Bruck, Techno-Z FH Research & Development, Austria
Guntram Geser, Techno-Z FH Research & Development, Austria
Thomas Olesch, Techno-Z FH Research & Development, Austria

As institutions of knowledge transfer and know-how generation schools are particularly effected by the rapid spread and extended functionality of the new information and communication technologies. The expectations concerning the benefits of the integration of ICTs in schools are high. Yet, there are many obstacles for a sensible use of these technologies in schools which are not easy to overcome. The financial capacity of schools to make the necessary investments into hard- and software are restricted by severe budgetary constraints. Local networks and internet access have to be adjusted, which is often a delicate exercise with flexible costs. Much of the multimedia content available on the market fails to serve the pedagogical needs; and - maybe the biggest problem - the new learning tools cannot be integrated into teaching practices, unless the teachers themselves have been trained adequately and are ready to transform their established working habits.

The paper will address the bundle of expectations around the efforts schools are making in order to be part of, if not to say spearheading, the Information Society. These expectations are set in relation to available hard facts on the effects of ICT implementation in schools. What happens, if school classes are equipped with computers and get connected to the Internet? What is the impact on classes, how does this influence the roles of teachers and pupils, and what is the impact on teaching and learning processes? The paper will contrast expectations with empirical facts, whilst "fictions" will be singled out and realistic and manageable routes to effective online education in schools will be suggested.

A CD/Web-Based Team Project For Undergraduate Business Ethics Students

Martin Calkins, S.J.
Santa Clara University
Management Department
500 El Camino Real
Santa Clara CA 95053
mcalkins@scu.edu

David Armstrong
Santa Clara University
Media Services Department
500 El Camino Real
Santa Clara CA 95053
darmstrong@scu.edu

Abstract: This article describes a case-based undergraduate business ethics team project that uses CD and web-based computer technologies to advance the moral decision-making skills of students.

Today, computer technologies are fairly well integrated in business school programs. They are not so firmly established, however, in the humanities and combination academic disciplines such as business ethics. The following describes one successful case-based team project that uses CD and web-based computer technologies in an undergraduate business ethics course. As does business ethics, this project co-joins academic disciplines. Unlike typical business ethics projects, however, it links computer technology with business management and ethics.

An Elementary Business Ethics Model

Although similar to other team projects in its attempt to teach students to describe, analyze, and resolve business ethics problems, this project is unusual for its concentration on a relatively young undergraduate population (first year/freshman and second year/sophomore students) having little or no previous formal ethics, business, or web design training. The project itself is simple. It merely has the students apply theory, principles, and select cases to a business ethics problem. Although this approach to moral problem solving is not as useful as a rich business-specific casuistry, it is helpful in educational settings to convey the underlying norms and issues at play in practical circumstances.[1]

In essence, the project is a summary exercise introduced at the beginning of the course. Students are assigned to four or five member teams, encouraged to meet with the professor to discuss acceptable cases, and then sent off to work independently. Students design or select a case embodying a particular moral business problem. They then analyze the case using the theories and cases learned in class, produce a CD-ROM containing their analyses, and present their findings to the class at the end of the academic term.

Technology

Not surprisingly, the project has evolved over the course of its implementation. Early on, we used a series of linked web pages to describe it. These pages were to serve a dual purpose: they were to describe

[1] For more on this distinction, see Martin Calkins, S.J. "Casuistry and the Case Method." *Business Ethics Quarterly*. Forthcoming.

the project to students and to be used as a template. Unfortunately, the template notion was lost on most of the students. To rectify this problem, we introduced a simpler template containing a single sample image and basic navigation and e-mail links. This seemed to work better. We also revised the description pages, reducing multiple pages to a single page. This made the pages easier to read and revealed how web pages can be simple, yet effective and user-friendly. For early and later versions of our project description pages, see:

Early version: http://www-acc.scu.edu/~mcalkins/BE10777Pg1.html
Later version: http://www-acc.scu.edu/~mcalkins/BE14573Pg1.html
Template: http://www-acc.scu.edu/~mcalkins/index.htm

From the beginning, we promoted the use of HTML because we believed that HTML allowed students to create and distribute rich and easy-to-use multimedia presentations over a variety of computer platforms (MAC or PC). We also chose Macromedia's Dreamweaver as our web-authoring tool because Dreamweaver, unlike other web authoring tools, relies on traditional word processing functions already familiar to students. Dreamweaver also lets more advanced users include visual page design, dynamic HTML, and Java Script in pages relatively easily. In addition, we required that students place their work on a CD-ROM. This was to avoid university server space problems, potential server inaccessibility, hassles involving the promulgation of ftp software, possible copyright violations, the necessity to establish student web accounts, and so forth. At presentation time then, students simply bring their CDs to class and flip them into a laptop that is hooked up to a large screen projector.

Assessment

At present, we have conducted this project over three academic terms. Our students' work can be viewed at:

BE Team Projects Winter 1999: http://medialab.scu.edu/mcalkins/winter99/index.htm
BE Team Projects Spring 1999: http://medialab.scu.edu/mcalkins/spring99/index.htm
BE Team Projects Fall 1999: http://medialab.scu.edu/mcalkins/fall99/index.htm

It is our view that the project has many positive attributes. It is simple and forthright. It promotes clear thinking and linear, deductive reasoning. It encourages students to reflect deeply on cases, to concentrate on the gist of arguments, and to think creatively.

At the same time, it *may* be no more effective than traditional paper-based projects in teaching business ethics and team participation. To date, it has always been implemented alongside a traditional, paper-based project. Each time, paper and CD/web-based projects were of similar quality in terms of the students' ability to apply theory and principles to situations. Interestingly, student evaluations reveal that two out of three times students expend the same or *less* effort on CD/web-based projects than they do on paper-based projects (see Table 1). This finding initially surprised us, but makes sense given some of today's students' familiarity with computer technology.

Table 1: Student Evaluations: Rated 1 (definitely false) to 5 (definitely true)

Question	Paper/Web Winter-99	Paper/Web Spring-99	Paper/Web Fall-99
I worked harder on this course than on most courses I have taken.	3.55/3.5	4.06/3.79	3.61/3.76
I found this course more difficult than most courses I have taken.	3.58/3.4	4.11/4.12	3.52/3.79

Conclusion

In the end, we recommend this CD/web-based project because we believe that it successfully integrates three factors essential to the success of technology-based learning projects. It (1) facilitates cooperation between the course instructor and the technology specialist, (2) keeps course goals before those associated with technology, and (3) fosters a supportive environment for student creativity. We recommend it, too, for its ability to help students see how ethics, management, and computer technology are more compatible than unrelated.

THE 7 C'S MODEL FOR LEARNWARE DEVELOPMENT

Tom Carey and Kevin Harrigan
Centre for Learning and Teaching Through Technology
University of Waterloo
Canada
{tcarey,kevinh}@uwaterloo.ca

At our institution we have been designing and developing interactive courses and course modules for some time. For example, recently we converted twelve one-semester Distance Education courses from traditional paper, audio and video to online and we are scheduled to convert many more in the next few years. These online courses are each a one semester course (36 hours of instruction) containing various modules some of which are highly interactive and some of which are not highly interactive.

The highly interactive components, also called Multimedia Interactive Learning Environments (MILEs) (Plowman et al., 1999), that we have been building for these Distance Education courses and other courses typically cover 1-3 hours of the course instructional material. The components are addressing instructional bottlenecks – parts of the course which students have been struggling with year after year

Our institution has been creating a development process for high quality MILES, which optimizes the use of faculty time, student engagement and instructional staff support. By structuring development around a set of incremental prototypes and instructional design tools, the **7 C'S MODEL** insures that support resources are applied at the right time and in the right measure to sustain learnware development. We are currently scaling up this process for use across the university, and developing partnerships for sharing the products and the process with other institutions.

The **7 C'S MODEL** has the following components: (a) Content bottleneck (b) Course prototype (c) Co-op project (d) Class pilot (e) Courseware Exchange (f) Commercial product (g) resource Centre. The process begins with (a) a content bottleneck identified by a faculty member. This is a part of the course that has students have had difficulty understanding year after year. The faculty member feels that technology may be useful in overcoming this bottleneck. The faculty member sponsors a team of four students who build and test a (b) prototype learnware solution for course credit in a third year project-based Independent Studies course called Designing Learning Activities with Interactive Multimedia. Successful prototypes are developed into (c) pilot systems by students on co-op work terms (normally with support from the university and government). The resulting product from the co-op work term is then (d) tested with pilot classes. The best of these learnware solutions are shared with other institutions, either as (f) commercial products or through a (e) courseware exchange where the market is limited. All of these activities are supported by a (g) central resource group: in our case it is the Centre for Learning and Teaching Through Technology.

Status

We have developed the **7 C'S MODEL** through pilot studies with 14 teams of faculty, students and staff. Five systems have reached the class pilot stage, one is now ready for commercial productization, and others are working their way through this pipeline. The process has now been institutionalized in the undergraduate course, *Designing Learning Activities with Interactive Multimedia*, which is supported by a Web-based support tool, the *Learner-Centred Design Idea Kit* (Carey, Harrigan, Palmer & Swallow, 1999). Two of the main features of the kit are a detailed learner profile section and a visualization of the learning activities based on Laurillard's Conversational Model (Laurillard, 1993). The design of the kit itself was informed by constructivist educational literature and thus the kit guides our novice designers through a design process which is based on the latest research.

An Example

Perhaps this process is best illustrated with an actual example. This representative **7 C's MODEL** project originated in Fall'98 when an Environmental Studies professor identified an Instructional Bottleneck in that year after year his students had difficulties appreciating and understanding Life Tables. There seemed to be two main concerns. First, the students didn't seem to appreciate that life tables are important in many fields. Life tables are used in many fields to determine the life expectancy - in environmental studies they are often used for plants and animals, in accounting they are used by actuaries in evaluations, and in the insurance business they are used in determining policy premiums. Second, about half the students did not have the math background to easily understand the math used in calculating the columns in a life table.

Students in our course created a design and produced a very primitive prototype in Winter'99. The design was broken into three main parts the first two of which addressed the lack of appreciation of life tables and the last of which addressed the math issue. The first section was a relevance section where video was used to go and interview people who work with life tables to show students that people in industry do use life tables. The second part was field trips that used video to show people collecting data for life tables in the field – for example one was tagging birds and another was counting the survival rate of trees. The third section was really the core of the system that allowed students to actually build a life table. This section had a lot of feedback, examples, and assistance to help learners who were having difficulties understanding the math.

In Summer'99 one of the students from the class group and one other were hired to finish the project. The resulting application is being piloted in the Fall'99 semester with approximately 100 students who are currently taking the course. In is anticipated that because Life Tables are used in many disciplines this product will be a good candidate for the courseware exchange or commercialization. Even within our own institution we anticipate that other departments many adopt, or modify and adopt, this application for their use.

All throughout this process the Centre for Teaching and Learning Through Technology has provided assistance with things such as: selection of tools, project management, feedback at various stages in the design/implementation, and overall advise on issues such as how to perform the evaluation.

Conclusion

In presenting our model we are showing the model that seems to work at our institution. We are not suggesting at all that this exact model is the best one for any other institution. It is a model that works and thus others may gain by exploring the model and adapting all or parts of the model for their institution. Perhaps the main point is that institutions need some such model – good instructional material does not come out of thin air – it has to be well thought out, plan, and implemented using a defined process. Also, it should be grounded in the research and practice that is documented in the literature (and which our Kit supports).

References

Carey, T.T., Harrigan, K. A., Palmer, A., & Swallow, J. (1999). Scaling up a learning technology strategy: Supporting student/faculty teams in learner-centered design. ALT-J, the Journal of the Association of Learning Technologies, 7(2), 15-26.

Laurillard, D. (1993). Rethinking university teaching: A framework for the effective use of educational technology. London: Routledge.

Plowman, L., Luckin, R., Laurillard, D., Stratford, M. & Taylor, J. (1999). Designing multimedia for learning: Narrative guidance and narrative construction. In Proceedings of CHI'99 Human Factors in Computing systems, pp. 310-317. Addison Wesley.

WWW-based Tools to Manage Teaching Units in the PLAN-G Distance Learning Platform

Clara Inés Peña de Carrillo
Ramón Fabregat Gesa
José Luis Marzo Lázaro
BCDS-DEIA
University of Girona
Building PII, Avinguda de Luis Santaló, S/N, 17071
Gerona, Spain
{clarenes,ramon,marzo}@eia.udg.es

Abstract: This paper describes a set of tools to assist teachers to support open and distance learning by means of the PLAN-G[1] hypermedia system, developed at the University of Girona with the aid of computer networks and, in particular, WWW technology. The web-based tools permit the creation and edition of didactic material, the transfer, organization and management of document contents files, the generation and management of different types of interactive exercises associated with a teaching unit, and the creation and management of a teaching unit. The current PLAN-G prototype has been successfully used on courses in different educational fields.

Introduction

At present, the PLAN-G is a hypermedia system that allows access to learning material in a static way (Marzo, 1998a, 1998b). We are currently working to include adaptivity in it for a specific student based on the knowledge of a student model (Peña, 1999). The teacher builds a linear navigational path by defining a directed graph (structure), using the contents stored in HTML page files (teaching contents), and linking them according to curriculum organization criteria. To make creation easy and to manage the teaching domain, we developed some useful web-based teaching contents authoring and managing tools (Fabregat, 1999) such as the contents generator JVS, the exercise generator, the contents organizer, publisher and searcher, and the teaching units editor. This set of applications is included in the PLAN-G platform environment. The PLAN-G system was designed as a learning platform, in which the teacher supplies the course contents and the students can navigate through them. Each course is called a "teaching unit" and is made up of a group of HTML page files structured by a directed graph. By means of the administration options of the graph, it is possible to create, modify and delete "teaching units", so giving the possibility of changing navigation destinations or defining linear paths. The navigational structure is managed independently of the contents and is stored in a database. Only the user type "teacher" has the power to adjust the structure and unit contents, as required. Basically, the PLAN-G works around three concepts: users, teaching units and a performance level defined by certain languages (the platform is multilingual). The system gives a configuration and a group of sessions and visits (static and dynamic data) to each user. Each node of the teaching unit graph has an associated group of basic exercises or bibliography and a selected language to fix the contents.

PLAN-G Teaching Units Management

The PLAN-G architecture, as a hypermedia system, has general components of generic intelligent tutoring systems. It has a hypermedia component represented by an interface, a navigation control area (buttons) and a navigation space. The tutor's component adds intelligent behaviour to the system based on the pedagogic organization of the

[1] This research was supported by the CICYTTEL98-0408-C02-01 project: "Study and Implementation of a New Generation Telematics Platform to Support Open and Distance Learning"

domain of learning and the student's preferences and activities. The *JVS Contents Generator Editor*, enables the teacher to create didactic material without having to write a line of code and with use of only the mouse buttons or input of some data through the keyboard. With JVS, each didactic content is made by a photogram sequencc or some screen displays related to each other, which should include texts, lines, arrows, squares, circles or images to create an interactive teaching content with graphic effects and animations. By creating interactive graphics, the teacher or the student can perform multiple activities from the interactive exposure of an image. To generate the exercise domain associated with teaching concepts, the *Exercises Generator* was developed as a user friendly tool that enables interactive closed-answer exercises such as multiple choice, gap-filling, associations drag & drop, selecting the correct answer, etc. to be created and managed. The exercise domain can be managed either by the teacher or by the platform administrator who can create, import, export or modify any exercise, create an HTML page with a particular execution exercise independently of the PLAN-G, move exercise parts from one exercise to another, ask for statistics of results, pre-watch the exercise and include multimedia files to complete the exercise. The exercise generator also acts in the navigation module of the PLAN-G structure by collecting, analyzing and evaluating the student's activities over the proposed training or evaluation material, and storing this knowledge in the database. Once the teacher has defined and created the didactic material, it is ready to be managed (organized, classified and published) in the server. The teacher must use the *Documentation Manager* tool to fix the files in the server if he/she has used any standard HTML editor to make the didactic material, because, the files made using the JVS tool are organized directly in the server by the tool itself. All the essential information for the documentation manager like, file owners, folders and filenames, folder locations, HTML and reference document words, is stored in the PLAN-G relational database; in consequence, any action over any document file that will be used to build a teaching unit will be updated in the database in order to ensure data integrity. The documentation manager also allows users to publish HTML documents on the network without specialist knowledge and to define easy search spaces over them, without any maintenance tasks or software installation. By means of a web-browser, the user may utilize the documentation manager tool to interchange files, to classify them and to design query forms for different document ambits; this tool is useful when the user decides to publish a large volume of documents and a rapid search through their contents is needed. Once the didactic material exists in the server in its corresponding directory path, the teacher should proceed to create the teaching unit by means of the *Teaching Units Editor* that enables the structure of the learning domain (hyperspace or traversing structure) to be created, defined and managed. Currently, PLAN-G just allows navigation on static way, and so the teacher can only create a directed graph over the learning domain. However there are some projects under way on using a multi-agent system to improve PLAN-G adaptivity by means of the information stored in user models.

References

Fabregat, R. & Marzo, J.L & Peña, C.I. (1999). PLANG: Plataforma Telemática para la Enseñanza Abierta y a Distancia Utilizando el Web como Soporte. Revista Española de Enseñanza y Tecnología, Asociación para el Desarrollo de la Informática Educativa, Spain.

Marzo, J.L. & Verdú-Carbó, T. & Fabregat-Gesa, R. (1998a). User Identification and Tracking into an Educational Web Environment. ED-MEDIA & ED-TELECOM, 1998, World Conference on Educational Multimedia and Hypermedia and World Conference on Educational Telecommunications, Freiburg, Germany.

Marzo, J.L. & Estebanell, M. & Fabregat, R. & Ferrés, F. & Verdú, T. (1998b). Support Units for University Teaching Based on WWW. ED-MEDIA & ED-TELECOM, 1998, World Conference on Educational Multimedia and Hypermedia and World Conference on Educational Telecommunications, Freiburg, Germany.

Peña, C.I. & Marzo, J.L. (1999). Intelligent Agent Approach to Guide the Web Navigation on the PLAN-G Distance Learning Platform. IEE Colloquium November 99: "Lost in the WEB Navigation on the Internet", IEE Informatics, London, 8/1-8/12.

Evaluation of Web-Based Distributed Collaborative Learning Community Based on Knowledge Building of College Students

Chi-Cheng Chang
Department of Educational Technology
Tamkang University
Tamsui, Taipei, Taiwan
samchang@mail.tku.edu.tw

Abstract: A web-based distributed collaborative learning community based on knowledge building for academic growth of college students was implemented and evaluated. The evaluation results indicate that it provides college students with effective telecommunication and collaboration tools, and students' responses toward the WBDLC have been very positive and encouraging.

Learning Environment of WBDLC

Students may actively learn through participating in knowledge building and collaborative-based activities as a member of an online group (Brandon & Hollingshead, 1999). An evaluation by Scardamalia & Bereiter (1994) of the CSILE (Computer-Supported Intentional Learning Environment) project clamed that collaborative learning community formed by students facilitated knowledge building and generated positive learning outcomes with the use of telecommunication technologies.

Through the use of telecommunication technologies of the Web-Based Distributed Learning Community of Academic Growth (WBDLC, http://etwblc.et.tku.edu.tw), it is intended to transform traditional classroom learning to better enable college students to engage the virtual and social practice of learning. The WBDLC consists of various functional elements and interactive types of telecommunication tools, thus users may learn the content relating to the course and social interaction with peer at the same time. These include: asynchronous discussion board, online synchronous chat room, real-time call on line, desktop video teleconferencing, access to the learning resources on the Web, links to the relative Web sites, online multimedia materials, files for upload and download, e-mail listserv, online learning portfolio, and asynchronous advice through field experts.

Evaluation Results of WBDLC

User Evaluation

Resulting from the survey of students' satisfaction showed that in general, they rated their learning experiences in the web-based learning environment consistently higher than those in the instruction of traditional classrooms. Students indicated that they learned more, the class was more interesting, they were more motivated, and that they were more activate to learn. They also reported that they had a greater opportunity to be heard by the teachers, they heard more from their peers, and that they gained more help from and interaction with their classmates. As far as the students' feedback on the satisfactions for the content, interface, and functions of WBDLC system reported that the system interface is easily accessible and usable to users. Comments from students showed that they liked having hands-on experiences with the web, they felt comfortable with the telecommunication capabilities provided by the WBDLC system, and that they would be willing to participate the learning activities of similar system to the WBDLC. The in-deep interviews of small-group were also conducted by group sampling based on students' performances on WBDLC. The student feedback from the small-group interviews formed by several deeper questions provided some insight into what needs to be taken into consideration when using the WBDLC. Interviewing comments from students also provided more deep insight into the advantages and disadvantages in the functions, uses and effectiveness of WBDLC system.

Although the majority of students offered a very positive response in the survey and small-group interviews on the functions and uses of WBDLC, the majority also offered anticipated disadvantages including not enough time to participate the web-based activities and insufficient feedback of field experts. The majority of the students indicated that knowledge building through the sharing of student work and idea was a great activity and was helpful to their learning outcomes. On-line activities like hands-on learning, resources hyperlink, synchronous chat, and asynchronous group discussion were common preference for the majority of the students. Moreover, students liked getting access to resources such as websites relevant to course and learning materials, to information such as course information and teacher notes, and to knowledge such as posting and replying ideas from peer in the Discussion Board.

Expert Evaluation

The teachers reported that additional time is required to prepare learning activity and make teaching materials on the web, however it is well worth the effort doing that in terms of greater learning efficiency and make themselves growth on teaching experiences. Moreover teachers also encountered obstacles in developing web-based collaborative learning activities for online groups due to the lack of support of providing teaching resources, experience of using telecommunication technologies, and familiarity with preparing and managing online activities on a web environment. It reveals that online teaching assistants are needed for web-based learning to help teachers doing relevant teaching activity and making decision on web. Our key insight to the evaluation results of the WBDLC system is the verification of its design, creation and use experiences.

Conclusions and Future Work

We work continuously with teachers and students at the Tamkang University to develop new curricular as well as more proper teaching approaches and strategies that use project-based and problem-oriented learning activities. The critical challenges the WBDLC will face in the future are not simply technological uses, but also the challenges of social interaction, knowledge share, and creating online communities of learners. The WBDLC can be a base to inform educators and policy makers on the effective and sustainable application of social, distributed, and collaborative virtual community on Internet for college education.

References

Brandon, D. & Hollingsheda, A. (1999). Collaborative learning and computer-supported groups. *Communication Education, 48*(4), 109-126.

Scardamalia, M. & Bereiter, C. (1994). Computer support for knowledge-building communities. *Journal of the Learning Sciences, 3*(3), 219-225.

Assessing the Effects of Web-Based Interactive Learning Environment Based on Virtual Reality Simulation for Constructive Learning

Chi-Cheng Chang
Department of Educational Technology, Tamkang University
Tamsui, Taipei, Taiwan
samchang@mail.tku.edu.tw

ABSTRACT

Abstract: A VR-based interactive and simulated environment on web for constructive learning slide projector operation has been evaluated. The evaluation results report that this learning material has positive effects on students' learning outcomes. Finally some indication of further researches to be done will be given based on using the material developed in this study.

Learning Environment of WebVR

With the multimedia capacity such as 3D graphics and animation, Virtual Reality technology could dynamically simulate the manipulating processes of psychomotor skills for the goals of immersive learning and situated learning (Youngblut, 1997). Students could then manipulate the VR-based system dynamically and learn by their own hands-on experiences how slides are produced and a slide projector is operated that is impossible to observe in real situation (Moore, 1995). The types of activities supported by VR capability facilitate current educational application that students are better able to acquire, master, retain, transfer, and generalized new knowledge whenever they are actively engaged constructing their knowledge in a learning-by-doing situation (Youngblut, 1997).

In the VR-based learning world of operating slide projector on the Web (WebVR), students can easily move around within and freely navigate through the virtual worlds and do all kinds of actions, such as freely manipulating virtual objects in any degrees of freedom. Additional, students immersively existing in the 3D environment of WebVR may experience several degrees of freedom, including full freedom in navigation, the access to information through multiple interactions, and the capability to figure their own learning process.

Evaluation Methodologies and Results of WebVR

User-Based Evaluation

The survey was involved 35 undergraduate students in Teacher Preparation Program and undertaken by sending the post-course questionnaires to them. We evaluated the quality of the WebVR through doing qualitative study for mainly examining the functions, interface, content, and learning experiences by means of questionnaires that embrace specific questions. The results from the survey of students' feedback on the satisfactions for the WebVR reported that the system interface is easily accessible and usable to users. They also indicated that there are many learning materials that can be delivered more effectively by video and audio media that are not provided in the WebVR materials. Students reported that they liked having hands-on experiences with the virtual worlds, and they felt comfortable with the simulated capabilities provided by the WebVR material. The results from the survey of students' perceptions on their learning experiences showed that in general, they rated their learning experiences in the simulated VR-based learning environment consistently higher than those in the instructions of traditional classrooms. Students indicated that they learned more, the materials was more interesting, they were more motivated, and that they were more activate to learn. They also reported that they had a greater opportunity to be heard by the teachers, they heard more from their peers, and that they gained more help from and interaction with their peers.

Although the majority of students offered a very positive response in the survey on the functionality and usability of WebVR material, the majority also offered anticipated disadvantages. These disadvantages contained: not enough time to participate the web-based VR activities, low speed of system, insufficient realism of scene in the virtual worlds, and insufficient feedback of the materials, teacher and peers.

Expert-Based Evaluation

Three experts involved in the expert-based evaluation. The three experts consisted of a teacher as a subject matter expert in slide production, a field expert in web-based VR, and a field expert in computer-aided instruction and web-based learning. A teacher experienced slides production instructor who has been teaching "instruction media" for 3 years was invited to examine the correctness, appropriateness, and consistence of the learning content and objects. A field expert in VR experienced the design and development of web-based VR system was invited to check the functionality, usability, and interface of the

WebVR. A field expert in computer-aided instruction and web-based learning experienced the design and development of CAI and WBL was invited to provide opinions on the VR-based instructional design and learning strategies used in the WebVR.

Conclusions and Summary

Based upon the evaluation results of WebVR, it is a helpful tool both for students and teachers in the learning process. This is concerned about the experiences students gained from the free navigation and high interaction afforded to them, and from the exploration of basic skills of operating slide projector. As we have emphasized, WebVR is a learning tool that allows students to manipulate objects, navigate through the virtual worlds, and can stimulate them to construct their own knowledge.

References

Moore, P. (1995). Learning and teaching in virtual worlds: Implications of virtual reality for education. *Australian Journal of Educational Technology, 11*(2), 91-102.

Traub, D. (1994). The promise of virtual reality for learning. In Loeffler, C. & Anderson, T. (Eds.) *The Virtual Reality Casebook.* New York: Van Nostrand Reinhold.

Youngblut, C. (1997). Educational uses of virtual reality technology. *VR in the Schools, 3*(1). Available on http://eastnet.educ.ecu.edu/vr/vrits/3-1young.htm

Multimedia Application to Motor Skill Learning

Li-li Chu
Center for Teacher Education,
National College of Physical Education and Sports, Taiwan
E-mail: llc0120@ms1.hinet.net

Wu-chou Chen
Institute of Sport Science
National College of Physical Education and Sports, Taiwan
E-mail: mars@mail.ncpes.edu.tw

Abstract: This article discussed the application of multimedia system to motor skills learning. First the authors reviewed motor learning theories. Then the development of application of information technology in physical education and sport learning in Taiwan was introduced. A specific study regarding the effect of multimedia computer-assisted learning in short service of badminton with forehand was described. According to the result, it is necessary that more efforts on design and development of the contents of multimedia that sufficiently represent the connection between cognition and skill performance on motor learning.

Introduction

Traditionally, motor skills learning proceeds the steps that include the learner observes, imitates the coach's modeling, refines his motor skills, and repeatedly practices. Diffusion of sports was limited by the lack of enough coaches, relative knowledge, and experiences. Information technology breaks through the obstacles of time and space, expands the approaches of learning, contribute to almost every part in contemporary human life and civilization. Therein, multimedia computer system condensing the necessary, versatile information on CD-ROM makes the diffusion of sports rapid, cheap, and efficient possibly. Motor skills learning, as a part of human life, was overlooked for a long period in my country, Taiwan. Therefore, trying to apply multimedia system to motor skills learning is being invoked because of the popularization of information technology.

Motor Learning Theories

Fitts and Posner (1967) have provided a model of motor learning that includes verbal-cognitive stage, associative stage, and autonomous stage. Jack Adams (1971) offered the verbal-motor and autonomous two-stage model. Schmidt (1975, 1982) proposed the schema theory of motor skill learning and emphasized learners to get sensory information before executing movement. Moreover, borrowed from Bandura's observation learning theory (1977), a notion was provided that the best situation for motor learning is to offer an appropriate model simulation (Iuppa 1984). In sum, observation of accurate motion demonstration and understanding cognitive activities behind motor skill performance will be helpful on learning motor skills. Many studies have showed that the cognitive effects of multimedia computer-assisted instruction are significant. Therefore, it is desirable that application of the features of multifunction and consistency of multimedia provide accurate modeling to help the sport learner acquire cognition and build up correct actions.

Research Tryout

The institute, which the authors belong to, has set up a particular section at graduate level to implement the information technology application in physical education and sport learning. Some projects involving in fitness, nutrition, health, and teaching in P. E. are in process. The following will introduce a study which researchers developed a multimedia prototype on short serve of badminton and conducted an experimental research with this prototype to explore whether the multimedia material is a helpful tool.

Subjects participating in this study were 111 sixth-graders from three classes in an elementary school. Each one of three classes received a specific one of three teaching methods: multimedia computer-assisted learning (MCAL), multimedia computer-assisted instruction (MCAI), and traditional instruction (TI.)

The whole teaching procedure included three sessions. In each session divided into three segments. During the second and the third segments, subjects received the same kind of activities in separate class at gymnasium. The first segment taking about five minutes was the three different treatments for respective groups. According to the results showed on the *cognitive test*, providing accurate video demonstration plus teacher's explanation and demonstration had significantly better effect than those of traditional instruction. The results indicated that presentation of image, video, sound, and related text explanation (MCAL group) indeed generated more efficient cognitive learning. Adding a human teacher's interpretation (MCAI group) could yield better learning. *Performance test* evaluated the students' posture, standard, pace, coordination, and stability while they performed. The results of analysis of variance on the performance test revealed the MCAI group had significantly better performance than that of the TI group. Result of analysis of variance on *skill test* failed to yield main effect. The result had the same finding as Ross (1994) did. But, it is different from Stiffen and Hansen's (1987) research finding that showed the CAI group had better skill test scores than those of the traditional instruction group. Because motor ability and practice affect sport skill learning, the reason of no difference might be that short serve of badminton is not so complicated to need more strength and endurance. Therefore, we suggest the continued research on other type of sports, time arrangement of practice, or different age learners to explore the appropriate explanation.

Conclusion

Motor skill learning has its own features that emphasize physical execution and practice. Furthermore, motor skill learning involves different response types that are either open or closed and either rapid or slow (Poulton, 1957). In other words, different sport type probably needs very different motor skills to perform. To a specific sport type, from the sensory stimuli, perception, memory, to movement, it could have its own particular cognitive process. From the study of short serve of badminton we can only assure the effect of multimedia application on cognitive learning of motor skill. However, mental training and mental rehearsal have showed effects in sport psychological research recently. Apparently, we need to make more efforts on design and development of the contents of multimedia that sufficiently represent the connection between cognition and skill performance on motor learning.

References

Adams, J.A. (1971). A closed-loop theory of motor learning. *Journal of Motor Behavior, 3*, 111-149.

Bandura, A. (1977). *Social Learning Theory.* Englewood Cliffs, NJ: Prentice-Hall.

Fitts, P.M. & Posner, M.J. (1967). *Human Performance.* Berlnont, CA: Brooks/Cole.

Iuppa, N.V. (1984). *A practical Guide to Interactive Video Design.* White Plains, N. Y.: Knowledge Industry Publications.

Poulton, E. C. (1957). On prediction in skilled movements. *Psychological Bulletin, 54*, 467-473.

Ross, J.R. (1994). A comparison of direct instruction and computer-assisted instruction on learning a motor skill by fourth grade students. Microfilm Publication, International Institute for Sport and Human Performance, University of Oregon, Eugene.

Schmidt, R.A. (1975). A schema theory of discrete motor skill learning. *Psychological Review, 82(4)*, 225-260.

Schmidt, R.A. (1982). Feedback and Knowledge of Results. *Motor Control and Learning, 13*, 527-523.

Stiffen, J., & Hansen, G. (1987). Effect of computer-assisted instruction on development of cognitive and psychomotor learning in bowling. *Journal of Teaching in Physical Education, 6*, 183-188.

Instructional Technology in the Classroom: New Directions for Foreign Language Faculty

Jessamine Cooke-Plagwitz
Mimms Foreign Language Learning Center
University of South Carolina
Columbia, SC 29208
jplagwitz@sc.edu

Abstract: This short paper is a report on efforts at the University of South Carolina to encourage and train foreign language faculty to be literate and enthusiastic in the area of instructional technology. The creation of a new position for the Academic Director of the Foreign Language Learning Center illustrates the school's belief in the importance of instructional technology and its dedication to ensuring that faculty in all of its departments be given the opportunity to incorporate it into their curricula.

Introduction

An increasingly "wired" learning environment compels faculty in foreign languages to learn and use a variety of new technologies. To that end, the University of South Carolina has created a new role for the Academic Director of its Foreign Language Learning Center. The position bundles administrative duties (including the daily operations of the Center) with teaching foreign language (in this case, German), and directing faculty development in the area of instructional technology.

Faculty Development Opportunities

According to the Department of Education's 1993 paper, "Using Technology to Support Education Reform", the challenges faced by today's faculty include:

- Learning to use a variety of technology applications;
- Using, adapting, and designing technology-enhanced curricula to meet students (sic) needs;
- Expanding content knowledge;
- Taking on new roles; and
- Responding to individual students.
  (Means, 1993, http://www.ed.gov/pubs/EdReformStudies/TechReforms/chap4c.html)

Furthermore, Kassen and Higgins (1997) include the following necessities in their list of requirements for faculty development programs:

- Establishing a comfort level with technology;
- Integrating technology into the curriculum;
- Developing the critical skills to use technology effectively. (p.264)

One key aspect of the new directorship entails creating and overseeing a Faculty Development Center for foreign-language faculty interested in increasing their employment of instructional technology. The Center provides an area where faculty can develop multimedia courseware, design and maintain Web pages, work with audio and video materials, and experiment with instructional technology in a non-threatening environment.

The Workshop Series

Included in the faculty development package is a series of instructional technology workshops designed specifically with foreign-language faculty in mind. Some of the topics covered in the workshop series include: using Microsoft PowerPoint in the language classroom (especially as it applies to distance learning), hypermedia in foreign language instruction, the hyper-syllabus and online course delivery, creation of CD-ROMs, courseware authoring and authoring software, and orientations to commercially available language-learning software packages.

Workshop participants are asked to arrive with a didactic project in mind that they can complete during the course of the meeting. Most workshops are two hours in length, with the first half consisting primarily of hands-on instruction, and the second half being set aside for participants to work on their own, ask questions, and get better acquainted with the application being covered.

At present, the workshop schedule is such that one workshop is offered each month. I anticipate, however, an increase in the frequency of workshops as demand has been steadily increasing.

Evaluation

Any new undertaking must be evaluated in order to ascertain whether it represents an improvement over past conditions. Thus, at the close of each workshop, participants are asked to fill out a short questionnaire. The results are compiled and will be presented as part of the Language Center's annual report, as well as becoming part of the Director's own research on faculty development. An additional aspect of this training is determining if the material covered is actually learned, and, in the case of faculty development, subsequently utilized by instructors in their classrooms. In order to measure these criteria, a second set of questionnaires will be distributed to workshop participants at the end of the semester following their workshop attendance, with the ultimate goal of establishing whether the workshops have encouraged increased use of technology in the foreign-language classroom.

As the workshop series has only been ongoing for one semester, questionnaire B has not yet been distributed to foreign language faculty. Initial results of questionnaire A are promising, however, and workshop attendance has progressively increased throughout the course of the semester.

Conclusion

Foreign-language faculty must be given the opportunity to develop their teaching skills in a non-threatening environment where support is available if it is necessary, and where creativity is encouraged and appreciated. A program like that currently in place at the University of South Carolina removes some of the unknowns that prevent many instructors from introducing technology into their courses by letting them take the technology for a "test drive" ahead of time. Ultimately, I hope that all foreign language faculty at the University of South Carolina will feel comfortable enough with instructional technology to make it a part of their courses. In the meantime, it is encouraging to see language professors attending the workshops, working in the faculty development center, and taking an interest in what they can do with technology in the classroom, as well as what technology in the classroom can do for them.

References

Higgens, Christopher J., & Kassen, Margaret. (1997). Meeting the Technology Challenge: Introducing Teachers to Language-Learning Technology. In Michael D. Bush, & Robert M. Terry (Eds.), *Technology-Enhanced Language Learning* (pp.263-285). Lincolnwood: National Textbook Company.

Means, Barbara, et al. (1993). Using Technology to Support Education Reform. In *U.S. Department of Education Publications and Products*. (http://www.ed.gov/pubs/index.html). Washington, DC: U.S. Department of Education.

Remote Controlled Teaching Experiments, in Science and Engineering Subjects, Accessible over the World-Wide-Web: the PEARL project

M. Cooper
Institute of Educational Technology / Knowledge Media Institute
Open University
Milton Keynes, UK
m.cooper@open.ac.uk

Abstract: This paper introduces a major European collaborative project, PEARL, that is developing a system to enable "real world" teaching experiments to be undertaken by students working collaboratively over the Internet. The paper outlines issues in university level education that led to the project's definition, summarizes its pedagogic foundations, and highlights the emphasis on making the science and engineering curricular accessible for students with disabilities.

Introduction to the PEARL project

The PEARL (Practical Experimentation by Accessible Remote Learning) is researching and developing a system to enable students to conduct real-world experiments as an extension of computer based learning (CBL) and distance learning systems. The objectives being to give high quality learning experiences in science and engineering education by bringing the teaching lab to the students; offering flexibility in terms of time, location and special needs. This will extend Internet course delivery to accommodate collaborative working in practical experimentation. The project is developing a modular system for flexibly creating diverse remotely controlled experiments, integrating this with a collaborative working environment and accessible user interfaces. The project will research the pedagogic impact of this approach, validating its developments in different educational contexts and subject areas. These include: foundation level physical sciences (as part of an open & distance learning introductory course); cell biology (as part of a final year undergraduate course); manufacturing engineering (post-graduate training) and digital electronics (as part of undergraduate courses in design and testing).

Educational Issues

Experimental work is a vital part of science and engineering teaching at all levels. There is an increasing trend to use multimedia science education packages and "virtual science" in both school and university level education. These approaches have great value and if done well, however they generally focus on the teaching of science facts and principles and not the teaching of the *process* of scientific enquiry or engineering practice. A key objective in PEARL is to create a (CBL) facility for learning science and engineering as a process.

Access to experimental work in distance education has traditionally been achieved by including simple home experiment kits or intensive residential schools as part of the course. The project is seeking to facilitate a wider participation in experimental work in distance learning courses and to make this available throughout the course. For campus based universities, the expansion of student numbers has put increasing strain on facilities and has made it difficult to provide adequate access to teaching laboratories. By making these facilities remotely accessible they, can be offered to students at different times and with less space demands on the teaching laboratory.

Increasingly there are demands on universities to teach their students the use of complex technical equipment. This pressure comes both from the need to introduce the students to state of the art practices in their subject and to fulfil the expectations of future employers or industrial purchasers of university education. By providing remote access to experimental work involving expensive and sometimes safety critical equipment, the widespread use of such equipment by undergraduates and industrial clients becomes feasible. Further it becomes possible to share the use of key teaching facilities with other universities with inherent economies of scale.

The distinction between distance learning and traditional university learning is blurring with the rapid increase in Internet course delivery. However there is widespread concern about the quality of the educational experience offered in some current Internet based courses. The PEARL system supports high quality science and engineering courses by enabling practical work to be integrated with other Web/multimedia based teaching material.

Pedagogic Foundations

Much educational research has shown that a key factor in the pedagogic advantagc of practical work is that it is normally undertaken by pairs or groups of students. This facilitates the development of the students' ideas in conversation with their peers (Scanlon, et. al. 1993). The practical work provides the focus for peer-to-peer interchange normally supported by the tutor. Important motivational gains for collaborative working have also been frequently demonstrated (e.g. Issroff 1993). Hence it is vital that the PEARL system facilitates such collaborative working at a distance.

Contemporary accounts of student learning accept that it is an active process and depends on interaction. Laurillard (see Laurillard 1993) offers a model of student / tutor / courseware interaction. She considers the learning process as a kind of conversation, and asserts that this process 'must be constituted as a dialogue between teacher and student (or student and student), operating at the level of description of actions in the world'. She classifies the types of interaction between instructor and student as being discursive, adaptive, interactive or reflective. In the PEARL system the teacher can implement a wide range of leaning modes. It facilitates the exchange and discussion of knowledge; reflection (by student and tutor); interaction at the level of the real world experiments; construction of and subsequent adaptation the experiments, by either the student or the tutor. There is thus a multiplicity of "conversations" envisaged in a PEARL practical session through which the learning objectives are achieved.

Science learning should also be an introduction to a community of practice (Lave and Wegner 1991), and this means that science learners need to be involved in the type of activities that real scientists perform. Therefore, all students need to experience practical work and all students need to experience collaborative working mediated by information and communications technologies, as these are the contemporary experiences of working scientists.

Access for Students with Disabilities

The PEARL project also seeks to make experimental work in science and engineering accessible to students with a wide range of disabilities. Indeed the project was originally conceived in to achieve this. Disabled students are grossly underrepresented in the science and engineering subjects at higher education. The reasons for this are complex, however access to experimental work is often cited as a key barrier. Much work has been done over the past 20 years to make computers accessible to people with all kinds of disabilities and a high degree of success has been achieved. Hence the tactic for the PEARL project is to firstly to make practical work computer controlled and then to ensure that the software and interface design follow well-established design for accessibility principles and that they are compatible with the available access technologies.

Acknowledgments

The PEARL project is funded by the European Commission's Information Society Technologies program (Project reference IST-1999-12550). Partners in the project with the Open University are University of Dundee, Trinity College - Dublin, Faculty of Engineering at the University of Porto and Zenon SA - Athens.

References

Scanlon, E., O'Shea, T., Smith, R. and Taylor, J. (1993) Running in the rain: can a shared simulation help to decide? *Physics Education*, March

Issroff, K. (1993) Motivation and computer assisted learning in different learning situations, *Proceedings of Artificial Intelligence in Education*, University of Education, Scotland, AACE

Laurillard, D. (1993) Rethinking university teaching, Routledge, London

Lave, J. and Wegner, E. (1991) Situated learning: legitimate peripheral participation Cambridge, UK: Cambridge University Press

SOS (SUBJECT ONLINE SURVEY) : AN ONLINE TOOL TO SUPPORT IMPROVEMENT IN TEACHING AND LEARNING.

Robert M. Corderoy[1], Ray Stace[1], Sandra Wills[1] and Albert Ip[2]
[1]Centre for Educational Development and Interactive Resources.University of Wollongong. Australia.
bob_corderoy@uow.edu.au, ray_stace@uow.edu.au, sandra_wills@uow.edu.au
[2]Multimedia Education Unit.University of Melbourne. Australia
a.ip@meu.unimelb.edu.au

ABSTRACT: Traditionally, data relating to the conduct of subjects at the University of Wollongong has been collected for teachers with one main purpose in mind: to provide the teacher with supporting information as to their teaching ability for the purposes of promotion.

SOS is a web based system which teachers can use to author customised surveys to collect information about the subject they teach. These surveys are completed anonymously by the students via the web (using randomly generated, survey specific numeric tokens) and the data is automatically collated and returned to the teacher. The teacher may also produce the surveys in hard copy, for manual distribution and collation.

The system provides a 'non-threatening' and 'informal' mechanism by which teachers can obtain useful information about the subjects they develop and teach in terms of subject based criteria rather than the 'teacher based criteria' of formal Teaching Surveys. In this time of declining University budgets, SOS provides a very cost efficient solution to the collection of this data.

This paper provides a background to the development of SOS in the context of the needs of the University of Wollongong and its teachers. It briefly outlines the main features of the system, new features being added to Version 2 and reports on the outcomes for the early adopters.

BACKGROUND

In 1998, the Director of CEDIR, Associate Professor Sandra Wills, secured funding to conduct research on the development of an 'informal' online survey system. The goal of this system was to provide teachers with personal formative data on the success of their subjects from a student's perception, allowing them to improve teaching and learning outcomes for students without the need to resort to numerous and expensive formal Teaching Surveys. The research working party examined the online methods used to conduct teaching surveys by 15 Australian universities including the Subject Evaluation kit developed by the Griffith Institute for Higher Education (GIHE) at Griffith University [1]. In summary the findings included:

- most existing web-sites were highly University specific
- none were using the web exclusively to distribute and collate the data
- most surveys seemed to consist of set questions plus some optional ones selected from item banks.

From this research the working party made several recommendations which later formed the basis of the development specifications for Subject OnLine Survey (SOS). These included:

- the tool should be totally web based and should require minimum web skills to operate it;
- there should be an item bank of 'standard questions' and the ability to author individual questions;
- there should be a variety of questions types available such as Likert scale, True and False, Yes and No
- there would need to be a concurrent staff development program

During the research phase, a generic evaluation tool LEO [2] or Learning Evaluation Online, which is a template based in the as OXYGEN (Object eXtensible analYsis and Generation of Education coNtent) software engine developed by Albert Ip [3] was identified as a possible engine and later implemented.

SUBJECT ONLINE SURVEY (SOS)

SOS is a web based system which provides a simple and intuitive interface through which teachers can construct and author customised surveys designed to collect information about the success or otherwise of the subjects and/or subject components that they provide for their students. These surveys and the returned data are password secure and student access is anonymous, survey specific and controlled via 'tokens'. The data is auto-collated and is made available through a data collection site and/or via automatic email posting.

DEVELOPING A QUESTION DATABASE

The Teaching Survey database previously in use within the university contained many hundreds of questions which were either directly suited or with modification could be used successfully. Many additional questions have been added to take account of a wider range of delivery options than the traditional lectures, tutorials, and laboratories including flexible and online delivery.

EVALUATION

Version 1 of the system was made available to three faculties within the university: Engineering, Commerce and Public Health. Over a period of approximately 6 months a total of almost 1000 students were surveyed using SOS In 2000, the University has launched two new remote centres at which two full degree programs are being offered flexibly including online. SOS will be used as part of the evaluation strategy for this initiative.

Much of the evaluative data collected so far is in the form of comments and suggestions from users. The most common responses include

- the simplicity of the authoring interface and low level of computer skills needed to operate it;
- the ease and speed of survey and the quick turn around compared to paper based surveys;
- the ease of customisation for a variety of different student groups and needs.

Teachers using the system to date have identified the following possible weaknesses of the current version:

- the 'set' 7 point Likert scale, possibility of others being available;
- no mechanism for students to see aggregated results, and;
- the need to manually modify the data collected before exporting to a spreadsheet.

FUTURE DIRECTIONS

User feedback over the trial 6 moths period has given us direction in further development into version two, greatly expanding the applicability of the system to all campus teaching and learning. Some of these include:

- The existing databases will be greatly expanded to incorporate all questions currently in use at UOW.
- Question categories will be expanded and current question categorisation will be re-assessed.
- Sets of faculty based "Standard Surveys" will be built up and provided at the top level of authoring.
- In the longer term, normative data on each question in the database will be collected, collated and analysed.
- Preliminary data analysis by teachers will be supported by a down loadable Excel macro which will have built-in frequency counts, bar chart generation and cross-tabulation.
- Finally, the program of staff training needs to be extended to include developing an understanding of the *application* of the survey results to teaching.

REFERENCES

[1] Armstrong, J. & Conrad, L. (1995) "Subject Evaluation: A resource book for improving learning and teaching". Griffith Institute for Higher Education - Griffith University. 2nd Edition.

[2] Ip, A. & Kennedy, D. M. (1999) "A Meta-analysis of Learning Evaluation Online: LEO's Useability, Adoption and Patterns of Use". Proceedings of ED-MEDIA 99.- World Conference on Educational Multimedia, Hypermedia and Telecommunications. (Eds), Collis, B and Oliver, R. Seattle, Washington. USA.

[3] Ip, A. (1988) "Authoring Educational Courseware Using OXYGEN". Proceedings of WebNet 98 -World Conference of the WWW, Internet & Intranet. (Eds), Maurer, H. & Olsen, R. G. Orlando.

Learning Object Containers:
A suggested method of transporting metadata with a learning object

Duane Currie, AITT, Acadia University, Canada, duane.currie@acadiau.ca

Craig Place, AITT, Acadia University, Canada, craig.place@acadiau.ca

Abstract: Learning Objects have the potential to revolutionize the delivery of technology enhanced courses. To realize this potential, standards for the production and transmission of learning objects must be developed and adopted. The IEEE and IMS have made a large effort in producing standards for describing meta-data, but there has been little work in producing standards for reliably connecting the learning object and its related meta-data. In this paper, we will describe an enhancement of an existing standard which allows effective encapsulation of both the learning object and meta-data in a single container.

The IEEE Learning Object Meta-data Working Group[1] defines a learning object as "any entity, digital or non-digital, which can be used, re-used, or referenced during technology supported learning." For the purposes of this paper, we will limit our scope to defining a learning object as any digital entity that can be used or referenced during technology supported learning. Currently, there is much existing work, by groups such as IEEE and IMS, on developing standards for the meta-data used to describe learning objects. However, less attention has been paid to the binding between the meta-data describing the learning object and the object itself.

Without some means of reliably storing and transferring the data and meta-data as a single entity, two problems easily occur. First, if the learning object is not packaged or appropriately connected with its descriptive meta-data, it retains little information about the appropriate use of the learning object, reducing its usefulness to the educator. The second problem is that of possessing meta-data which describes and links to a learning object which either no longer exists or has moved elsewhere, making the learning object useless to the educator. Unfortunately, both problems currently exist.

Binding the two (or "Ensuring the twain shall meet")

Currently, the IMS Meta-data specification[2], based on the IEEE specification[3], describes a large amount of standardized meta-data to be used in describing a learning object. As well, they provide a proposed XML binding for this meta-data[4].

With little effort, this XML binding for learning object meta-data may be extended to include the associated data. All that is required is a few additional XML tags, and a data encoding scheme. The first tag to introduce would be a pair of tags to delimit the block(s) which contains the data files ("sub-objects"). Keeping it simple, we could use <DATA> and </DATA> tags for this purpose. This data block could adequately be placed within the record block, as described in the IMS XML bindings specification. Within this data block, specific files must be enclosed. For this purpose, additional tags may be used: <FILE name="filename"> and </FILE>.

Now, the problem of conflicts between the XML allowed character limitations, and the contents of the data arises. This is easily remedied by using a base64 encoding scheme[5] for files contained within the XML document. This format uses only characters which are valid for inclusion in XML fields.

As an illustrative example:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE RECORD SYSTEM "http://www.imsproject.org/XML/IMS-MD01.dtd">
<RECORD xmlns="http://www.imsproject.org/metadata/">
```

```
  <!—the standard IMS specified data would be here. →

  <!—now for the added data component →
  <DATA>
    <FILE name="instruction.ppt">sdkjKJSDiwnxc/sdksKDKED ... sdkKFWlkdf+dfj===</FILE>
    <FILE name="exercise.swf">dsk7dsFIS9dsaKu7 ... adskfj8xsdk39asdFH==</FILE>
  </DATA>
</RECORD>
```


Linking the meta-data and data (or "Letting the left hand know what the right hand is doing")

Allowing more powerful connection between the meta-data and data is the XLink specification[6], currently under development by the W3C. The XLink specification allows for linking between XML documents, and linking within XML documents. This allows for a more natural connection between the meta-data and data, and even allows for more powerful learning objects.

For example, in the meta-data, you may wish to identify which concepts are required in order to gain most benefit from the learning object. With the use of these XLinks, you may explicitly link to learning objects which instruct the required concepts. Also, the sub-object you use to demonstrate the concept to be learned, may be a different sub-object from that which you would use to test or exercise the student's learning of the concept. This linking specification provides a means of using other applications to describe the particular metadata element, and through the use of multiple sub-objects, provide a more complete educational experience for the learner.

Developing a solution

Currently, an application for using learning objects of this style is under development. It uses a small Java based web server as an intermediary between a web browser client and the XML files containing the learning objects. This is intended to be able to run on personal systems as well, using any web browser as the primary user interface for accessing the learning objects. More information is available at http://aitt.acadiau.ca/research/lo, and an example implementation should be available in late April for download.

References

[1] IEEE LTSC Learning Objects Metadata Working Group Home[On-line]. Available: http://ltsc.ieee.org/wg12/index.html

[2] IMS (2000). IMS Learning Resource Meta-data Information Model Version 1.0 [On-line]. Available: http://www.imsproject.org/metadata/mdinfo01.html

[3] IEEE (1999). Learning Object Metadata: Base Scheme – v3.5 [On-line]. Available: http://ltsc.ieee.org/doc/wg12/scheme.html

[4] IMS (2000). IMS Learning Resource Meta-data XML Binding Specification Version 1.0 [On-line]. Available: http://www.imsproject.org/metadata/mdbind01.html

[5] Borenstein, N., Bellcore, N. Freed (1993). MIME (Multipurpose Internet Mail Extensions) Part One: Mechanisms for Specifying and Describing the Format of Internet Message Bodies [On-line]. Available: http://www.ietf.org/rfc/rfc1521.txt

[6] W3C (2000). XML Linking Language (Xlink). W3C Working Draft 21-Feb-2000 [On-line]. Available: http://www.w3.org/TR/2000/WD-xlink-20000221

[7] W3C (1998). Extensible Markup Language (XML) 1.0 [On-line]. Available: http://www.w3.org/TR/1998/REC-xml-19980210

Preparing our Teachers for Distance Education

Christina Dehler and Christina De Simone
Centre for the Study of Learning and Performance
Department of Education, Concordia University
Montreal, QC Canada H3G 1M8
cdehler@education.concordia.ca
cds@alcor.concordia.ca

Introduction

Much of the focus in the distance education (DE) literature centers around the learner and learning, almost to the exclusion of the teacher and teaching. Consequently, instructors of DE courses have been left suspended in virtual space. This paper focuses on the teachers' position in the DE course context, especially with respect to the type of training they receive. An example of an alternate mode of teacher preparation is presented and suggestions for further improvement in DE teacher training are discussed.

The Challenge of Providing Adequate DE Preparation

The majority of faculty have little knowledge about what DE is, what it entails, and how it is successfully taught (Moore & Kearsley, 1996). Yet instructors receive little or no training prior to being assigned a DE course (Dooley, 1995; Gehlauf, Shatz & Frye, 1991) which leads to teachers being under-prepared, frustrated, isolated, and disillusioned. Teaching at a distance requires methods of instructional delivery that are different from the strategies and approaches commonly used in a traditional classroom setting (Northrup 1998, Moore & Kearsley, 1996) because the structure of the teaching is changed. Rather than being the typical source of information, the instructor assumes the role of facilitator, monitor and peer collaborator, engaged in creating discourse with students (Shedletsky, 1997). DE teachers must be willing and able to develop new methodologies of teaching that re-distribute power, roles, and responsibility within the learning community. Therefore, to ensure the success of learning activities carried out at a distance, DE faculty must not only develop the necessary competencies to do their work but must also develop a clear understanding of their re-defined roles and responsibilities.

The Training Strategy

While the importance of technical training for distance educators is well documented (see Hiltz, 1986; Schuttloffel, 1998), it is often the only type of training offered to faculty, in insufficient amounts and using inappropriate techniques (Schuttloffel, 1998). Northrup (1998) argues that additional training on new instructional techniques and strategies for promoting interactivity and for providing adequate and timely feedback may promote a DE environment more conducive to learning. Teachers need to extend their learning to beyond how they will use the technology. They also need to understand how the technology enables and affects their pedagogy and need to be given the time to digest and accommodate this new knowledge.

In our situation, the teacher training differed from the traditional DE training described above in the following ways: a) it was designed to take place over the summer months prior to the course implementation; b) the teacher (second author) worked in collaboration with a Ph.D. student in Educational Technology (first author) who assumed the roles of pedagogical technology consultant and teaching assistant; c) in contrast to a "just in time" training approach, the instruction was structured over a period of several weeks, building in time for practice and reflection; d) the training program was experiential in that the teacher was able to acquire technological skills within the context that she would be later teaching; e) training was carried out in close proximity to course implementation so that skills and knowledge were retained, practiced, discussed and contemplated upon, in relation to the DE environment; and, f) the training focused on helping the teacher to understand and become familiar with her new role as a DE teacher. More specifically, the teacher created a metaphor which helped the instructor to deal with her own feelings of isolation, especially from her students and from colleagues who had no experience with the DE environment.

Future Implications for DE Teacher Training

Presently, adequate training and support for distance teachers remains piece-meal and strongly associated with the efforts of key individuals, not with the university community. Bringing about large institutional reform, however, is no easy feat and certainly not accomplished in a short period of time. As DE increases in popularity, teachers will need to be prepared for new distance teaching assignments. Below are some strategies that can help DE teachers develop the skills and knowledge required to comfortably grow into their new roles.

With respect to faculty development, it is important to institute a training program for initial preparation and ongoing support that is sensitive to the needs of the teacher and the learning goals. Such a program should recognize that teachers need time to become familiar with the technology, their pedagogy in the DE environment and their role as DE teachers. If DE faculty training continues to focus only on technological skills, at best what is addressed is something akin to what Abhram Maslow (1987) refers to as teachers' *basic needs*. Therefore, it is critical that training of DE teachers evolve and expand to incorporate issues such as defining one's role as teacher in a virtual learning environment, building interactive learning communities of responsible learners, and creating a supportive collegial infrastructure so as to minimize not only isolation but increase feelings of belonging to a community of scholars, learners, and compassionate individuals. An effective training program should foster a community of resources (i.e., people, materials, technology) so that faculty can share knowledge and expertise as well as stories of successes and failures. This will not only help distance teachers overcome feelings of detachment from their peers but also build a strong collective knowledge of what teaching methodologies are most effective in DE environments.

References

Dooley, L.M. (1995). The virtual faculty office: Changing perceptions of traditional workload practices. Paper presented at the meeting of the Distance Education Conference, San Antonio, TX.

Gehlauf, D.N., Shatz, M.A., & Frye, T.W. (1991). Faculty perceptions of interactive television instructional strategies: Implications for training. The American Journal of Distance Education, 5(3), 21-28.

Hiltz, S.R. (1986). The "virtual classroom": Using computer-mediated communication for university teaching. Journal of Communication, 36(2), 95-104.

Maslow, A. H. (1987). Motivation and personality (3d ed.) New York: Harper & Row.

Moore, M.G. & Kearsley, G. (1996). Distance education. A systems view. Belmont, CA: Wadsworth Publishing.

Northrup, P.T. (1998). Faculty perceptions of distance education: Factors influencing utilization. International Journal of Educational Telecommunications, 3(4), 343-358.

Shedletsky, L. (1997). Teaching with computer-mediated communication [15 pages]. Available Internet: cei.hagg.umkc.edu/comm/faculty/aitken/sct/sctb/htm.

Schuttloffel, M.J. (1998). Reflections on the dilemma of distance learning. International Journal of Educational Telecommunications, 4(1), 45-58.

Architectural Aspects of an Interactive Multimedia Environment for Training Employees in Internet/Intranet Technologies

Gregory Derekenaris, John Garofalakis, Jim Prentzas, Spyros Sioutas, Athanassios Tsakalidis
Computer Engineering and Informatics Department
University of Patras, 26500 Patras Greece
and
Computer Technology Institute, Research Unit 5
P.O. Box 1122, 26110 Patras, Greece

Abstract: In this paper, we present a multimedia-based system facilitating the training of an organization's employees in Internet/Intranet technologies over a LAN connected to Internet. The system uses several types of multimedia educational patterns, such as hyperlinked text and images, special sounds, animations, interactive simulations demonstrating the use of various Internet tools, e.t.c. It contains several training courses, depending on each trainee's background in using Internet/Intranet technologies. All the multimedia material is stored in a multimedia database, which can be accessed and updated by the trainer through a user-friendly interface consisting of forms.

1. Introduction

The use of multimedia technology has given a great impetus to the training evolution. Multimedia systems provide an integrated environment for the creation, storage and presentation of a variety of media types enabling the development of a great number of successful prototype educational applications (Faconti 1994). This paper presents the architecture of an interactive multimedia-based environment as an assistant for training an organization's employees in Internet/Intranet technologies over a LAN connected to Internet. The environment incorporates a multimedia interface, and a multimedia database for storing and organizing all the multimedia assets. The information presented to the trainees via the multimedia interface during a course is dynamically accessed from the multimedia database. This feature facilitates the modification of the multimedia database's contents by the trainer through a user-friendly interface.

2. The Front-End Component

The main issue was to develop an interactionally rich system that would support user functionality efficiently and effectively, taking advantage of the new infrastructures currently available. The functionality concerns both training activities and navigational ones, like moving through hypermedia objects and browsing large multimedia structures (Schnaze 1993).

The information provided by the system is presented in a variety of ways, such as interactive simulations demonstrating the use of various Internet tools (e.g. Internet browser), hypertext, special sounds, appropriate images and animations, hypermedia object, educational games. Certain hyperlinks correspond to URLs of WWW servers. Therefore, from within the multimedia system the trainee can start his/her computer's default Internet browser and thus, put everything he learns in the specific section into practice. The content is distributed in sections, subsections and topics. Each topic comprises a series of educational screens. The user determines the presentation flow, by using hot area selections as well as buttons. On-line help is available, usually via messages at the bottom of the active screen, where necessary. Furthermore, the user can consult a glossary of primary Internet terms in order to enrich his/her knowledge.

There are different components of the system interface (front-end), related to the user views, described in section 4. One of the distinctive features of our approach is *dynamic linking* to the various multimedia assets (e.g. images, audio and video tracks, text files, animation files) by submitting queries to the multimedia database. This means that the contents of the multimedia interface are established dynamically, at run-time, since the information is structured appropriately in the database. This minimizes the cost of the system's maintenance, results in consistent presentations and ease of tailoring. In addition, the data modification effort is reduced.

3. The Back-End Component

The back-end component consists of the SQL components, ODBC software and a multimedia database. The multimedia database is used to store and organize all the multimedia assets of the system. The SQL components contain the SQL statements used to access the multimedia database through the ODBC software. The two SQL components related to the user views (section 4) are as follows:

1) SQL component for the trainer: This component enables the trainer to access and update the multimedia database keeping thus, all the multimedia material up-to-date with advances in the Internet/Intranet technologies. Furthermore, it enables the trainer to establish login names and passwords for the trainers which are stored in the database.

2) SQL component for the trainees: This component is responsible for validating the trainee's login name and password and accessing the system's multimedia assets.

4. User Views

The user interface is unified offering different view to different users. We can distinguish three basic views as far as the users are concerned corresponding to the components of the system's user interface:

1) General view: In the general view, the user can access all available information regarding Internet/Intranet technologies by navigating through the sections, subsections and the topics of the multimedia application.

2) *Trainer view:* In the trainer view, the user is able to modify the contents of the multimedia database with a user-friendly interface consisting mainly of forms and establish login names and passwords for the trainees.

3) Trainee view: In the trainee view, the user identifies himself/herself to the system.

The trainees can use the general and the trainee view whereas the trainer all the views.

5. Implementation Aspects

The system, in the form of an advanced prototype, has been developed under the Windows 98 and Windows NT operating systems. The multimedia interface (front-end) was developed using the Macromedia Authorware 5.0 and Macromedia Afterburner authoring tools. Additional code was written using Visual Basic. The multimedia database application was developed using the Microsoft SQL Server on Windows NT 4.0 Server operating system. The application handling the communication between the user interface and the database is comprised of a number of SQL components using Authorware's ODBC functions. These functions are called via calculated icons. Dynamic linking is implemented by connecting Authorware parameters to database items.

References

Faconti, G. P. (1994). Consistently Presenting Multimedia Information from Heterogeneous Data Sources. *ERCIM News*, 17, 19.

Schnaze, J. (1993). Semantic Data Modeling of Hypermedia Associations. *ACM Transactions on Information Systems*, 11 (1), 27-50.

Navigating Scholarship: A Study of Discipline-Based Web Gateways in Large Research Libraries

Barbara I. Dewey
University Libraries
University of Iowa
United States
barbara-dewey@uiowa.edu

Abstract: Research libraries have always built and organized authoritative discipline-based collections. This short paper provides a preliminary look at the state of discipline or subject-based web gateways to so-called authoritative scholarly works in large research libraries. The study is based on an in-depth analysis of the 30 largest academic research libraries (based in universities) as defined by the Association for Research Libraries' index ranking. The study also draws upon the results of a survey to each library revealing comparative data on gateway content decision-making and application of learning technologies to promote gateway usage within the universities' respective curricula. Gateway content is examined in terms of subjects covered, methods of content selection, formats pointed to, and integrative features with "traditional" online catalogs of the libraries' owned physical and electronic holdings. Goals for the study are two-fold: a) obtaining a profile of subject-based gateway development, structure, and maintenance practices, and b) seeking models for effective subject gateway development in light of efforts to improve aggregation of web resources with online library catalogs.

Introduction

The explosion of information resources available on the web has driven many research libraries to develop a subject-based gateway to selected sites deemed particularly useful for the scholarly community. The labor intensive nature of developing, maintaining, and updating these gateways provides motivation to identify best practices which can be applied successfully to other institutions. This analysis is also important given the growing number of web-wide search engines available to the user (Yahoo, Alta Vista, etc.) as well as software to apply to a more selective group of sites chosen by research library subject specialists. Boundary crossing between institutionally created subject gateways, library catalogs, commercial indexes, and other sites on the libraries' web presence is becoming more essential for comprehensive navigation of scholarship. Another factor is the emerging ease by which library users can create and customized their own gateways.

Methodology

The target population for this study are the 30 largest Association of Research Libraries (ARL) academic research libraries based on the ARL membership criteria index.[1] The large academic research libraries[2] were examined in two ways: 1) an examination by the author of the libraries' Web presence in terms of gateway existence, and 2) administration of a questionnaire to each library to self-identify their gateways and answer specific questions regarding the creation, content, and maintenance of the site. These include existence of a locally maintained subject gateway, its name, description of search engine, selection information, comprehensiveness and depth, type of resources included, maintenance procedures, and prominence factors within the library website.

An Example -- Iowa's Gateway to Online Resources

As with most research libraries the University of Iowa's efforts in developing an internal subject-based gateway are continually evolving. The goal of the Gateway to Online Resources is to allow users to find high quality sources quickly and efficiently. The resources in the Gateway have been selected by the Libraries' bibliographers and reference librarians, who use their knowledge of faculty research interests and class assignments to select the most reliable and well-designed electronic resources. These resources include authoritative Web sites maintained by professional societies or leading faculty as well as databases licensed by the Libraries from reputable publishers. It also includes databases and reference to materials in the online catalog. The Gateway (http://www.lib.uiowa.edu/gw/) consists of two sections: 1) reference categories including links to dictionaries, style manuals, encyclopedias, etc. and 2) subject headings including links to 57 subject areas at this writing. Thc Gateway holds a prominent place within the Libraries' web presence and uses File MakerPro as its search engine. At this point in time Iowa's Gateway does not feature automated web checking and links are corrected as errors are reported.

Preliminary Survey Results

Preliminary results of the survey are trickling in at this writing but of 10 respondents eight report having gateways. Of these eight, two are unnamed. One of the two responding in the negative did indicate they had separate pages with subject access to areas such as electronic journals, indexes, reference links, and bibliographer pages. Seven report having search engines for their gateways including WWW wais, htdig, InfoSeek, Index Servicer, Filemaker Pro, Glimpse, and MySQL. Most of the respondents indicate their gateways are somewhat selective. Respondents with gateways indicate that they include links to resources on the web, in the catalog, databases, electronic journals, and references to print materials. None indicated specializing in a particular subject area. The majority of respondents indicated that their gateway holds a prominent place within the library website. Three institutions used a software program to check links while the rest used staff. Software included Linkchecker, MySQL, and Linklint.

Conclusion

Best practices among the research libraries' gateways to scholarship will inform next steps in individualized and collaborative development to improve web-based navigation of scholarship (regardless of format), gateway placement, maintenance and long-term viability. New developments and trends in commercial browser development will impact in a variety of ways on the structure and proliferation of individually crafted gateways. At the same time more and more individual scholars are building their own customized gateways. These factors, along with the implementation of new web-based automated catalog systems in research libraries, will affect future subject gateway development and architecture.

---

[1] Based on the 1997-98 ARL membership criteria index and index formula. The index is a summary measure of relative size among the university members of the association. The index is calculated using five data elements including number of volumes held, number of volumes added, number of current serials received, total operating expenses, and number of professional and support staff.

[2] Harvard, Yale, UCLA, Toronto, UC-Berkeley, Stanford, Illinois-Urbana, Columbia, Michigan, Cornell, Texas, Washington, Penn State, Indiana, Minnesota, Wisconsin, North Carolina, Princeton, Chicago, Pennsylvania, Duke, Virginia, Ohio State, New York University, Iowa, Rutgers, Arizona State, Georgia, Alberta, Northwestern

The University of Iowa Science Information Literacy Initiative

Barbara I. Dewey
University Libraries
University of Iowa
United States
barbara-dewey@uiowa.edu

Abstract: The University of Iowa Libraries recently received a two-year $270,000 grant from the Roy J. Carver Charitable Trust to develop a new program called the Science Information Literacy Initiative (http://sciencelit.lib.uiowa.edu/), which is designed to help University of Iowa undergraduates taking courses or majoring in the sciences to develop skills in locating, critically analyzing, organizing, and applying scientific information. Participating academic departments include Biological Sciences, Chemistry, Geology, Mathematical Sciences, Psychology, Science Education, and Engineering. This paper will describe the steps taken with the College of Liberal Arts prior to receipt of the grant to launch the more general, UIII (University of Iowa Information Literacy Initiative) (http://www.lib.uiowa.edu/user-ed/uiii/index.html). Concepts behind planning and implementing the Science project will then be examined. Project staff, science librarians, and faculty design discipline-specific components and assignments to meet a set of learning objectives. Faculty and librarians test these components in actual courses and present them in a variety of formats depending on the course requirements, needs, and structure. Information literacy components deemed successful will be further developed into what is hoped to be an easily adaptable program for widespread use throughout the sciences. Issues and challenges faced in launching the Science Information Literacy Initiative will also be featured.

Why Science Information Literacy?

The ability to locate, critically analyze, organize and apply scientific information is an important skill for University of Iowa science and technology graduates. On a daily basis students preparing for professional and academic careers in science and technology will need, to correctly locate, evaluate, and apply science information from the constantly growing and rapidly changing universe of print, electronic, multimedia, and web-based sources.

Advancing information literacy in the sciences and technology is of major importance at the highest levels of national policy. Albert Henderson writes that "an ideal vision of science requires goals and strategies to deal directly with the growth of new information. "Information Age" science policy fails to do this. By ignoring the study of science communications, it fosters a policy vacuum on information."[i] Although the more general concept of "science literacy" has been recognized as a concern and challenge in the U.S., particularly since the post-Sputnik era, proponents have focused primarily on recruiting students into the sciences and heightening the public's understanding of science issues rather than on addressing effective scientific information seeking.[ii] Academic libraries have not developed comprehensive science-based literacy programs although many science librarians have been successful in promoting certain information seeking skills such as specific database manipulation and web searching. For example, a widely cited *College & Research Libraries* article reviewing the advances of information literacy efforts by librarians made no mention of specific applications in science or technology.[iii] The University of Iowa Science Information Literacy Initiative seeks to address this void for the campus and as a potential model for other institutions.

The Roy J. Carver Charitable Trust

A major factor in the development of the Science Information Literacy initiative was the interest and subsequent funding of the project by the Roy J. Carver Charitable Trust. The Carver Trust had funded the successful Information Arcade, the Information Commons, TWIST, and a new Biological Sciences Library, a total of $2.13million in awards. Senior library staff developed a prospectus and presentation for Carver and were then encouraged to submit a formal grant proposal. Funding of $270,000 was recently received for the two-year project. Funding supports a coordinator, an instructional designer, and two graduate assistants.

University of Iowa Information Literacy Initiative (UIII)

Both the UIII and the Science Information Literacy Initiative are based on the University of Iowa Libraries' philosophy that integrated curriculum-based user education in the most effective and scaleable approach for developing students' portfolio of information literacy skills. An important outgrowth of the information literacy programs will be development of alternative methods for faculty to incorporate into their courses for each component including web-based methods, in class presentations, use of existing library web tutorials, and other means since librarians are not numerous enough to appear in every introductory class at a university of Iowa's size.

Student Learning Objectives

Development of relevant student learning objectives in partnership with faculty is an essential part of the Science Information Literacy Initiative. Below are examples of objectives likely to be included in the program:

- Identify problems that require solutions based on scientific information
- Identify appropriate scientific information sources and execute effective search strategies
- Interpret and analyze search results
- Critically evaluate scientific information retrieved
- Organize, synthesize, and apply scientific information
- Understand the structure of the information environment and the process by which scholarly and other information in the science and technology fields are produced and disseminated
- Understand the ethical issues related to access and use of scientific information.

Methodology and Project Evaluation

Science Information Literacy project staff and science librarians are working directly with select faculty in each science discipline to customize curriculum components which meet the student learning objectives. Faculty and librarians will test these curriculum components in actual courses and may present them as web-based instruction, in-class instruction or some other format depending on course requirements, needs, and structure. Evaluation of the project will be accomplished using appropriate tools to measure students' acquisition of the learning objectives. Information literacy components deemed successful on the basis of student outcomes will be developed into an easily adaptable program for widespread use throughout the science and technology curriculum.

Initial Projects. Besides enhancing course assignments, the University of Iowa plans to develop an easier interface for beginning level students in the sciences who need to access various science information databases. This part of the project is currently in the initial development stage, but will include examination of various basic science databases to determine how beginners might best choose which database to use in response to particular needs.

Conclusion

Gradually integrating new initiatives into the existing framework is sometimes a slower process than we might like, but patience developing the collaborative process often pays off in the final outcome. We have at this point laid the groundwork for successful implementation of our project goals and hopc to report on our further progress at a later date.

---

[i] Henderson, Albert. "Science in the Twilight Zone; Or, Are Science Libraries Related to Science?" *Issues in Science and Technology Librarianship*, Fall 1998:1. http://www.ucsb.edu/istl/98-fall/article1.html

[ii] Paisley, William J. "Scientific Literacy and the Competition for Public Attention and Understanding," *Science Communication* (September 1998) 20(1):70-80.

[iii] Behrens, Shirley J. "A Conceptual Analysis and Historical Overview of Information Literacy," *College & Research Libraries* (July 1994) 55(4): 309-322.

Increasing Explorativity by Generation

Stephan Diehl, Andreas Kerren

University of Saarland, FR 6.2 Informatik
PO Box 15 11 50, D-66041 Saarbrücken
{diehl,kerren}@cs.uni-sb.de

Abstract. Visualization of computational models is at the heart of educational software for computer science and related fields. In this paper we look at how generation of such visualizations and the visualization of the generation process itself increase explorativity. Four approaches of increased explorativity are introduced.

1 Introduction

Educational software mostly aims at width of knowledge (facts) and is not able to teach complex processes. The majority of systems are intrinsic electronic books, encyclopaedias and dictionaries. Process-oriented systems exist mostly for physics. In the area of computer science tutorials of programming languages prevail. Particularly in computer science and compiler design the theory and algorithms are very abstract and usually complex. Therefore visualizations are appropriate for computer science instruction. Although compiler design is often considered a practical field within computer science, most of its techniques are based on work in theoretical computer science, e.g. formal languages, automata theory and formal semantics. In recent years we have developed several educational software systems for topics in compiler design and theoretical computer science. These systems have in common that they teach computational models by animating computations of instances of these models with example inputs. But they differ in the level of explorativity.

Approach	Input	Computational Model	Generator
Static	fixed	fixed	none
Interactive	user	fixed	none
First-order generative	user	user	yes
Second-order generative	user	user	yes/visualized

Table 1. Levels of explorativity

Table 1 not only reflects the increased flexibility of the software developed, but also the chronological development of software in our group. Higher levels of explorativity demand more prerequisites and self-control by the learner. Thus, in the educational software the learner should start with static examples and as the user advances the level of explorativity should be increased. Exercises and textual hints in the educational software should guide the learner, to make sure he/she doesn't miss the important issues.

2 Approaches

Static Approach In the static approach the execution of an instance of a computational model is animated for a given, fixed input. The educational software "Animation of Lexical Analysis" [Braune et al. 99] is an example for this approach (http://www.cs.uni-sb.de/RW/anim/animcomp_e.html).

Interactive Approach In the interactive approach an instance of a computational model is animated for an example entered by the user/learner. An example for this approach is our application "Animation of Semantical Analysis" [Kerren 99] (http://www.cs.uni-sb.de/RW/anim/animcomp_e.html).

First-Order Generative Approach In the first-order generative approach the user enters the specification of an instance of a given computational model. Then an interactive visualization of this instance is generated and the user can enter an example input as in the interactive approach. As an example of the first-order generative approach we present GANIMAM [Diehl et al. 99], our web-based generator for interactive animations of abstract machines (Fig. 1 and http://www.cs.uni-sb.de/RW/users/ganimal/GANIMAM/).

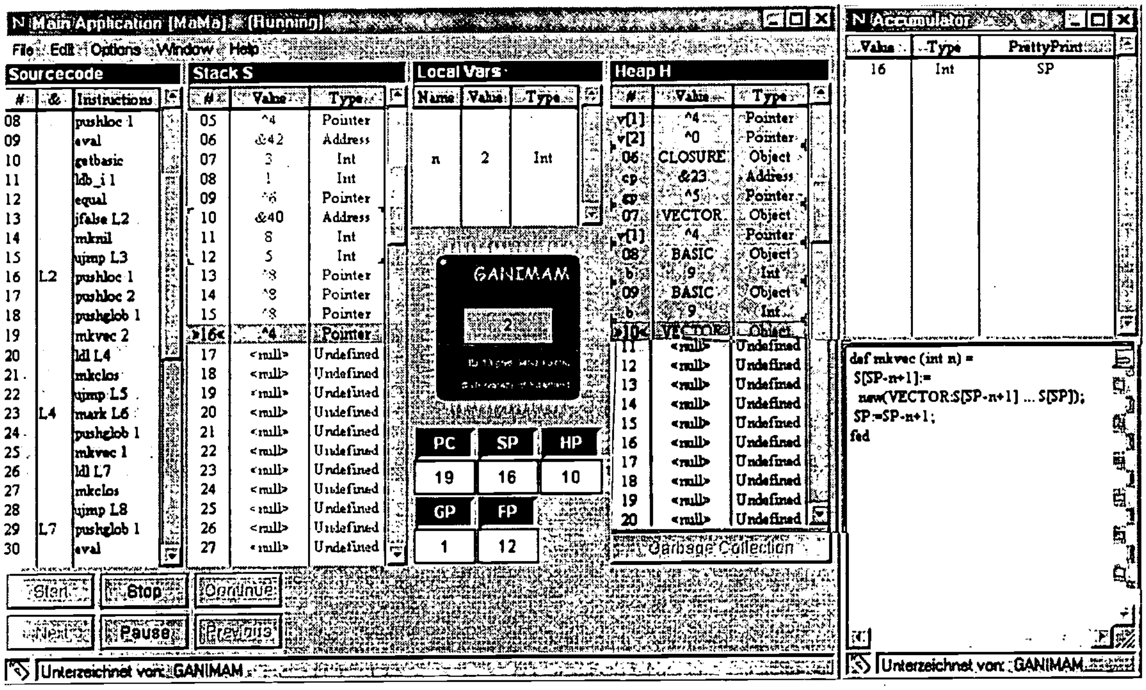


Fig. 1. Screenshot of an animated abstract machine

Second-Order Generative Approach As in the first-order generative approach the user enters a specification of an instance of a given computational model. But in the second-order generative approach in addition to visualizing the computation also the generation process is shown as an interactive visualization. An example of this approach is our application GANIFA, a web-based generator for animated finite automata (http://www.cs.uni-sb.de/RW/users/ganimal/GANIFA/).

3 Explorativity and Learner Control

In conventional educational software answers of an exercise are checked for correctness. Unfortunately such correctness checking is not possible in most interesting cases. In computer science, many properties of computational models can not be checked because of the halting problem. As a consequence we need alternative ways to provide feedback for the learner.

In the generative approaches an interactive animation is produced from the response (specification) of the learner. Then the learner can test it on the basis of own examples. In this way he/she can detect errors. The generative approach offers a way for explorative, self-controlled learning. The learner can focus on certain aspects in the generated, interactive animation and see what effects small modifications in the specification have. With the help of such observations he/she formulates hypotheses and checks these empirically. In the interactive approach such checkable hypotheses are restricted to the instance of the computational model. In the first-order generative approach also hypotheses about the computational model and in the second-order generative approach about the generation process itself can be checked.

References

[Braune et al. 99] B. Braune, S. Diehl, A. Kerren, R. Wilhelm. (1999). Animation of the Generation and Computation of Finite Automata for Learning Software. To appear in *Proceedings of Workshop of Implementing Automata WIA '99*, Potsdam, Germany.

[Diehl et al. 99] S. Diehl, T. Kunze. (1999). Visualizing Principles of Abstract Machines by Generating Interactive Animations. To appear in *Future Generation Computing Systems*, Elsevier.

[Kerren 99] A. Kerren. (1999). Animation of the Semantical Analysis. In Proceedings of "8. GI-Fachtagung Informatik und Schule INFOS99" (in German), Informatik aktuell, Springer, pp. 108-120.

The Study of Newtonian Mechanics in junior high school.
A new technology - based learning environment.

P. Dimitriadis,L. Papatsimpa, K. Kampouris,K. Papamihalis, G. Kalkanis
University of Athens, Pedagogical Dept. P.E
Navarinou 13A,
Athens, GREECE.
Author Email: lpap@pi-schools.gr

Abstract: New technology – Microcomputer Based Lab (MBL) in particular – was beneficially used to support Mechanics teaching at Junior High School students. Two series of seven experiments each were developed and implemented at five schools, including control and experimental groups of approximately two hundred students in total. The experiments focused on linear motion, Newton laws and conservation laws. The students of the experimental group demonstrated a significantly more successful ability of distinguishing among position, velocity and acceleration versus time graphs. Furthermore, they appeared to better understand the proportional relation between force and acceleration, the equality between action and reaction, as well as momentum conservation and mechanical energy conservation laws. In conclusion, new technology enables students to build scientific concepts taking profit of their own experience of real world.

Introduction.

As we approach the new millenium, a general attitude is developed towards the improvement of quality and effectiveness of the provided education, regarding Natural Sciences, which has two objects. The scientific and technological "literacy" of the average citizen, on one hand, and on the other, the preparation of future scientists and instructors so as to utilize the outcomes of the rapid scientific and technological developments of our times. Since the beginning of our decade, an intense concern has been created among the natural sciences education researchers about the effectiveness of the traditional instructive system as far as the understanding of the natural world on behalf of the students is concerned. Almost everybody seems to agree that listening to someone talking about the natural phenomena does not constitute a productive way of understanding the laws and concepts of nature. Students of all ages approach science better by actively participating in the examination and the interpretation of the natural phenomena [1] .

Subject/problem.

Many researchers hold the view that the use of new technologies will supply students with the ability to successfully take in concepts of physics by putting to use their own experiences from the natural world. One of the interactive educational technologies is the real - time, computer-based data-logging tools (often called microcomputer-based laboratory or MBL). These new methods using the L were implemented for teaching the Newtonian Mechanics to first-year students and schoolchildren of the last classes of senior high school in the USA, leading to particularly positive results [2,3] . Up until now and to our knowledge, no attempt has been made towards the utilization of new technologies regarding the teaching of Physics to students of younger age. The Greek syllabus does not give such an opportunity, since it provides the teaching of the elementary concepts of the Newtonian Mechanics in Grammar school (age 13-15).

Design and procedure.

In order to investigate the effectiveness of the new teaching methods of Physics in the low secondary education we put to practice a project with the general title «Physics and New Technologies». The chapters of Heat and

Mechanics were chosen based on the criterion of their position in the Greek curriculum and their suitability for the development of laboratory experiments in an MBL environment. The part of the suggestion, which is related to Mechanics, is presented in this paper. Two series of 7 experiments were designed: one for the groups of control classes and one for the classes of experimental application. The duration of every laboratory experiment was the same for both classes. The experiments included all the basic topics of Mechanics at this level: linear motions, Newton's laws and conservation of momentum. The design of the experiment for the control classes was based on the electrical ticker-timer and the cart that comes along with it. The experimental application classes used various simple means (their hands, little wagons, toys etc.) as mobiles, and worked in MBL environment, which disposed a computer, proper software, a printer, a projection screen, a video projector, sensors of position and force, as well as an interface for the sensors and the computers. Five grammar schools in Athens were selected to be school units of application, so that the sample would represent the average Greek student. The experiment and control classes operated equally in every school unit, on every aspect. The teachers were the same for both classes. Students in both classes worked under the supervision of two teachers and they filled in worksheets. The efficiency of each teaching intervention was evaluated through a questionnaire, common for both classes. (The filling in of the questionnaires was conducted a week after every laboratory experiment).

Results.

The results presented here concern concepts of kinematics motion and immobility, velocity, acceleration, gravity acceleration while research related to dynamics is in progress. As a sample of the experiment we mention the following: One out of two students of the experimental group E G (48,5%) and one out of five of the control group C G (20,3%) recognized motion with uniform velocity in a position/time diagram. The difference is more striking in the identification of the immobile condition: E G (68,7%), C G (25,2%); as well as the backward motion: E G (67,7%) and C G (13,1%). At this point we should mention that the electrical ticker-timer or every other «typical» means cannot register the motion backwards [(4)]. At a linear motion with constant acceleration, 80% of the E G and about 55% of the C G understood the concept of velocity, while for the acceleration the results were: E G (65%) and C G (50%). Finally, for the case of the free fall of a rubber ball and a metal sphere, 60% of the E G and 40% of the C G understood that the two bodies have the same acceleration.

Conclusions.

Based on these results, it becomes obvious that the use of new technologies in the Physics laboratory offers the possibility of a simultaneous supervision of motion and of the model of its representation (diagram). This activity - based, computer - supported, interactive learning environment helps students of this age:

1. To identify the trajectory of a motion from the depicting motion diagram. Not to confuse the position, velocity and acceleration diagrams in relation to time [(5)]. To discern the analogy of force – acceleration. To comprehend the third law of Newton and the conservation of momentum, which derives from it.
2. To acquire the ability to describe the behavior of a natural system based on the model it depicts [(6)].

References:

1. NATO Advanced Study Workshop: Student development of physics concepts: The role of educational technology, (Pavia, Italy,1989)

2. Redish, E.F. at all On the effectiveness of active-engagement MBL, American j. of Physics 65 (1) 45-54,(1997)

3. Thornton, R.K.(1999) Using the results of research in science education to improve science learning, 1th International Conference on Research in Science education., Cyprus 3-5 January 1999.

4. Panagiotis Dimitriadis at all: Linear motion study through graphs -A new Technology-based learning environment,2nd International Conference of the European Science Education Research Association Proceedings ,Kiel, Germany, August 31 - September 4, 1999.

5. Mc Dermott, L., Rosenquistm, M., van Zee, E. Student difficulties in connecting graphs and physics: Examples for kinematics, American J. of Physics55(6)503-513, (1987).

6. Hestenes D. :Modeling games in the Newtonian Word, American j. of Physics, 60 (8), 732-748, (1992)

Supporting Developers of Inquiry Based Instruction:

Performance Support on the Web

Jackie Dobrovolny
University of Colorado at Denver
12281 E. Villanova Drive
Aurora, CO. 80014
jdoffice@home.com

Scott Grabinger
University of Colorado at Denver
Campus Box 106
P.O. Box 173364
Denver, CO 80217-3364
scottgrabinger@ceo.cudenver.edu

Jenn Light
University of Colorado at Denver
Campus Box 106
P.O. Box 173364
Denver, CO 80217-3364
Jenn_Light@ceo.cudenver.edu

Abstract: The University of Colorado at Denver, Indiana University, Western Governors University, Educause/IMS and Phi Delta Kappa are working on a five year FIPSE (Fund for the Improvement of Post-secondary Education) grant to develop the Learning to Teach with Technology Studio (LTTS). The LTTS is an Internet-based, anywhere, anytime learning environment designed to help K12 teachers integrate technology into their instruction. The instruction in the LTTS is designed from an inquiry based learning model. A key objective of this project is to ensure that it is replicable and self-sustaining. The strategy for achieving this goal is to develop an initial set of modules and then invite other professionals in the field (teachers, university faculty, technology coordinators) to contribute modules. Thus, it is critical to provide strong support for the multitude of authors that may contribute to this project. The Design Strategy Environment (DSE) provides this support; it is a resource-rich environment that helps developers create high quality, self-contained, problem-centered learning modules.

Background

The National Center for Education Statistics (1999) found that 80% of K12 teachers do not believe they are prepared to integrate technology into their curricula and the Milken Exchange (Solmon, 1998) found that teachers do not model the integration of IT skills in their teaching. One of the reasons for this ill-preparedness is a lack of relevant instruction for both pre-service and in-service teachers.

To meet this need, the University of Colorado at Denver (UCD), Indiana University (IU), Western Governors University (WGU), Educause/IMS and Phi Delta Kappa began work in September, 1999 on the Learning to Teach with Technology Studio (LTTS), an Internet-based, anywhere, anytime learning environment. The LTTS will provide self-paced instruction in the following six content areas: (1) design of learning environments, (2) measurement and evaluation, (3) technology and production proficiency, (4) project management, (5) leadership, and (6) applied research. This work is funded by a five-year, FIPSE grant.

The instruction in the LTTS uses an inquiry based learning (IBL) model; each instructional unit is structured around a problem-based case. While many potential developers probably have prepared materials for information transmission-based online courses, few have experience in preparing inquiry-based online activities. Shifting to an inquiry-based mode of instruction is a difficult process for many educators, a fact confirmed by the professional development literature (e.g., Richardson, 1998). In our extensive experience offering problem-based learning workshops, we have found that nearly all educators willingly accept the idea that students must learn to solve problems, work with others, and create meaningful products. However, we have also found that they are reluctant to change their teaching methods, believing that their students need to know "stuff." Unfortunately, the information transmission model of learning conflicts with the inquiry approach to instruction.

The change to an inquiry based learning model is even more complicated on the LTTS project because the instruction is self-paced and web-based. Most of the literature and guidelines for developing inquiry based learning are designed for group-paced, classroom-based instruction. Further, in addition to developers from Indiana University and the University of Colorado at Denver, we will invite other professionals in the field, e.g., teachers, university faculty and technology coordinators, to contribute modules to the LTTS. Thus, we anticipate the possibility of having hundreds of developers contribute instructional material to the LTTS.

Design Strategy Environment

To assist and support those who are developing instruction for the LTTS, we are creating the Design Strategy Environment (DSE). The DSE is a resource-rich, performance support site, which provides instructional guidance, templates, and examples for developers. Our goal for the DSE is to make the work of our developers as efficient as possible, and to insure a consistent look and feel of the interface. In order to achieve this goal, the DSE uses forms, templates and other automated techniques.

We provide a Developer Notes Worksheet which developers can use as they review the DSE site. The purpose of the worksheet is for developers to record their ideas, notes, reflections and concerns as they research and review the information in the DSE. This worksheet is divided into four sections that correspond to the four-step development process: (1) Describe the problem, (2) Describe and define the resources, (3) Describe the learning activities, and (4) Describe the assessment criteria.

For each of these four steps, the DSE provides the following information:

- A brief description (50-100 words) of that component of the inquiry based instruction. For example, the brief description of the first step (Define the problem), indicates that a good IBL problem is ill-structured, situated, authentic and complex.
- Links to our examples. These examples are other LTTS modules that contain comments and notes. That is, for the first step (Define the problem), an example problem is displayed in the first column of a two-column table. The second column contains comments, notes and explanations about how this problem exemplifies the critical characteristics of a good problem.
- Link to detailed explanation. This information is essentially an elaboration on the brief description (a. above). It contains not only a full description of the topic, but also provides a reference list and links to LTTS examples.
- Link to necessary features. This is a checklist developers can use to evaluate their work. It is a list of the necessary features each of the four components of their module must contain.

References

National Center for Education Statistics. (1999). *Internet access in public schools and classrooms: 1994-1998.* (NCES 1999-017). Washington, D.C.:U.S. Department of Education, Office of Educational Research and Improvement.

Richardson, V. (1998). Teacher Change. In V. Richardson (Ed.), *The Handbook for Research on Teaching* (Fourth ed.). Washington, D.C.: AERA.

Solmon, L. C. (1998). *Progress of Technology in the Schools: Report on 21 States : The Milken Exchange on Education Technology.*

Accessing Advocacy Training Virtually and Physically

Dr. Tanis Doe
Computer Master/ Canadian Association of Independent Living Centres
6 1261 Goldstream Ave
Victoria BC V9B 2Y9
techolt@home.com

Abstract: This is a research project conducting a comparison of traditional classroom instruction and self-paced multimedia training in "advocacy" for people with disabilities. The three main populations are Deaf sign language users, blind users who do not read print, and people using alternative input, such as Dragon Dictate or puff and sip switches. Technical specifications for access to html using WWW3 universal design standards will be discussed. Advantages and disadvantages to both classroom and virtual training will be compared using evaluation data.

Comparing Methods for Delivering Advocacy Training

Advocacy is a skill required for navigating life as a person with a disability. The Canadian Association of Independent Living Centres was funded by the Office of Learning Technologies to conduct a research and demonstration project to understand the differential impacts of learning technologies on people with disabilities.

Traditional Classroom Delivery

The advantage of classroom delivery is the interactivity and direct feedback available in real time. Students may ask questions, have them answered and participate in group activities. For Deaf students, another advantage is that the course content is delivered directly in sign language. Although handouts and exercises are in written English, there is an opportunity to ask directly for clarification and access new concepts in sign language. Students who do not read print, and who process information aurally, are able to benefit also from spoken discussions, role plays and interactivity. No reading or print processing is required in a traditional classroom situation. The provision of handouts in alternate formats- such as in Braille, diskette or on audiotape, also enables learners to access material after the class is completed. Because the classroom course delivery involves other peers, similarly situated blind people, the participants directly benefit from experiences of others. This is a key in the process of adult learning. For students who cannot use text input due to physical limitations or learning disabilities classroom participation can be very enabling. The verbal participation and support given by human staff in a classroom situation may enable learners to avoid some of the limitations that their disabilities create when interacting with text or technology. For example, even turning a page of a workbook may require a technical aid for a quadripelegic and a person with a learning disability may need a screen reader to process assignments in writing. Having a human instructor also provides the flexibility of gearing the course to the topical and learning needs of participants.

Virtual Training Delivery

This project was designed to test virtually learning in comparison to classroom learning. Realizing that private citizens have a wide range of access to computers and the internet, the "lowest" common denominator was selected for delivery. (Cantor 1998) CD technology using html allowed any one with basic internet software and NO connection to the internet to take the course. Students would be able to email, phone, fax or even write to instructors. (Burgstahler 1995) By providing OFF line access, students without fast modems, students with time limited access and people who have CDROM drives but no internet access can still benefit from the course material. This is particularly important for disabled learners who use augmentative technology that slows down participation and interaction. (Coombs 1999) Participation in the on-line version of the course (same content) will only be different because it allows direct emailing to the instructor and potentially a response within a very short time. There will be on interaction with other learners in this project, but students will be asked at the end of the project if that was something they would be interested in. A bulletin board style noteboard will be used for students to post their comments about the course and any suggestions- either anonymously or through their own email address. (Brooks

1997) The text only version of the course will enable blind users to access the text and exercises through both screen readers and audio files without navigating through frames. The deaf users and the people using alternative input will benefit from the enhanced visual navigation and easy to use self-pacing. Interactive exercises, sign language video and audio files will be available on demand. The advantages of these processes include a slower or more individualized pace of learning, opportunity to repeat and review more frequently, a chance to complete exercises before and after course work, and the ability to stop the process and return to it at any time. Classroom teaching doesn't allow this flexibility and the presence of other students often reduces the opportunity to individual the steps to learning achievement.

Training Design Standards

While WWW standards for accessibility do exist, and the WWW consortium has an ongoing list of requirements, (Web Accessibility Initiative 1999) html is not always used to deliver training. Other sources of accessibility design standards will also be used to inform the training design standards. (Waddell 1998; Vanderheim, Chisholm & Ewers 1996) This project seeks to combine accessibility standards with training design standards to ensure that web/on line training is as flexible and accessible as possible for diverse learners. This project is still in progress but the following technical specifications have been used to implement the project. The starting point for the content was the pre-post test which would be used to measure achievement of skills and knowledge about advocacy. The contents of the in class instruction and the multi-media instruction had to be compatible so we began with the text and graphical content. Images were imported from ClipArt and custom drawn by an artist. All images have alt-tags but the html text-only site does not rely on graphics for navigation. (Khan 1997) In addition, we provided sign language versions of instructions and difficult vocabulary which was accessible by clicking a particular location identified by signing hands. In addition, the "hot spots" or links in the software were made to work without timing limits and through keystrokes so that people using Dragon Dictate and alternative input switches did not always need to move the "mouse" but could directly control the navigation. By building in accessibility at the design stage, more flexibility for consumers is achieved. (Waddell 1999) Evaluation to date has shown that disabled participants benefit from both in class and on-line delivery methods. Different individual preferences, access to technology and learning needs help determine which suits each student. Design standards will be developed as a result of this project to increase access to future training initiatives.

References

Brooks, D.W. (1997). A Guide to Designing Interactive Teaching for the World Wide Web: Innovations in Science, Education and Technology. New York: Plenum.

Burgstahler, S.E. (1995). Distance Learning and the Information Highway. Journal of Rehabilitation Administration. 19 (4) 271-276.

Cantor. A. (1998) Accommodating People with Disabilities in Web-Based Training Programs. Available at http://www.interlog.com/~acantor/

Coombs, N. (1998) The Underprivileged and Universal Access to Distance Learning: Disabilities and Beyond. 1998, EvNet Conference, Montreal, Quebec Available at http://socserv2.mcmaster.ca/srnet/confabstracts/coombsab.htm

Khan. H. (1997). Interactive Multimedia & the World Wide Web: A New Paradigm for University Teaching & Learning. Educom Review, 32(1), 48-51.

Law, C., and Vanderheiden, G., (1995) Trace Research and Development Center. EZ Access Strategies for cross-disability access to kiosks, telephones and VCRs. Madison, University of Wisconsin-Madison.

Solomon, G. and Gardner, H. (1986) Computer as Education, Lessons from Television Research. Educational Resources 15 (1) 13-19

Vanderheiden, G.C., Chisholm, W.A., & Ewers, N. (1996) Design of html Pages to Increase Their Accessibility To Users with Disabilities. Available oat http://www.trace.wisc.edu/world/web/index.html

Waddell, C. (1999). The Growing Digital Divide in Access for People with Disabilities: Overcoming Barriers to Participation. Washington, D.C.: US Department of Commerce. Available at http://www.aasa.dshs.wa.gov/access/waddell.htm

Waddell, C. (1998) Disability Access Design Standards. San Jose, CA: City of San Jose. Available at http://www.ci.san-jose.ca.us/oaacc/disacces.html

Web Accessibility Initiative. (1999). World Wide Web 3 Consortium Web Accessibility Initiative Guidelines. Available at http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/

Is the expression "Instructional Engineering" justified?

Sylvie Doré
École de technologie supérieure
1100, Notre-Dame Ouest
Montréal (Québec), Canada H3C 1K3
sylvie.dore@etsmtl.ca

Josianne Basque
Télé-université
4750, avenue Henri-Julien, bureau 100
Montréal (Québec), Canada H2T 3E4
jbasque@teluq.uquebec.ca

Abstract: In this text, we explore the similarities between engineering and instructional design, in terms of methodology, tools used and emerging trends (growing consideration for the client, research of quality, prototyping, concurrent approach). We conclude that the expression "instructional engineering" is amply justified.

Introduction

In recent years, instructional design (ID) is more and more often equated with instructional engineering (Paquette, Crevier and Aubin, 1999). Engineering is a process covering the whole life-cycle of a product. The engineering process is generic as is applied in all fields where one has to image a solution that will satisfy the needs of potential customers whether those needs be educational, financial, medical, etc. When this process is put to use to solve a problem industrial in nature, it is said to be applied to the *field* of engineering. Similarly, the ID process has been traditionally defined as this whole cycle of analysing, designing, producing (or developing), evaluating, implementing and revising a learning system. In this sense, the expression "instructional engineering" is well justified. As we will see throughout this presentation, it is not the only reason.

Tools

In both fields, engineering and education, introduction of computers has greatly increased the productivity of the designers by easing the creative process, by facilitating modifications, by performing simulations more rapidly. But what about supporting decision making within the engineering process?

In 1992, Spector and his colleagues predicted that the automation of the instructional engineering process (through the use of expert systems) would evolve in much the same way as word processors have. Unfortunately, the passage of time has not proven them right. The use of expert and other knowledge-based systems is much more frequent in engineering. This may be explained by the fact that a large portion of the body of knowledge is rooted in "hard" science as opposed to "soft" science, much more open to debate, in the field of education. Furthermore, the rules included in educational expert systems are much more difficult to formulate.

Quality

One usually associates quality with a lack of defects, with reliability. In engineering, nowadays, a quality product is one that responds to the needs of the customer. One can therefore never overemphasize the importance of the first phase of the engineering process: problem definition. This is true irrespective of the field.

Traditionally, problem definition has been performed through analysis. A growing number of companies developing new engineering products rely on Quality Functional Deployment (QFD), a method devised to clearly identify customer needs. The method rests on a graphical tool called the House of Quality. While developing a technology-enriched course, we used this tool and found it to be a highly effective communication and design tool.

Another mean of achieving quality in engineering is through a prototyping approach as proposed by Smith (1991), which is also an emerging trend in education (Moonen, 1996; Tripp and Bichelmeyer, 1990). Needs and requirements are no longer viewed as input but as output of the design phase. The goals of the prototypes are to solicit, to elucidate, to define customer needs and requirements. The method is useful if a prototype can be easily and quickly produced, thus the expression "rapid prototyping". In general, the more specific the tool used (from general programming languages to learning systems shells), the more quickly the prototype is produced. Merrill (1996) does warn however that education authoring tools do require some type of programming, that they are not neutral with regard to instructional theory and that the user must have some knowledge of ID. Ignoring these warnings may result in an inadequate product, that is one that lacks quality!

Concurrent engineering

The classical work organization is sequential. This type of organization is often referred to as "over-the-wall" or "waterfall" since each team works independently of one another, with minimal communication. This lack of true communication results in multiple errors, increase in development time and cost. *Concurrent engineering* was devised to overcome these shortcomings. The proposed solution is simple : create a single multidisciplinary team, whose members work concurrently on different aspects of the product. A mounting body of literature is available to document the effectiveness of the concurrent engineering process when applied to the field of engineering. Meanwhile timid incursions are observed in the field of education. Most classical ID models have a bias for sequential engineering with numerous feedback loops providing for iterations, very few incorporate task parallelism. However, there exists a few attempts to embed concurrent engineering in ID (Paquette, Crevier and Aubin, 1999).

Conclusion

Our analysis shows that the expression "instructional engineering" in amply justified. The similarities between engineering and ID, in terms of methodology, tools used and emerging trends (growing consideration for the client, research of quality, prototyping, concurrent approach) are quite amazing. Up to now, there have been very few occurrences of borrowing engineering principles to shed new light in the field of ID (Teslow, 1997; Yang, Moore and Burton, 1995). Our own experience of combining ID and engineering expertise to the task of developing a computerized learning environment and to reflect together on the theoretical underpinnings of both fields has been an experience which gains to be repeated by others and become a practice more widely spread.

References

Merril, M.D. and ID_2 Research group. (1996). *Instructional Transaction Theory: Instructional Design Based on Knowledge Objects*. Educational Technology, 36(6), 30-37.

Moonen, J. (1996). Prototyping as a design method. In T. Plomp and D.P. Ely (eds.), *International encyclopedia of educational technology* (pp. 186-190). Cambridge, UK: Pergamon.

Paquette, G., Crevier, F., and Aubin, C. (1999). MISA, A knowledge-based Method for the Engineering of Learning Systems, *Journal of Courseware Engineering*, vol. 2.

Smith, M.F. (1991) *Software prototyping. Adoption, practice and management*. London: McGraw-Hill Book Company.

Spector, J.M., Muraida, D.J. and Marlino, M. (1992). Cognitively Based Models of Courseware Development. *Educational Technology Research and Development*, 40(2), 45-55.

Teslow, J.L. (1997). Production of instructional multimedia: An engineering perspective. A presentation to the 1997 Annual Convention of the Assocation for Educational Communications and Technoogy (AECT).

Tripp, S.D. and Bichelmeyer, B. (1990). Rapid prototyping: An alternative instructional design strategy. Educational Technology Research and Development, 38(1), 31-44.

Yang, C.-S., Moore, D.M., Burton, J.K. (1995). Managing courseware production: An instructional design model with a software engineering approach. *Educational Technology Research and Development*, 43(4), 60-70.

Technology Across the Curriculum

Gerald W. Drake
George Mason University
4400 University Drive
Fairfax, Virginia 22030-4444
gdrake@gmu.edu

Abstract: The College of Arts and Sciences (CAS) at George Mason University has launched a program - *Technology Across the Curriculum* (TAC) - to promote student use of information technology. The TAC initiative supports faculty to develop technology-enhanced course assignments with funding provided by the Vice-President for Information Technology. Through their work to promote these innovations, faculty have opportunities to take a deeper look at their teaching and scholarship. Students who enroll in TAC courses are not only empowered with advanced tools for problem solving, they also acquire a conceptual understanding of "applied" technology so that the utility of these tools can be transferred to different domains over time.

The College of Arts and Sciences (CAS) at George Mason University has launched a program - *Technology Across the Curriculum* (TAC) - to promote student use of information technology. The TAC initiative supports faculty to develop technology-enhanced course assignments with funding provided by the Vice-President for Information Technology. Through their work to promote these innovations, faculty have opportunities to take a deeper look at their teaching and scholarship. Students who enroll in TAC courses are not only empowered with advanced tools for problem solving, they also acquire a conceptual understanding of "applied" technology so that the utility of these tools can be transferred to different domains over time. With this extensive exposure to a wide range of information technologies, CAS students graduating from George Mason will have an education that is both grounded in the critical perspective of the liberal arts and bolstered by new ways of thinking for the digital age. The broader community served by the University is the ultimate beneficiary of the TAC program. Present and future generations of students will enter the region's workforce confidant in their ability to master new technologies and therefore better prepared to face the challenges of a rapidly changing global economy.

The TAC program has identified three basic types of technology competencies that would have practical value in the classroom as well as the workplace: *information management, electronic collaboration, digital authoring.* Each is supported by a subset of specific tools and activities that will be an integral part of course assignments and the learning outcomes intended for TAC courses.

1. Information Management
   Students will collect, organize, evaluate, and analyze different types of data. They will conduct research using *web-based directories* and *search engines* or *on-line library catalogs*. They will evaluate *digital archives* using sources and citations. They will use *databases* to create relational data structures that are the basis for queries and reports. They will use *spreadsheets* for data entry, plotting and graphing charts, and for descriptive statistics. They will use *geographical information systems(GIS)* for spatial analysis for descriptive statistics, economic geography, and environmental data.
2. Electronic Collaboration
   Students will engage in online collaboration for learning and to produce knowledge. They will communicate using, *e-mail, listserves*, and *asynchronous conferences*. The will exchange documents and other materials using *e-mail attachments, FTP, and netware*. They will collaborate on group projects and organize workflow using online tools that permit conferencing and the posting of documents.
3. Digital Authoring
   Students will be able to present information in an engaging, effective manner using digital authoring tools. They will design, develop and maintain websites using an *HTML editor*. They will learn visual principles of

communication(effective color and graphics, text treatment, and audience targeting) using *PowerPoint* to create a technology-enhanced presentations.

ITBeankit: An Educational Middleware Framework for Bridging Software Technology and Education

Abdulmotaleb El-Saddik[1], Stephan Fischer[2], Ralf Steinmetz[1,2]
1) Industrial Process and System Communications, Dept. of EE & Info. Technology
Darmstadt University of Technology
Merckstr. 25 • D-64283 Darmstadt • Germany
2) German National Research Center for Information Technology (GMD IPSI)
Dolivostr. 15 • D-64293 Darmstadt • Germany
{Abdulmotaleb.El-Saddik,Stephan.Fischer,Ralf.Steinmetz}@kom.tu-darmstadt.de

Overview: In this paper we describe a layered approach, which allows the adaptation of the visualization content according to the user's needs using meta-data. In contrast to existing approaches, the educator can adjust both the level of explanation and the level of interactivity of an animation, thus influencing the presentation and the results of the algorithms being illustrated according to a desired level of functionality and appearance, suitable for the specific needs of the learner. Our approach is similar to a middleware approach. In this three-tier model, the lowest layer of this paradigm suits the programmer. On the middle layer, which is composed of various services common to all educational animations, such as management of data, control, interaction level and presentation, acts the educator. The user interface of the current educational visualization is the top-layer medium with which the end-user (learner) interacts.

Meta-Data within Algorithmic Animations

One way in which software evolves is to push a configuration out onto the user and to make the program as interactive as possible. An alternative way is to defer such decisions until runtime, or to push configuration decisions out into the data. Data itself become more universal and reusable when it is accompanied by meta-data. As *meta-data* we define data that describe other data, rather than aspects of the application domain itself. These data may become even more general and independent when they are integrated into the code, which may be transferred over the Internet. Using the object-oriented language Java to implement data to be described, the use of meta-data or code descriptions as objects has great advantages. Instead of using meta-data in its general term and traditional role, to create universal descriptions of objects (for example in digital library systems) these meta-data are used instead to describe properties. Runtime mechanisms for accessing, altering, adding and removing meta-data or properties at runtime should be provided by the programmer in order to integrate data with meta-data seemlessly.

Several works have dealt with classifications of meta-data, for example [Böhm et al. 94] or [InfoQuilt]. InfoQuilt classified meta-data into two categories: content-dependent and content-independent meta-data. All of the methods used to classify meta-data make use of meta-data in its traditional sense of describing data to facilitate search activities of the data (in general the documents) they describe. That is, the meta-data descriptors are associated in a fixed way with the data sets and as granular as defined initially. However, meta-data can also be seen as parameters that are passed to some object of a system in order to change its behaviour as well as providing information, which will help search engines. In order to change the behaviour (dynamic property of a resource allowing it to be integrated into a desirable context) of an object, it should be possible to change parameters on the fly. For this purpose dynamic meta-data are needed, extending the static nature of meta-data in the traditional sense.

- *Static Meta-data*
  Static meta-data are meta-data that are used to create universal and widely applicable descriptions of objects, which may not change the behavior of the described object. Examples are [IEEE-LOM] and [DC].
- *Dynamic meta-data*
  We suggest the use of the new term "dynamic meta-data", describing the possibility to adapt the content of an object according to the value given in the description and the ability to change the value of a parameter of a given object in order to change its behaviour. As an example of dynamic meta-data we examined the Ethernet protocol. In the visualization of this protocol, changing the value of the meta-data field "PROBLEM" (being represented in the program as a property) from "Collision" to "Shortframe", may change the whole behavior of

the algorithm to be visualized. Dynamic meta-data can in its turn be divided into the following two categories. We further subdivide into horizontal and vertical dynamic meta-data. *Horizontal meta-data* contain information that does not depend on the content of the algorithm to be visualized. The meta-data fields defined within this category are common for all visualization units, and thus can be applied to all animations. *Vertical meta-data* are used when the decision of changing the value of a field is up to the user. Parameter panel is an adequate representation of these meta-data.

itBeanKit

We use the itBeanKit (interactive teaching Bean Kit) to develop animation chains consisting of modular animations visualizing the steps of an algorithm. The itBeanKit comprises the following levels:

- *Programmer*
  First, the programmer identifies animation objects that visualize the steps of an algorithm. He defines the smallest entities of the algorithm and develops them as black-box software components, which may be re-used for the development of other algorithms. The programmer specifies animation actions at particular points in the algorithm chain according to a predefined set of meta-data. The programmer's view has been described in detail in [Elsaddik et al. 99].
- *Educator*
  As a middleware actor, according to the needs of the end-user, the educator may convert an algorithm developed by the programmer to a series of animation sequences by mapping algorithm variables, specifying animation actions, and associating execution points in the algorithmic chain to perform the desired animation. He uses dynamic meta-data, which have been pre-defined by the programmer.
- *Learner*
  For the learner, a visualization window is divided into three areas: an animation pane, an explanation area, and a parameter pane. The animation pane displays the resulting animation envisioned by the educator. The explanation area displays some hints and information concerning the visualized algorithm. The parameter pane is divided into two parts: interactive utilities and a VCR, allowing the learner to control the progress of the animation. The interactive utilities pane depends on the algorithm and on the topic, defined by the programmer and customized by the educator. The animation may request intermediate input from the learner, allowing him to control the path of the algorithm.

CONCLUSION AND OUTLOOK

The itBeanKit provides an environment in which an educator, without conventional programming skills, can build an interactive visualization of an algorithm. We currently extend the itBeanKit, particularly by increasing the available choice of components. As a prototype, we implemented animations, for example "Ethernet" or "JPEG". Details can be found under the URL
http://www.kom.e-technik.tu-darmstadt.de/projects/iteach/itbeankit/applets/paradelektion/index.html.

REFERENCES

[Böhm et al. 94] Böhm K. and Rakow T. (1994), "Metadata for Multimedia Documents". In Metadata for Digital Media, Special issue of SIGMOD record, 23 (4), ACM Press.

[DC], Provisional Report of the Dublin Core Subelement Working Group and http://purl.oclc.org/metadata/dublin_core/wsubelementdrafts.html

[Elsaddik et al. 99], El Saddik A,. Seeberg C., Steinacker A., Reichenberger K., Fischer S., and Steinmetz R. (1999): "A Component-based Construction Kit for Algorithmic Visualizations. In Proceedings of the Integrated Design & Process Technology "IDPT'99, June 1999, will appear in the IDPT 2000 proceedings.

[IEEE-LOM], IEEE Learning Technology Standards Committee (LTSC): Learning Object Meta-data (LOM): http://www.manta.ieee.org/p1484/

[InfoQuilt] InfoQuilt: Information Brokering for Globally Distributed heterogenous Digital Media. Large Scale Distributed Information Systems Lab, Department of Computer Science, University of Geargia. http://lsdis.cs.uga.edu/infoquilt.

[Stasko et al. 93] Stasko J., Badre A. and Lewis C. (1993), "Do Algorithm Animations Assist Learning? An Empirical Study and Analysis", ACM Interchi Conference Proceedings.

Evaluation of a Systematic Tele-Tutor Training

Bruno Emans, Noor Christoph, Jacobijn Sandberg
Department of Social Science Informatics
University of Amsterdam
The Netherlands
emans@swi.psy.uva.nl

Introduction
The Lilienthal project is a collaboration of 5 European flight schools (Lufthansa, KLM, EPAG, IAJM and HORIZON), and the universities of Berlin, Stuttgart and Amsterdam. Within this project a Distance Learning Platform (DLP) for pilot training is developed. Students can study 250+ modules and they can communicate with their tutor and peer-students via e-mail, chat, discussion groups and bulletin boards.
In a distance learning environment, the role of the tutor is different from the role of a classroom teacher. Traditional teachers from the flight schools now had to learn to become a successful distance tutor. A Tele-Tutor Training has been set-up to provide for this need. This paper describes the systematic set-up and the evaluation of this Tele-Tutor Training.

Systematic set-up of Training Tele-Tutors
From the early beginnings of the project it was considered necessary that the classroom teachers would be trained for their role as distance tutors. Since communication between students and teacher is of vital importance for the learning process (see for example Laurillard, 1993), the DLP was designed with much possibilities for interaction (e-mail, chat, bulletin board and discussion groups). Now the teachers had to be trained to work with these communication tools. They need both practical knowledge of how to use the tools and strategic knowledge about when to use the communication tools.

For the training program a user-driven approach was chosen. The (future) tutors were asked to fill in (part) of the training objectives. They were provided with an electronic template, which they could use to describe the requirements and skills that they would need while teaching with the DLP. The basis of this approach was formed by the activity template provided in Barnard and Sandberg (1994) which links activity descriptions to technical support that is required for facilitating or enabling the performance of activities (Sandberg, Christoph and Emans, 1999). This inventory formed the basis of a list of six main categories of requirements for distance tutors on the DLP (see table 1).

Requirement categories
1. Background in distance learning and the DLP
2. Communication requirements
3. Information storage and retrieval requirements
4. Adaptation requirements
5. Administrative and management requirements
6. Coping with difficult situations

Table 1: Six main categories of requirements for distance tutors.

Categories 1 and 2 contain mainly basic requirements and skills in the field of distance learning, the DLP itself and the communication tools. Categories 3 to 6 contain the more advanced requirements and skills for being a distance tutor.

Description of the training
The different requirements and skills were trained in three phases. First a two-day seminar was organised to teach the tutors the basic skills of the communication tools and the DLP. Then a simulation program was set up. During two weeks, the tutors had the opportunity to practice these skills in a real distance education simulation. Each tutor was assigned a class of students. The tutor never lived in the same city as his/her students, so no other than distance communication was possible. Before this simulation the teachers were

asked to formulate their own learning goals, besides getting practical experience with the DLP. (For example "To be able to interest students".)
The Tele-Tutor Training concluded with another two-day seminar. During this seminar the experiences of the simulation program were discussed. Furthermore the advanced skills and requirements like time-management and the strategic use of communication tools were trained.

Evaluation Results
The three parts of the Tele-Tutor Training were evaluated separately, and one over-all evaluation was performed. The evaluations focused on the actual skills the tutors gained during the different parts of the training, and on the confidence and motivation of the teachers to become distance tutors.
After the first Tele-Tutor Training seminar, all tutors mastered the basic skills for using the DLP. This was a good result, since some teachers that had never used e-mail before now were able to use the different communication tools on the DLP swiftly. And more important, the motivation and confidence of most teachers to become distance tutors grew during the seminar. The simulation program resulted in 82% of the teachers achieving (partly) their learning goal. Furthermore, experience with the 'real situation' was of great value.
All subjects in the last Tele-Tutor Training was reported to be useful.. The tutors were asked for their opinion on the usefulness of the different parts of the training and of the complete training as a whole. These overall figures can be found in figure 1.

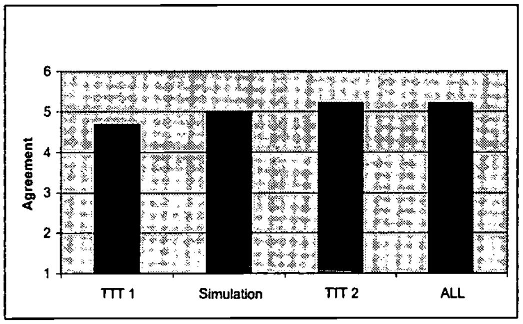


Figure 1: Mean answers to the question on the usefulness of different training parts. (1 = strongly disagree, 6 = strongly agree)

Conclusion
We tried to set up a Tele-Tutor Training that trained all skills and requirements needed to become good distance tutors. The requirements where gathered by the (future) tutors themselves, giving them influence in their own learning process. The first skills and requirements that were trained were the basic skills for handling distance communication and the practical and technical knowledge for working with the DLP. The training seminar for this purpose was successful, since the confidence of the tutors grew, and they were all able to handle the communication tools and DLP on a basic level.
The follow up training would involve more advanced skills. It was felt that these could only be trained in a real distance course simulation. It turns out that this feeling was correct. Real problems only come up in a simulation as we performed it. And in a simulation as we set up, the tutors finally got an idea of what it would be like being a distance tutor. The set-up was such that every tutor could individually train on his own personal learning goals, while all the tutors were forced to train the essential skills, and build up experience with the DLP.
We strongly advise everyone to incorporate a simulation in a distance tutor course. Distance tutoring only can be taught over a distance. During the presentation I would like to illustrate this with some more examples and evaluation results.

References

- Barnard, Y.F. and Sandberg, J.A.C. (1994). *The learner in the centre: towards a methodology for open learner environments.* (Doctoral dissertation, University of Amsterdam, 1994). Koninklijke bibliotheek, Den Haag, The Netherlands.
- Laurillard, D. (1993). *Rethinking university teaching. A framework for the effective use of educational technology.* Routledge, London and New York.
- Sandberg, J.A.C., Christoph, L.H, Emans, B.S. (in press). Tutor training: a systematic investigation of tutor requirements and an evaluation of a training. *British journal of educational technology.*

Perceptions of a Fearless Experimenter:
Student Perceptions of Creating Electronic Portfolios

Dr. Susan Eskridge, Benerd School of Education, University of the Pacific, USA, HYPERLINK mailto:seskridge@uop.edu seskridge@uop.edu

Ray Posey, Benerd School of Education, University of the Pacific, USA, email: rposey@uop.edu

A simple definition of a portfolio is "a container of collected evidence with a purpose" (Collins, 1992). Many schools of education across the country ask students who are entering the teaching profession to create these "containers" and provide evidence of their successful completion of their preservice experience. Some of these schools have offered students the opportunity to create their portfolios through the use of technology. Rather than creating a binder with a collection of artifacts, students who use a technological approach to create a multimedia presentation of their preservice experience. It seems that the purpose of most portfolios completed by preservice students is to exhibit their performance during course work and student teaching. Electronic portfolios seem to have a secondary purpose: they communicate an expertise and enthusiasm for the use of technology on the part of the student. Our study considers this secondary purpose from the students' viewpoint.

The National Council for Accreditation of Teacher Education (NCATE) issued a report called "Technology and the New Professional Teacher: Preparing for the 21st Century Classroom" in 1997. The NCATE technology task force suggests that perhaps the best way teacher education faculty can inspire future teachers to use technology is "to cast themselves as learners and to experiment fearlessly in the applications of technology," making themselves "role models of lifelong learning" (p. 9). The U.S. Department of Education states that technology offers "numerous possibilities for integrating assessment into the daily life of the classroom" (1997, April, p. 6). This study asked students to reflect upon their experiences and perceptions as "fearless experimenters" with electronic portfolios.

This study asked students from a small California university to reflect upon the process of creating multimedia portfolios during their teacher education program. This study considers student perceptions of electronic portfolios during four stages of their teacher preparation program; 1) during the very first course in education, 2) at the end of their teacher education course work, 3) during student teaching, and 4) after completing the education program and obtaining a teaching position. Students in each of these categories were interviewed to gain insight into the experience of collecting and preserving artifacts electronically. From these interviews with students, their perceptions evolved into themes that focused on issues such as the experiences of creating the portfolio, the students' personal reflections during the portfolio process, the manner in which students selected particular artifacts, and the usefulness of the electronic portfolio once it was completed. The students' insight was significant and may have an impact upon other schools of education as they consider embarking upon the electronic portfolio process.

Some of the emerging themes mentioned by the students included 1) time constraints and issues, 2) familiarity with software used to create electronic portfolios, 3) the need for guidance and support from those with expertise in creating these portfolios, and 4) the opportunity to manipulate, experiment, and create by themselves, rather than having the "expert" provide short cuts by pushing the student through the process more quickly than their current knowledge would allow.

Students expressed that the most pressing need for creating an electronic portfolio is the issue of time. Within a hectic schedule, students found that when asked to create an electronic portfolio, they were overwhelmed by the process. Some indicated that they had no understanding of the time commitment needed to create this type of document. They also expressed that the concern about time was very individualized. Some students needed time to become familiar with the software program while others, who already had experience with the program, needed time to push themselves beyond their current level of understanding.

Familiarity with the software was a concern for some students who wished to create a portfolio. They believed that it was a great burden to become familiar with the software at the same time as they tried to create their portfolio. Prior working knowledge of the software was seen as crucial by these students.

A third concern expressed by the experimenting students was that they needed access to individuals who had some expertise either with the software, with creating portfolios, or with creating actual electronic portfolios in the past. The students did not care whether the "expert" was a faculty member or simply another student. They seemed to be very comfortable with learning from their peers. Some students expressed that other techonology-using students were often more understandable than technology faculty because their level of expertise was more comparable to that of the novice student.

Another concern expressed by students focused on the nature of the help they received from "experts". Students mentioned that often, the expert "grabbed the mouse and sped through the process" rather than guiding the students and allowing them to experience the process for themselves. The students felt that once the "expert" left them to work on their own, their understanding was not enhanced by the assistance. The students expressed frustration that they were often left to work their way through the process alone. Because the "expert" had by-passed the student's involvement rather than serving as a guide in the process, their assistance was not seen as helpful.

In conclusion, if faculty members in schools of education continue to encourage students to create an electronic portfolio of their college and/or student teaching experience, they must remember that the students have concerns about the process of creating such a document. As stated previously, the issues found in the study focused on time, software knowledge, and the helpfulness of those with expertise in the area of technology. As students work through the process of creating electronic documents, faculty members need to listen to and compile their concerns in order to better meet the needs of future students. Through a deliberate conversation with student experimenters, those interested in promoting technology among preservice teachers may obtain valuable insights that will assist students in the creation of creative, organized and frustration-free projects.

Helping K-12 Teachers Integrate Internet Technology in their Classrooms

Christopher Essex
Instructional Systems Technology
Indiana University
United States
cessex@indiana.edu

Abstract: This paper describes the design, development, evaluation and revision of an online course over the six semesters that it has been offered. The course is designed for K-12 teachers and librarians interested in integrating Internet technology into their teaching. In this course, students research educational resources on the Internet, design their own educational websites, and develop educational activities that utilize the Internet. Recommendations for others teaching similar courses are offered.

Introduction

According to the National Center for Education Statistics (1999), in the Fall of 1998, 89% of public schools were connected to the Internet. But do our K-12 teachers know how to use this new technology? The same study states that "teachers commonly report that they have not received adequate preparation in the effective use of computers within the classroom." Throughout the nation, K-12 teachers are feeling pressure to integrate Internet technology into their teaching, but even if the hardware and technical support is available, pedagogical support is often lacking or totally unavailable. Now that the classroom is wired, how can the elementary and secondary educational process benefit from the availability of the Internet? This online course was developed for K-12 teachers who are not finding much support locally in answering this crucial question.

Description of Course

My decision to offer this course came out of experiences I had in the real world of K-12 education. While teaching a summer computer course at a local elementary school, I introduced my students, fourth through eighth graders, to the wealth of educational resources available on the Internet, and I gave them the opportunity to practice their research skills and explore their creativity through creating their own websites. The other teachers at the school were intrigued by our use of the Internet and wanted to learn more about how they could integrate this new technology into their teaching practice. Because of this experience, I decided to develop an online course on the topic.

The audience for this course is, as I have stated, K-12 teachers; however, I was pleasantly surprised to discover that K-12 librarians were also interested in the course. I have had students from all over the US in the course, as well as from as far away as the Philippines and Colombia. The course is a graduate-level, one-credit-hour course offered for credit by the School of Education at a leading Midwestern state university. The course delivery is 100% online (the students and instructor never meet face-to-face), though the students still are assigned a print textbook (though this may change in the future). The course was first offered in the summer of 1998, and has been offered every semester since then.

My initial design for the course was based on my own experience as a teacher, both at the K-12 and the postsecondary level, and an instructional designer, having spent four years working with instructors to develop other online courses. After reviewing other courses and textbooks on this integrating technology into the K-12 classroom, I decided on the following objectives for the course.

In this course, the students will gain experience in:

- Using email for contacting outside experts and other students

- Utilizing an online, asynchronous bulletin board system for class discussion
- Communicating with other students and the instructor via a live, synchronous chat program
- Evaluating existing online resources for educational value
- Using HTML to create web pages

But above and beyond the above technology-related goals stated above, the students will also gain experience in:

- Designing lesson plans that integrate Internet usage into the curriculum
- Sharing their experiences with, and concerns about, using the Internet in their classroom with fellow teachers
- Dealing with issues of Internet safety and student use of Internet resources
- Reviewing current research on teaching with Internet technology

Changes in the Design of the Course

Over the six semesters that the course has been offered, I have made many changes to the course design, both for technological and pedagogical reasons. In terms of the technology-related changes that were made, it is obvious to even a casual observer that computer hardware and Internet software have changed enormously since Summer 1998. Faster computer processors, increases in modem speed, more advanced browsers, and improved email and synchronous and asynchronous conferencing programs have all influenced the design of the course, and they will continue to do so as Internet technology continues to develop.

Pedagogical changes that occurred over the six semesters were primarily related to my interest in improving the quantity and quality of our online class discussion. Feenberg (1993) described the role of the instructor teaching through computer-mediated communication technology as having three roles: that of providing context, monitoring, and meta-commenting. Feenberg's three roles provided me with a useful framework for thinking about my activities within our online conferencing forum. In terms of my contextualizing function, I would open discussion, generally by posting a question to respond to, or by giving them a task to perform. Early on in the semester, it is important to set the norms of the conversation by making a few postings which will serve as models for the students, in terms of the language and tone and level of formality that our conversation should have. I also provided context by providing the schedule and an overall agenda for our discussions over the semester. My monitoring functions included welcoming students, assigning them to teams, and nagging them when they weren't posting enough. Finally, my metacommenting included providing students with summaries of what we had accomplished in the discussion up to that point, and working with students to resolve any problems in communication or misunderstandings of the context of our communication that occurred.

Conclusion

If our nation's classrooms are to truly benefit from the sudden infusion of Internet technology that the latter half of this decade has witnessed, teachers must be given both technological and pedagogical support as they begin to integrate this technology into their teaching. It is my belief that online courses such as the one described in this paper are an important way to address this need, especially for teachers who find it difficult to attend on-campus courses.

References

Feenberg, A. (1989). The Written World: On the Theory and Practice of Computer Conferencing. In Mason, R. and Kaye, A. (Eds.), *Mindweave: Communication, Computers, and Distance Education.* Oxford: Pergamon Press.

National Center for Educational Statistics. (1999). *Internet Access in Public Schools and Classrooms: 1994-98.* (On-line). Available: http://nces.ed.gov/pubs99/1999017.html

"NEXT STEPS"

Dr. Josephine Ferazzoli Farrell
State University of New York at Oswego
Oswego, New York 13126
jfarrell@oswego.edu

Abstract: The education of preservice K-12 teachers in using communications technologies has not kept pace with the technologies themselves. Consequently, when new teachers enter the classroom, they routinely limit their use of technologies to add-ons and skill/drill exercises rather than integrating those technologies into their lessons to create optimal learning environments for students. A consortium of Central New York educators, led by the State University of New York College at Oswego, along with both rural and urban K-12 school districts, will remedy this situation by implementing a program to provide preservice teachers, teacher educators, and K-12 teachers with improved access to and support with technology. The plan also provides preservice teachers the opportunity to model teachers who are experienced in infusing technology into the New York State Standards-based curriculum

NEED FOR PROJECT

Educators have seen a recent proliferation of initiatives aimed at infusing technology into Teacher Education Programs. Current conditions contributing to this effort are:

1. Recent standards developed by the International Society for Technology in Education (ISTE) and adopted by the National Council for the Accreditation of Teacher Education (NCATE).
2. The NCATE Task Force on Technology in Teacher Education's recommendation that schools of education have a technology infusion plan (NCATE,1997),
3. The subsequent National Education Technology Standards Project (Thomas & Knezek, 1998),
4. The availability of federal funds from several sources, as well as,
5. The demand of the K-12 schools for technologically sophisticated teachers.

With all of these initiatives, why haven't teacher education programs kept up with these crucial technology requirements? We all know that generally change is a slow process. It is time that helps change take place. Already over-scheduled educators with full class loads are reluctant to spend time on initiatives that take time away from tried and true programs and curricula. Of course, times change and educators must change from what worked well or adequately in the 50's and 60's, and maybe up until recent years, to what our children need to function optimally in the global marketplace of today. The major effect of the multimedia emplacement may be in adapting students for the technological world they are soon to enter as productive society members. Additionally, the traditional methodology is no longer suitable for preparing preservice teachers for dealing with the complex demographics of the schools (Allen, 1997); they can easily communicate with people around the world, and the schools no longer have to rely on outdated texts to deliver this information to them.

Clearly our K-16 schools have not kept up-to-date with what is happening with regard to technological advances. The millennium is upon us, and our teachers are not prepared to teach the children in a manner that will help to insure their future success. Although e-mail is a word that is on the lips of most people today, whether or not they use it themselves, some educators do not use it, even when they have access to it. Access to new technologies will not by itself solve this problem because it is two-fold: educators need to have access, but they also need confidence and knowledge about the pedagogical potential of the new technologies. Preservice teachers need to experience ways in which new technologies can be integrated seamlessly into lessons in order to make active and pedagogically sound use of technology.

A key element in promoting a natural integration of technology into lessons is an opportunity to model excellent classroom use of technology. One can lecture about how a unit plan is created, BUT it is not until a preservice teacher actually creates a unit plan that real learning and understanding about unit planning takes place. The same is true for teaching with technology. Preservice teachers can know about technology, word processing, e-mail, and the World Wide Web; however, one cannot conclude that they will be able to utilize technology appropriately in the K-12 classroom to enhance the teaching/learning process. In fact, the opposite is the case; preservice teachers who are technologically literate have indicated that they had false notions about what you would do with technology in a K-12 classroom before they were exposed to methods courses where their instructors served as models for technology infusion; had field experiences in classrooms with master teachers who integrated technology into their curriculum and used it as a tool, instead of an add-on or skill/drill; and watched excellent (model) teachers via videoconferencing (Vannatta, 1999). Preservice teachers need technology to get a glimpse of real-world contexts and to connect to practitioners in the real world (Jonassen, 1995).

Current practice, however, provides too few opportunities for preservice students to model after others. A consortium of schools including the State University of New York at Oswego and partner K-12 schools will continue its efforts to remedy this problem by building on lessons learned in an earlier effort to infuse new technologies into teacher education. Specifically, through the establishment of a plan that is inclusive of more teacher educators than are presently included through our Goals 2000 Grant, we will provide technology, technological support, and mobile teacher stations that include the ability to do desktop-to-desktop videoconferences with partner schools. Overall, we will improve preservice teachers access to observing and modeling "real classroom" uses of technology.

Gaps and Weaknesses in Current Practice--Project 2000

The consortium's participation in a project funded by a Goals 2000 Grant has allowed us to see first hand the weaknesses in current practice and the ways they can be remedied. The Goals 2000 technology infusion project began in 1997 with the purpose of increasing preservice teachers' proficiency in classrooms through videoconferencing and technology infusion. The effort was supported theoretically by a constructivist view of learning, which identifies three essential elements as contributors to preservice teachers learning how to teach: reflection, active student involvement, and development of a community of learners (White, 1996). All of these elements can be enhanced through the use of computer-mediated instruction (Ford, et al, 1999).

The Goals 2000 project involved partnering college faculty from the School of Arts and Sciences and the School of Education with K-12 teachers to infuse technology in preservice education. The project supported a continued revision of education courses, implementation of an integrated MST course at one of the partner high schools, ongoing training and mentoring of faculty and inservice teachers, and infusion of technologies into science foundations, general methods, special education methods, and reading methods courses. A key component of these activities was the targeting of methods courses offered each semester for enhanced infusion of technology. Enhancements were chosen or developed in partnership with Arts and Sciences faculty and K-12 partners during a summer workshop and subsequent team meetings. Among other activities in these methods courses, there was also a concerted effort at modeling integrated classroom uses of technology. Methods classes used the School of Education's computer lab and the Goals 2000 Project's "technology" classroom. There, instead of using computer- aided instruction as add-ons to lessons, or sending preservice students to the computer for additional research, a methods faculty member would link writing assignments to her web page, provide a link to a group unit assignment and then to hyperlinks on related topics. Research assignments seamlessly lead to the use of web technologies to enhance research and encourage group interaction. In addition, students in methods courses were periodically linked via videoconferencing to K-12 project partners in order to observe the technology at work in real classrooms.

These activities provided students with experiences that would increase their confidence with the technology, permit them to model imaginative uses, and forestall the tendency to use the technologies merely as add-ons. Moreover, and importantly, the videoconferencing provided them with an early and real-time experience in the potential use of technologies in teaching specific subject matters.

Formal evaluation after the second year of the Goals 2000 Project, as well as formative focus group feedback, testified to the success of the project. Pre- and post-tests indicated that the technology infusions did, in fact, significantly increase preservice teachers' proficiency in integrating technologies. After preservice students completed their practicum experiences, supervising teachers indicated their significant approval of the students; they were seen as "heads and shoulders" above earlier practicum students in their ability to infuse technology into the New York State Standards-based curriculum.

So what is the problem? If we know what our preservice teachers need to develop into the teachers that we need for tomorrow, why haven't we restructured our teacher preparation programs to reflect those necessary changes? The answer to that question is not a simple one; it is complex and multi-faceted. It has to do with change, human nature, knowledge, money, and much more. It is indeed a dilemma. How does one accomplish teaching a new group of teachers to be technologically prepared for a technological environment if they are not prepared themselves? One can compare it to trying to teach someone to fly an airplane, when they are not truly comfortable with flying an airplane themselves! A whole generation of teachers needs to learn new tools, new approaches, and new skills. This will be a challenge, not just because of the slow moving wheels of the change process, but because of financial cutbacks, low teacher morale, increased workloads, and reduced retraining budgets (Tapscott, 1999).

References

Allen, K.W. (1997). Enhancing multicultural education with technology. Technology & Teacher Education Annual, 1997, Charlottesville, VA: Association for the Advancement of Computing in Education.

Ford, M.J., Dobyns, S.M., & Poe, V. (1997). Using the Internet and children's literature to understand cultures. Technology & Teacher Education Annual, 1997. Charlottesville, VA: Association for the Advancement of Computing in Education.

Jonassen, D.H. (1995). Supporting Communities of learners with technology: A vision for integrating technology with learning in schools. Education Technology/July-August 1995, 60-63.

National Council for the Accreditation of Teacher Education (1997). Technology and the new professional teacher. Washington, DC: National Council for Accreditation of Teacher Education.

Roberts, G. (1999). Lessons from Sisyphus in a technological Age. Educational Leadership/February 1999, 75-77.

Tapscott, D. (1999). Educating the net generation. Educational Leadership/February 1999, 7-11.

Thomas, L.G. & Knezek, D.G. (1998). National educational technology standards. Educational Leadership, 56 (5), 27.

Vannatta, R. (1999) Goals 2000 technology infusion project: Evaluation of year 2. Evaluation report available from Vannatta, Bowling Green, OH: Bowling Green State University.

Wetzel, K. (1993). Teacher educators' uses of computers in teaching. Journal of Technology and Teacher Education, 1 (4), 22-27.

White, C. (1996). Relevant social studies education: Integrating technology and constructivism. Journal of Technology and Teacher Education, 4(1), 69-76.

User Studies: Evaluating the Use of EPSS Tools for Self-Management by Children

Overview of the Presentation

The presenters will report the results of a research project designed to evaluate the effectiveness of new EPSS software created for children to provide them tools for managing their personal behaviors in classroom settings. The presenters will demonstrate the EPSS software and an online resource infobase that supports teachers' use of the software tools. Methodology for the user studies will be explained. These include the use of a behavior rating scale by teachers, perceptions of locus of control by children, software audit trail logs, an examination of artifacts created by children, and results of interviews with teachers. This research study is underway during the 1999-2000 school year and results will be available for presentation at Ed-Media.

Theoretical Base for the Use of EPSS with Children

Computer-based training and support mechanisms are an innovative approach for helping children gain control over personal behaviors. Although there are limited data on the use of computer-based instruction to support behavior change in children to date, research results are promising. Fitzgerald and Werner (1996) reported success with a computerized verbal mediation essay as a cognitive retraining procedure to assist a student with significant behavioral disorders in changing his behavior; the computerized essay provided consistent practice and focused the child's attention and thoughts on behavioral choices and consequences. In another case study, the same researchers reported a procedure in which software templates were developed for a student to create self-monitoring materials. This study was the pre-cursor to this work to develop and investigate the use of EPSS tools with children and their teachers as part of a federally-funded initiative focusing on children with classroom behavior problems (Fitzgerald & Semrau, 1998-2001).

The Two Components of the EPSS System

1. KidTools

KidTools is a software program designed as easy-to-use templates that can be individualized by children and/or their teachers. The software is kid-friendly with colorful graphics, text-with-audio directions, and simple formats. KidTools has undergone usability testing with children ages 7-10 to ensure literacy is appropriate for young children (Fitzgerald & Lynch, 1999). The text and audio in KidTools utilize natural language of children, graphic characters serve as "guides" to the different tools, and audio directions are provided to supplement the simplified text instructions.

KidTools is designed for children to use independently on classroom computers. To use the templates, the child simply clicks on "hot words" on the template form to enter personalized content and then prints the completed form for use in the classroom. The program automatically enters the child's name, date, and establishes an audit trail for recordkeeping purposes and user studies.

2. Teacher Resource Infobase

The online resource infobase provides adults with information to assist children in using KidTools. The tools in the program are grouped into six types of self-management procedures: point cards, countoons, self-monitoring cards, STAR (Stop-Think-Act-Results) cards, make-a-plan procedures, and contracting. The infobase includes descriptive information for each type of procedure, steps for implementation, a variety of examples for students, troubleshooting tips, and recommended resources. It is expected that teachers introduce children to effective use of KidTools and troubleshoot the procedures as they are implemented in classrooms. This information resource component has been developed in conjunction with KidTools for teachers and is available on CDROM as well as online for easy access.

Participants

The research project is underway in three elementary schools in two states. The participants are children, ages 7-10, whose teachers nominate them for inclusion. Children selected to participate are those either (a) showing behavioral difficulties in classroom settings, or (b) having personal habits that can be improved through a self-management process. Participants can be attending general and/or special education programs and there are no disability requirements. To be eligible, each child and his/her parent must voluntarily agree to participate and the teacher must attend an orientation session.

Methodology

Each child utilizes KidTools under the guidance of the classroom teacher for a four-month period. The process of identifying behaviors and selecting the tools for self-management is negotiated between the child and the teacher. Implementation decisions also include length of time for use of each tool and positive outcomes for success with the tools. Parents may be involved in daily communication regarding use of the tools at school. It is anticipated that tools will be used for a wide variety of behaviors and that tool usage will change as the child demonstrates progress. These kinds of unique applications that will be examined through the audit trail data and tool artifacts.

Data Collection

1. Gruen, Korte, Stephens Internal-External Scale for Children: Each child completes a simple questionnaire about his/her perceptions of internal versus external behavior control in school.

2. Comprehensive Behavior Rating Scale for Children: The primary teacher who nominates the child completes a normed, objective rating scale on 45 behavior items.

3. The audit trails stored on the computer disks will be analyzed for tool selection, content entered into the tools, and frequency of use by each participant.

4. Artifacts created by the participants and saved by the teachers will be collected and analyzed for indicators of success and actual use by the children.

5. Teachers will be interviewed at the close of the project regarding use of the tools, perceived impact on children's behavior, usability of the resource infobase, satisfaction with the software tools, and recommendations for improvement.

Data Analysis and Interpretation

Results from the locus of control questionnaire, behavior rating scale, and usage data will be entered into a computer file for statistical analysis. These data will be linked to qualitative information derived from audit trail data, artifacts, and teacher interviews. The interpretation will include: (a) an examination of the behavior characteristics of the participants (Comprehensive Behavior Rating Scale for Children), (b) an examination of the beliefs children have about behavior control in the classroom (Gruen, Korte, Stephens Internal-External Scale for Children), (c) descriptive data on frequency of use and content entered into the tools by children grouped by age and locus of control, and (d) qualitative analysis of artifacts and teacher perceptions.

The results from these user studies will allow developers to improve future design and development of EPSS software for children. Interview responses will help define the need and use of supports for teachers who implement EPSS procedures with young children. Finally, the approaches utilized in these user studies may provide guidance to other researchers who conduct usability tests with young children.

References

Fitzgerald, G., & Lynch, J. (1999, June). EPSS in the classroom: Self-management tools for kids. Ed-Media 99 World Conference on Educational Multimedia and Hypermedia, Seattle, WA.

Fitzgerald, G., & Semrau, L. (1998-2001). Virtual Resource Center in Behavioral Disorders. U.S. Department of Education Grant # H029K0089.

Fitzgerald, G., & Werner, J. (1996). The use of the computer to support cognitive-behavioral interventions for students with behavioral disorders. Journal of Computing in Childhood Education, 7, 127-148.

Distance Learning Development Teams

Anthony J Frisby, PhD
Thomas Jefferson University
1020 Walnut Street
Philadelphia, PA 19107
Tony.Frisby@mail.tju.edu

Abstract: Thomas Jefferson University, an urban health sciences university located in downtown Philadelphia, Pennsylvania, has produced and evaluated two very different distance learning format courses. Each course was a partnership between TJU's Academic Information Services and Research (AISR) division and the College of Health Professions' Nursing Department. The Nursing Department was concerned about local competition for students and wanted to attract potential program candidates for its graduate degree program unable, or unwilling, to avail themselves of the traditional campus-based course schedule. This short paper describes the development team approach used to produce each course and presents descriptive and anecdotal feedback from students.

Development Team

The literature in software development and distance learning indicates considerable benefits in using a team approach. As Ramesh Rao, associate dean of the Graduate Business School at the University of Texas-Austin states, "From the standpoint of development, creating courses in a new medium such as the Internet can be very exciting. Very often, however, the faculty member, well-versed in his or her own subject area, does not possess sufficient knowledge in the areas of technology or instructional design." (Jeff Cobb, 1999) AISR has effectively used development teams in designing and producing high quality instructional material. The team contributes qualities no one person can master. Development team roles are outlined below.

Subject Matter Expert (SME) is the primary content person and responsible for writing, or identifying an existing source of course content, determining appropriate exercises, and reviewing all material for accuracy.

Course Editor is responsible for keeping the group organized and on schedule, as well as reviewing material for consistency. The role of editor is similar to that in the print industry and a project manager.

Instructional Designer works closely with the programmer and artist to develop the user interface for the course, identify appropriate learning technology tools for the course, and converts the content supplied by course faculty into storyboards. The instructional designer analyzes the educational goals and determines the best activities to allow learners to reach those goals.

Programmer uses the supplied storyboards, text, and graphics to code the online course using a combination of HTML, Flash Shockwave files, JavaScript, and PL/SQL commands. At Jefferson, we use a number of programming tools to facilitate production and improve the level of interactivity with the content.

Graphic Artist works closely with the SME and instructional designer to produce graphics and animations that engage the learner with the content.

Database Administrator is responsible for developing the database tables and access procedures, and for creating routines to record the students' progress through the material and responses to questions. At this time Jefferson is using Oracle as its database allowing considerable customization to meet both instructional and faculty needs.

Course Design and Production

Epidemiology, a graduate course for advance practice nurses, was selected as the first course to produce in this format. A web-based version of the course was developed over a nine-month schedule. The distance learning course covered the identical content as the campus-based course, but substituted alternative activities for those in the classroom. Online course materials included graphics, animation, over 1200 information "pages," a search utility, glossary, self-assessment practice quizzes, exercises, discussion boards, and case studies.

The second course, *Health Policy, Ethical and Legal Dimensions of Care*, was developed soon afterwards using a very different, much less labor intensive, approach to distance learning. Whereas the Epidemiology course produced a completely self-contained learning environment and used standard examination techniques, Health Policy used an existing, print-based textbook and online group work for evaluation.

These two courses (in either campus-based or distance-learning format) are required of all matriculating graduate nursing students. However, non-matriculating students may take these courses as well, allowing interested candidates the option to experience the curriculum before committing to a degree program. Current plans include developing online versions of all core courses in the graduate nursing program, with the goal of reaching a wider pool of students from which to recruit.

Course Results and Comparison to Campus Group

Quantitatively there was no significant difference between the distance learning and campus-based groups. The no-significant difference result is not unusual in alternative education programs. Years of research studies designed to compare traditional instruction and different computer-based learning models have suggested that the actual method of delivery may matter very little in the final outcome of student learning. Perhaps the most reliable variable for predicting student results is their involvement with the content. Time involved with the content or time interacting with the content seems most related to student success. On a subjective measure, students in the online Epidemiology course reported greater satisfaction with the course overall, and rated the course as more relevant to nursing practice than did the campus-based group.

Summary

Faculty and most students expressed their satisfaction with the distance learning format. It should be noted that distance learning is not suitable for every student. Distance learning requires a largely self-directed learner, with a fair amount of self-discipline to regularly interact with the content. Some students enrolled in the distance learning format course expecting it to be easier or require less work than the traditional course. They were surprised by the amount of effort required. As universities learn more about the needs of distance education students, new tools will be developed to meet these needs. A larger instructional design toolbox will allow developers to include an increasing variety of interactive exercises and make learning more meaningful for all students.

Our foray into distance learning was very successful. We are pleased to report that not only did the majority of students say they would take additional distance learning courses, several have. Since the first course was offered in 1998 two additional courses have been released and course enrollment has increased with each semester.

Acknowledgements

The author acknowledges the contributions of the content faculty, Dr. Molly Rose (Epidemiology course), Dr. Mary Bowen (Health Policy course), and the development team of Michael Hamlin (editor), Susan Jones (editor), Christopher Braster (programmer), Paul Soler (graphics), Inessa Melamed (database administrator.)

Virtual Reality Simulation of Reovirus

Denis Gadbois, David Rittenhouse, Dave Goulden
University of Calgary
2500 University Drive N.W.
Calgary, Alberta, Canada, T2N 1N4
dgadbois@ucalgary.ca

Abstract: There is an increasing role for 3D imaging and animation in clinical medicine and in scientific and educational visualization in recent years. Indeed, it is evident that computer graphics are poised to replace hand-painted textbook illustrations to become the main vehicle through which complex scientific phenomena are visually expressed. This paper describe steps taken to help visualize and popularize the research done by the Cancer Biology Research Group of the University of Calgary on the reovirus (Dr. Patrick Lee, Dr. P. Forsyth, Dr. M. Coffey and Dr. P. Strong).

Introduction

Generally speaking our survey has found that medical animation are used for: 1) demonstrating and popularizing surgical procedures and biological processes; 2) simulating surgical procedures; 3) educating, students, patients and healthcare professionals; 4) visualizing macroscopic and microscopic anatomical structures; 5) introducing new products to physicians or consumers. In the field of medical animation, popularization can be described as the breakdown of the seemingly impenetrable wall that sometimes stands between hard medicine, student and the public. The focus of this work is to render any discovery in a visually arresting manner without sacrificing the clarity of message. The goal is to represent complex phenomena as understandable and plausible animations.

The reovirus (reo is an acronym for respiratory enteric orphan) is a naturally occurring virus that is believed to cause mild infections of the upper respiratory and gastrointestinal tract of humans (2). Preliminary research shows that the reovirus is a potent killer of cancer cells and can selectively kills cells with an hyperactivated Ras biochemical pathway (2). The Ras pathway normally regulates cell growth but becomes highly active in about 75% of tumors (including breast, pancreatic and brain cancers). Infection of a single cancer cell by a single reovirus particle can generate a thousand progeny reovirus particles, which in turn infect and destroy neighboring cancer cells. This cycle continues until all cancer cells are eliminated. Throughout this process, normal cells are spared. Tested on mice only at this point, this approach could have a tremendous implication for the treatment of cancer in humans.

The Method

An animation was developed to illustrate the research work and educate the student about how reovirus kills cancer cells. Our animation team chose SOFTIMAGE | 3D. Softimage is well designed for scientific visualization where the goal is not solely to represent scientific data, but to also tell a story. To represent these complex events (the processes of initiation, infection and replication), we used the following steps to achieve our goals:

a) Storyboading

Several meetings were held with the research team to discuss the purpose of the animation, the intended audience and the level of detail required. Several two-dimensional illustrations were provided for the animation team to work from The sketches and eventual storyboards for the animation were planned using these reference materials and related literature in molecular biology. One of the first facts that became evident in the planning period was the varied levels of scale that would have to be represented. A way had to be found that would enable the story to move from a macro scale (the mouse), to a cellular scale, and finally to a biochemical scale. These scale jumps had to be seamless enough to prevent the viewer from becoming disoriented about what was being shown. One way this was achieved, for example, was zooming into the cancerous tissue on the mouse and then fading into a scene showing the cellular surface. In addition, aesthetic choices about how the environments would look had to be made. It was decided that monochromatic tones would be used to de-emphasize often complex background scenes. Elements that needed to be highlighted against this background would be given different colours to bring them to the viewer's attention.

b) Model Building

1) The Mouse

To design the mouse we used photographs of mice taken from a top, side and front views. The pictures were scanned and converted into tiff format. The scans were then imported into SOFTIMAGE | 3D. Using both the autotrace and the rotoscope option, the mouse was designed with nurbs (Non-Uniform Rational B-Splines). The tumor location on the hind flank of the mouse was based on actual experimental protocols used by the research team. The final stage involved placing and positioning fur as a two-dimensional (2D) texture map.

2) Cell Surfaces and Proteins

The plasma membrane of each cell was modeled from a primitive two-dimensional grid. An earth tone was given to the outer surface of the cell, while the inside surface was given a water tone. Various surface proteins and receptors were created from other primitives and revolved two-dimensional profiles, and attached to the plasma membrane model using constraints. To conserve disk space, instances of these proteins and receptors were duplicated over the surface of the plasma membrane model. This made the editting of hundreds of these shapes simple and screen refresh rates much faster. A cyclic wave deformation was assigned to the plasma membrane to help create a dynamic, "living" environment . Special attention was given to the proteins and receptors of the Ras biochemical pathway, in lieu of its importance to the story being told. These models were built in consideration of their affinity to the plasma membrane and to each other. Plausible structural details were created on each model to illustrate its binding specificity to the next and previous proteins in the chain. To emphasize their importance, the proteins of the Ras pathway were given contrasting textures to the blue and purple-shaded elements comprising the background .

3) The Reovirus

A detailed model of the reovirus was created based on the structure of the actual virus as determined from electron and cryoelectron micrographs, and image reconstructions (4,6). The ultrastructure of the reovirus consists of a non-enveloped double shell of inner and outer capsids which enclose several proteins which aid in its replication, as well as a genome of double-stranded RNA (3). The components of the capsids were modeled with extruded polygons and circles, the proteins with metaballs, and the RNA stands with simple paired spheres. Where possible, instances of these models were used in place of actual geometry to reduce the model's polygon count. This detailed model was used in those scenes where the virus was disassembling, replicating and assembling itself. A simple dodecahedron was substituted in those animation sequences which called for multiple instances of the virus. In both cases, a green texture map was applied to the models to accentuate its foreign nature within the cell.

C) The Animation

The main purpose of the animation was to explain how the reovirus kills cancer cells. Accomplishing this meant showing what normal cells look like, comparing normal cell growth to that in cancerous cells, and finally demonstrating how the reovirus interacts with cancer cells to ultimately destroy them. This task involved the visualization of a complex series of biochemical interactions to simulate both an active and a hyperactive Ras pathway, some of which were simplified to preserve the clarity of the story. The storyboards for the animation composed five sequences: 1) an introduction, 2) a depiction of normal cell growth via the Ras pathway, 3) uncontrolled cellular growth in a cancer cell, 4) the introduction and replication of the reovirus in a cancer cell, and 5) cell lysis (disintegration) and tumor regression. The narrative was added to simplify and reinforce concepts that were visually being presented.

D) Rendering

Approximately 1000 hours were used to construct the models and render the resulting five minute animation within SOFTIMAGE | 3D version 3.8SP1. The animation sequences were rendered using the Softimage rendering algorithm on 10 Intergraph workstations and one SGI Octane workstation at a resolution of 640 by 480 pixels. The five sequences were then composited and rendered with the narration using Adobe Premiere 5.1.

Conclusion

In the end, Dr. Lee and his research teams were exuberant in their praise of this project. The animation was selected for the prestigious SIGGRAPH 1999 computer animation festival and a frame from one sequence has appeared in Computer Graphic's World (August 99).

(1) Kerr, J., Sellberg, M., Ratiu, P., Knapp, D., Caon, C., "Photorealistic Volume Rendered Anatomical Atlases and Interactive Virtual Dissections of the Dissectable Human (TM)" Engineering Animation, USA

(2) Coffey, M., Forsyth, P., Lee, P., Strong, J., "Reovirus Therapy of Tumors with Activated Ras Pathway", Science, November 13 1998 Volume 0 http://www.sciencemag.org reference no. RE983749/ECK/CANCER

(3) Brock, T. D., Madigan, M.T., "Biology of MicroOrganisms", Prentice Hall, Englewood Cliffs, N.J., USA, 1988

(4) The Research School of Biological Sciences at the Australian National University http://life.anu.edu.au/viruses/ICTVdb/60010000.htm

(5) Genetech Inc. San Francisco CA USA http://outcast.gene.com/ae/AB/GG/structure.html (Structure of DNA and protein synthesis) http://outcast.gene.com/ae/AB/GG/retrovirus.html

(6) The Institute for Molecular Virology http://www.bocklabs.wisc.edu/

Orienting Tasks to Enable Hypertext Learning

James E. Gall
Department of Educational Technology
University of Northern Colorado
United States
gall@edtech.unco.edu

Abstract: This paper is a report on the findings of a study conducted with a hypertext learning system used in a sophomore history class. The participants were given an orienting task (browsing, searching, connecting) to guide their use of the system. The connecters performed the best on conceptual understanding of the material, followed by the searchers with the browsers performing the worst. A number of en-route indicators also showed similiar patterns of access by all three groups, including access to articles directly related to items of the posttest measures. Connecters also reported the highest levels of database utility for completing their task and the posttest. These findings demonstrate positive effects for both learning and attitudes when students are given a conceptual orienting task in the use of a hypertext system.

Introduction

Hypertext is a method for organizing information that allows meaningful, non-linear access to text-oriented resources. Unlike traditional computer-based instruction and databases, hypertext systems allow the user to access information by "jumping around" via a series of electronic links, whether in encyclopedias, textbooks, magazines, journals, databases, knowledge bases or other resources. Although the concept of hypertext can be traced back at least 50 years (Bush, 1945), it's "practical" history has unfolded over the past ten years. Personal computer software, such as HyperCard and Toolbook, have allowed the most novice computer user to create hypertext. The emergence of the the World Wide Web in the past few years has pushed the concept of hypertext into popular usage.

The ease in both producing hypertext environments and providing access to students has created considerable research opportunties. Gall and Hannafin (1994) outlined a framework for the study of hypertext. Within this framework, they suggested examing hypertext from the perspective of a learning environment, consisting of the hypertext learning system, learner attributes, the learning task, and educational setting. More recently, Ayersman (1996) has summarized a number of research studies on hypermedia-based learning. He has organized this review into categories based on the main focus of each study (perceptual/attitudinal, individual differences, systems analyses, and performance). In short, the careful analysis of hypertext from a number of perspectives is a timely and important topic for educators and researchers in the field of educational technology.

At a surface level the concept of hypertext is appealing for education due to its flexibility and degree of learner control. However, past research on learner control with other media has led educators to be wary of the effectiveness of giving learners too much responsibility for managing their learning. Unless they are highly experienced or dealing with familiar content, this additional managment chore can easily detract from the learning.

This presentation reports the results of a study conducted on the use of external orienting tasks to facilitate learning. Within the context of a learning environment, it was proposed that providing learners with goals in the form of conceptual questions would allow them to better manage their use of a hypertext system. Many of the advantages of hypertext, such as flexibility and non-linear access, would still be available to the student. However, the conceptual questions would foster better understanding of the material with corresponding positive attitudes towards the use of hypertext. Whether differences in these measures existed or not, it was also important to record the en-route behaviors of learners to better understand the way in which this flexible medium was used. This insight came from critiques of earlier learner control research.

The Study

The purpose of this study was to determine the effects of various external orienting tasks on learning, learner attitudes, and en-route behaviors in the use of an educational hypertext system. Thirty-one sophomore students enrolled in three honors sections of an introductory military history course at a major service academy served as participants in this study. During three 50-minute class periods, the participants used a hypertext database containing approximately 200 articles on World War I. To examine the efficacy of the hypertext, it was important to conduct the study within the context of an authentic learning environment. The content was both relevant, and with regard to the structure of the course, timely for the participating students. The prior knowledge and experience of the students suggested that they would be likely to be able to successfully manage their learning even when presented with a novel delivery method.

Each section was given one of three orienting tasks--one in which they were asked to browse the database to learn about airpower in World War I (browsing condition), a second in which they were required to answer factual questions about the material in the database (searching condition), or a third in which they were required to answer conceptual questions (connecting condition). These tasks were chosen as representative of the types of activities (except for the creation of links) with which hypertext users are typically involved (Gall & Hannafin, 1994).

Findings

The results indicated that the connecters performed the best on conceptual understanding of the material, followed by the searchers with the browsers performing the worst. It would follow that those pursuing the answers to conceptual questions would perform well on that type of question. However, it is more interesting that high-achieving students in the other conditions did not develop that same understanding. The factual questions answered by the searchers were specifically keyed to lead them to the same information accessed by the connecters. A number of en-route indicators also showed similiar patterns of access by all three groups, including access to articles directly related to items of the posttest measures. Connecters also reported the highest levels of database utility for completing their task and the posttest.

Conclusions

These findings demonstrate positive effects for both learning and attitudes when students are given a conceptual orienting task in the use of a hypertext system. These findings do not discount the value of searching or browsing. However, they do suggest that these activities may limit understanding when they serve as the primary mode of interaction. Further research could focus on having students develop their own goals or questions for exploration in addition to other types of self-monitoring activity.

References

Ayersman, D.J. (1996). *Reviewing the research on hypermedia-based learning.* Journal of Research on Computing in Education, *28*(4): 500-525.

Bush, V. (1945). *As we may think.* Atlantic Monthly, 176(1): 101-108.

Gall, J.E. & Hannafin, M.J. (1994). *A framework for the study of hypertext.* Instructional Science, 22: 207-232.

A Split-Brain Human Computer Interface

Gregory P. Garvey
Quinnipiac University
275 Mount Carmel Avenue
Hamden, CT 06518 USA
greg.garvey@quinnipiac.edu

Abstract: This paper describes the prototype design of a *split-brain user interface* which delivers two independent audio-visual streams simultaneously to each hemisphere of the brain. Users view digitized C-SPAN Archival Video of the emotionally charged testimony of Clarence Thomas and Anita Hill from the 1991 United States Senate Supreme Court Nomination Hearings. This interface presents these two diametrically opposed versions of events to each hemisphere of the brain creating a kind of artificial cognitive dissonance.

Introduction

This paper describes the prototype design of a *split-brain human computer user interface*. Like research in augmented virtual reality, augmented interaction and wearable computers [Mann 1998] this approach seeks to extend, enhance and augment natural intelligence by matching the innate capacity to process and understand parallel streams of dynamic audio-visual data with a new interface. Inspired by the split brain research this interface delivers dynamic audio-visual data independently to each hemisphere of the *normal* brain.

The initial prototype was tested with the Virtual Research Systems V-6 Head Mounted Display which supports two 640X480 60Hz VGA Active Matrix Liquid Crystal Displays. *A split-brain human computer user interface* permits the user to comfortably watch one digital video delivered to the left eye while watching a different digital video delivered to the right eye. Simultaneously the user hears different speakers in the right and left ears. By restricting the resolution and position to one half of the raster graphic liquid crystal display the left or right hemisphere can be targeted. The interface permits the user to fluently control playback by pushing buttons or turning control handles.

Background

This "split-brain" approach to user interface design was inspired the "split-brain" research conducted by Roger Sperry and Ronald Meyers, J.E.Bogen and Michael Gazzaniga (Sperry et al. 1969). Gazzaniga along with others tested 'split-brain' patients who have undergone the surgical procedure of commissurotomy in order to limit the spread of an epilectic seizure from one hemisphere to the other. Gazzaniga's research in particular suggested the feasibility of a split-brain interface.

In a study of a split-brain patient who developed a capacity for speech in the right hemisphere, Gazzaniga presented two stories separately to the left and right hemisphere. When read by a normal subject these two stories would be read as one complete story. The split-brain patient first reports only what the left or normally verbal hemisphere sees. Then the right hemisphere reports what it read and when the patient is asked a third time to explain what was read, a third story is told made up of what was read by both hemispheres and embellished by items not contained in either source story (Gazzaniga, 1985). Gazzaniga attributes to the left hemisphere a "creative narrative talent" which he calls "the interpreter mechanism" which "is constantly looking for order and reason, even when there is none–which leads it continually to make mistakes. It tends to overgeneralize, frequently constructing a potential past as opposed to a true one." (Gazzaniga 1998)

Splitting the Brain

The split-brain effect requires matching the visible image to the nasal (closest to the nose) or temporal half of the retina. As the optic nerve leaves the eye, fibers from the nasal half of the retinas cross at the optic chiasma and continue along the optic track to opposite side brain hemisphere. The fibers from the temporal half of the retinas do not cross but continue to the same side hemisphere (Swanston & Wade 1991). The view of the world seen by each eye can be divided in half by a line at the nose. The left and right field of view are referred to as the left and right hemifields. The light coming from each hemifield is refracted and inverted through the lens of the eye to the opposite side retina. The temporal retina of the left eye together with the nasal retina of the right eye see the right hemifield of the visual world while the temporal retina of the right eye together with the nasal retina of the left eye see the left hemifield. The hemifields overlap which is essential to providing the stereo depth perception of binocular vision.

Because the resolution of the digital video was selected to be less than half the display resolution the digital video image could be registered along the inside (nasal edge) or the outside (temporal edge) of each LCD. Two placements of the digital video afforded two viewing modes which I term *Convergence* and *Divergence* Mode. The user can choose either Viewing Mode and switch them at will.

Divergence Mode delivers the digital video to each nasal retina and therefore to the opposite side hemisphere of the brain. With *Divergence* Mode the majority of first time users-viewers can quickly and comfortably view both digital videos as separate images. With Convergence Mode the digital video is seen only by the temporal half of the retinas of each eye and is routed to the same side hemisphere. With Convergence Mode the two image appear to be superimposed and overlap. At least a third of the users experienced difficulty in fusing the images.

Conclusion

This 'split-brain' interface does seek to induce in the 'normal' person the strange behavior and experience of split-brain patients. Rather it is intended to create a new and different kind of viewing experience. Additional research is required to unravel how the normally connected brain filters and apportions attentional focus when two parallel audio-visual data streams are presented independently to each hemisphere. The results of such experiments may yield additional insights that can be applied to the design of a *split-brain interface.*

References

Mann, S. (1998). Humanistic Intelligence: WearComp as a new framework for Intelligent Signal Processing Proceedings of the IEEE, 86 (11), 2123-2151.

Sperry, R. W., Gazzaniga, M.S., & Bogen, J. E. (1969). Interhemispheric relationships: The neocortical commissures; syndromes of their disconnection. Handbook of Clinical Neurology, ed. Vinken, P. J. & Bruyon, G. W. 4 273-90.

Gazzaniga, M.S. (1998). The Split-brain Revisited, Scientific American,, 279 (1), 54.

Gazzaniga, M.S. (1985) The Social Brain: Discovering the Networks of the Mind. New York: Basic Books, Inc., 90-91

Swanston, M. & Wade, M.J., (1991). Visual Perception: An Introduction. London: Routledge. 70-71.

BIDACI: Modeling Agents for a Learning Environment based on a Digital Library

Gerardo Ayala, Felipe Cocón & Layda Agosto
Universidad de las Américas-Puebla
Sta. Catarina Mártir, Cholula, Puebla, MEXICO 72820
ayalasan@mail.udlap.mx

Abstract: Currently, in the area of computer aided learning, the field of Computer Supported Collaborative Learning (CSCL) presents research opportunities. Of special interest of our group has been the development of a CSCL environment based on a Digital Library. In this context, we have been working on the modeling of software agents that assist the participants in the establishment of virtual communities of practice and locate easily the knowledge considered of their interest, making a digital library a source for a more adaptive and collaborative learning environment.

Introduction

Digital libraries are repositories developed in order to collect and organize knowledge and information, making them easily accessible to users [Fox, 98]. At the Centro de Investigación en Tecnol Automatización (CENTIA) of the Universidad de las Américas, we have been developing BIDACI (Biblioteca Digital para el Aprendizaje Colaborativo en Informática), a collaborative learning environment based on a digital library in computer science.

Digital Libraries in Education

Digital libraries in education offer opportunities to provide access to resources beyond the school and establish distributed learning communities, increasing the integration of formal learning and informal learning at the workspace or home [Marchionini, 97]. In this perspective, we consider digital libraries as the fundamental repositories for CSCL environments and lifelong learning environments.

The objective of this project has been the research and development of software components that allow the distributed, continuous and organized construction of educational material in computer science by academics from diverse institutions in Mexico. The idea was to develop a digital library that allow the exploration, construction and presentation of the material. The project has been supported by the Informatics Research & Development Network (REDII) of the CONACyT, the Mexican National Council of Science and Technology. The central objective is to increase the quality of education in computer science and information technologies in Mexican universities For the development of BIDACI we considered three primary roles for digital libraries in education [Maly, 98]:

1) Course-related information and course materials for asynchronous distance learning.
2) Tools for constructing and organizing materials. The processes for construction must be easy for authors (technical skills and motivation).
3) Tools for an active virtual session. It must support active learning, where learners construct their own knowledge through resource discovery.

Software Agents in BIDACI

The first version of BIDACI allow the users to organize and locate easily the material, as well as communicate, cooperate and collaborate using groupware tools. For the next version we proposed the development of three software agents in order to increase the adaptiveness with the users and facilitate the maintenance and location of material in BIDACI. Based on previous work on agents, digital libraries and learning environments [Sánchez, 98] we modeled and developed:

1) A user agent.
2) An information agent.
3) A management agent.

BIDACI's User Agent

The user agent in BIDACI allows it to be an adaptive environment. The agent holds a user model [Ayala, 96] which represents the user's preferences, being a representation of her/his interests about the material. Based on this information and data from other user agents, it autonomously proposes the configuration of discussion groups, helping in the commitment of a chat session among possible participants in the virtual community. The user agent proposes a discussion group when there are potential participants in BIDACI's community. A user is considered a potential participant when s/he has shown interest in a given topic or area, which is supported by the data of the user model provided by her/his user agent. Once a group has been proposed the potential participants are notified. At any time a learner can manually make a subscription to a given discussion group, or remove her/his name from the list. The user agent notifies the elimination of a discussion group where only one member remains.

BIDACI's Information Agent

The user must be aware of the changes of the dynamic repository of distributed educational material. S/he must be aware of the material that is considered relevant and popular by the community and the new members who show interest in the same topics or areas. The information agent has been developed in order to keep the user informed of:

a) new educational material considered of her/his interest.
b) updated educational material considered of her/his interest.
c) educational material considered popular (and therefore relevant) by the community.
d) chat sessions established related to the discussion of a topic considered of her/his interest.

BIDACI's Management Agent

The management agent is designed in order to provide information to the manager of BIDACI concerning the status of the educational material. Periodically it autonomously checks the material and obtains information about:

a) the web sites that have not become accessible.
b) the material that have not been updated in a given period of time.

The management agent sends warning e-mail messages to the authors, with a copy to the manager. It constructs also a report for a given period. Here is convenient to mention the commitment of the authors of provide to BIDACI educational material every year, and keep it accessible and updated.

Conclusions

We have been working on the modeling and development of software agents that assist the participants in the establishment of virtual communities of practice, and locate easily the knowledge considered of their interest, making a digital library a more adaptive and collaborative learning environment. We believe that software agent modeling, from the perspective of learning environments, will make digital libraries the fundamental repositories for CSCL environments and lifelong learning environments

References

[Ayala, 96] Ayala, G. & Yano, Y. (1996). Learner Models for Supporting Awareness and Collaboration in a CSCL Environment, Intelligent Tutoring Systems, Claude Frasson, Gilles Gauthier and Alan Lesgold (Eds.), Lecture Notes in Computer Science 1086, Springer Verlag 1996, pp. 158-167

[Fox, 98] Fox, A. & Marchionini G. (1998) Toward a Worldwide Digital Library. Communications of the ACM, 41(4), pp. 28 - 32

[Maly, 98] Maly, K., Zubair, M., Shen, S. & Zeil, S., Planning Grant for the Use of Digital Libraries in Undergraduate Learning in Science, 1998, http://dlib.cs.odu.edu/documents/index.html

[Marchionini, 97] Marchionini, G. et al. Content + Connectivity => Community: Digital Resources for a Learning Community, ACM Digital Libraries '97, Robert B. Allen & Edie Rasmussen (Eds.), pp. 212-219

[Sánchez, 98] Sánchez, A. & Ayala, G. (1998) User Agents in Digital Libraries and Collaborative Learning Environments, Memorias del Taller de Inteligencia Artificial TAINA'98, Mexico City, Mexico, Francisco Cantú y Alvaro de Albornoz, (Eds.), pp. 361 - 365

Establishing and Operating an Institutional Centre for Instructional Technology (Paper # 5362)

Diane M. Goldstein
Coordinator Instructional Technology Resource Centre
University of Western Ontario
London, ON N6A 5C1
dianeg@julian.uwo.ca

Michael W. Clarke
Department of Microbiology and Immunology
Faculty of Medicine and Dentistry
University of Western Ontario
London, ON N6A 5C1
mwclarke@uwo.ca

Abstract: The University of Western Ontario (UWO) is a large, research-intensive university (equivalent to a Class I institution in the US) with a traditional undergraduate curriculum as well as a number of professional schools. As a regional institution, UWO is situated in the centre of the southwestern Ontario industrial and agricultural heartland. This presentation will describe the ongoing evolutionary process that has given rise to a centralized facility, the Instructional Technology Resource Centre (ITRC), that supports faculty in the development of on-line curriculum and course materials. Issues that are relevant to this process touch on the very core of the educational enterprise in an institution of higher learning.

The Instructional Technology Resource Centre (ITRC) at the University of Western Ontario

The Present

The ITRC was born in November of 1998 when the Vice-President, Academic allocated targeted funds for the creation of a central support area dedicated to supporting faculty in the development and use of computer-based instructional materials. The ITRC is administratively located within the central unit that supports all computational activity on campus, the Information Technology Services (ITS) unit. The ITRC mandate states, "The Instructional Technology Resource Centre is a multi-media support facility for faculty who wish to integrate technology into their courses."

ITRC is managed by an Advisory Board composed of the Directors of the Ancillary Academic units (Libraries, the Educational Development Office, the Western Centre for Continuing Studies, ITS, the Coordinator of Summer and Distance Studies) and a faculty member from each of the 12 Faculties selected by the Dean. Logistical support is provided by ITS.

ITRC is fundamentally an instructor driven enterprise in that it functions as a resource centre for those who have the interest in the development and use of computer-based teaching and learning materials. ITRC is managed on a day-to-day basis by a full-time Coordinator who has a strong background in both information technology and educational practice. As well, two part-time ITS staff provide technical support and assistance in high-end content development for specific projects. Student developers are hired from the undergraduate population, and all have skills in the production of on-line curriculum materials.

The ITRC operates in two main modes: first, as a drop-in centre where faculty can make use of the human, hardware and software resources. Secondly, ITRC issues requests for proposals to the campus community twice yearly. Faculty and professional librarians submit proposals to the Advisory Board where they are reviewed according to established criteria and voted upon for support. Supported projects are assigned a student developer who then works with the faculty member to develop the project from concept to product under the supervision and advice of the Coordinator. Although faculty are encouraged to acquire themselves the skills needed to develop their project, this is not an absolute requirement. The ITRC student developer is considered to be the technical "hands-on" individual.

The Past

The ITRC represents the most recent iteration of central support for instructional technology at the University of Western Ontario. In 1992, the so-called "multi-media" studio was established and operated for four years on grant funds that were used to "buy" faculty from a half-course teaching load allowing them to spend the time in the studio acquiring the necessary technical skills and developing their projects. The studio was located within one of the 12 Faculties and did not have a high profile on campus.

This model proved to be relatively unsuccessful in that faculty were unable in most instances to develop the depth of necessary skills and create their products in the time available. Only a very few of the projects that were completed ever did see use in the classroom or computer lab. However, the studio did serve very effectively as a pilot project and contributed greatly to the design and concept of the ITRC.

The Future

The University of Western Ontario is currently developing an institutional strategic plan for instructional technology (IT). IT has become a very visible issue with the Faculty Association, with academic departments, with the Distance Studies operation and with the central administration. The planning process is affected by both internal and external factors: educational quality, demand, opportunity and alternative sources of instruction. The universal input from faculty members to this process has been to support an expanded version of the ITRC with additional professional staff and financial resources.

The goals of the planning process will be to maintain the current philosophy of the ITRC as an instructor-led as opposed to top-down operation and to respond to the needs of both instructors and students. Consideration of how to arrive at these goals has touched on the very core of the university's mandate; issues such as the role and place of teaching at a research-intensive university, the promotion and tenure process as it relates to teaching as a scholarly activity, the role of part-time faculty, the perceived versus actual demands from students for flexible learning opportunities and the financial implications of technology-based teaching and learning.

A New Education Framework within IMS-Specifications

Antonio Gómez Skarmeta, Eduardo Martínez Graciá, Pedro García López
Departamento de Informática, Inteligencia Artificial y Electrónica
Facultad de Informatica. Campus de Espinardo.
Universidad de Murcia. 30071 Murcia, España
{skarmeta,edumart,pedro}@dif.um.es

Abstract: Educational Institutions have been using the World Wide Web for a long time in the provision of education. Currently we can observe a growing knowledge complexity and a widening variety of backgrounds and qualifications. As a consequence, we need modularly structured contents, which are linkable across subject domains and support different kinds of usages. However, the demanding requirements for comprehensive and flexible educational services clash with the complexity of its development. To alleviate this tension, the IMS Project proposes a generic architecture for online learning based on extensibility and composability of its components.

WWW and University Education

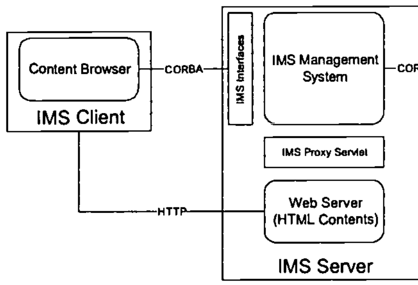
People from all corners of the university community now have the ability to create Web pages and make them available to the world. While the benefits of HTML-based documents are clear, it is also evident that this use has some deficiencies: there is no interactivity, the concept of role is not included, it does not take into account the state of the learning process, it is restricted to a few information formats and there is no quantitative measure of student performance or the effectiveness of teaching. There are several technologies that overcome the HTML limitations (Allen 1998): interactivity can be achieved with Java applets embebed in HTML pages, or JavaScript combined with HTML forms; with VRML, teachers can create virtual environments where students are invited to deal with realistic situations; XML – a system for defining, validating, and sharing document formats on the Web, appropriate for separating user interface behaviour and the semantic content of information; SMIL – an application of XML to coordinate a streaming multimedia presentation with more than one type of media file.

However, we can not talk only about technologies, there is also a new learning style and it is necessary to design tools that support it (Schlichter 1998). In this way it is common that students work in groups to write and submit reports, or debate alternative perspectives and solutions on a common problem. Tools to engage this collaborative work in a distributed way are needed, like discussion forums, chats, whiteboards and collaborative authoring tools. This leads to the creation of new powerful learning environments, which are not adaptations from classical teaching and training, able to produce high quality multimedia education material, learner-centered and network-based. To show our work in this line, in the next section we present one of the main standardisation effort in the educational environment the IMS project.

The IMS System of the University of Murcia

The Instructional Management Systems (IMS) project (http://www.imsproject.com) is a partnership of academic, commercial and government organisations to cooperate in the definition of an Internet architecture for instructional systems and learning content, with a primary objective: enable an open architecture for online learning in all sectors of lifelong learning. Learning materials are collected in IMS containers, which include a unique identifier and metadata that describes the container and its contents to facilitate search, storage, retrieval and use rights. Learning materials can be web pages, interactive content or collaboration tools. Containers can be aggregated or nested, and the contents of a container may be sequenced according to different rules. IMS environments are software developments that implement the IMS Specification. The IMS environment extracts the contents from IMS containers and delivers them to users, normally with a Web server.

The next figure shows the components of the IMS System and the relations between them. The central element is the Management System, the component that provides the interface to access or administer learning materials. It identifies users, creates sessions to facilitate a uniform mechanism of access control and supervises the actions that users can perform, according to their roles. Through the Management System, an administrator can install new content packages, and perhaps create new users or groups and edit access rights. A student also uses the Management System to operate with content.



The Content Server (there would be more than one) stores the learning materials and their metadata, and provides the IMS CORBA interfaces to access those materials. A Search Engine can use those interfaces to perform intelligent searches. As a first prototype, our IMS System will use already created html-based documents as learning-material, with associated XML files to describe them. The Management System also uses Content Servers to get the materials requested by users. User profiles are stored on the Profile Server, which also provides a special interface to access this information.

The University of Murcia, like other Spanish universities – UNED, UOC – has a clear interest in the use of new technologies applied to higher education as a way to improve the quality of the learning process. This interest took shape last year in a project called SUMA – Servicios Universidad de Murcia Abierta. SUMA affects two main fields: network infrastructure, that will be scaled to support 10.000 users and 1.000 concurrent connections, and telematic services. We are designing the new architecture of the SUMA framework taking into account the ideas defined in IMS, and considering CORBA and XML as fundamental elements of the learning support. We are also working in the introduction of videoconference tools and security elements in this system. There is a PKI based on the use of X509 certificates that has been completed successfully with the development of a PKCS11 module that lets students use web-based services securely with HTTPS. Each student and teacher has his/her private key stored on a smartcard protected by a PIN. When the user connects to a secure web server, the Netscape browser activates the PKCS11 module, which performs cryptographic operations with the smartcard. SUMA project of the University of Murcia represents one step in the development of an Open University, based on the used of the WWW technologies. In order to be successfully implemented, it is necessary not only to create innovative collaborative tools that support the active learning, but also to design the whole system under the light of open specifications like the one proposed by IMS.

References

R. Allen (1998) The Web: interactive and multimedia education. In *Computer Networks and ISDN Systems 30.*

B. Ibrahim, S. Franklin (1995). Advanced Educational Uses of the World-Wide Web. *3rd International WWW conference (WWW3)*, Darmstadt, Germany.

J. Slichter, G. Teege (1998). A Web-based Information Space for University Education. *Association for Information Systems America Conference.*

Acknowledgements

This work has been partially supported by CICYT project TEL98-0454-C02-01 and Fundación Séneca project PLP/5/FS/97.

Art and Technology in the Classroom: The Activities and Impact of a National Project.

"The Community Discovered: The Search for Meaning Through the Integration of Art and Technology in K-12 Education"is now in its final year of its five years of funding, and is being conducted by Westside Community Schools in Omaha, Nebraska. The major focus of The Community Discovered project is represented by its five goals, which are carefully integrated into the objectives undertaken in the project. These five goals, and brief examples of activities within the project, consist of the following:

Goal 1: To enable students to achieve high academic standards by integration of the arts and technology into core subject areas

Goal 1 Example Activities: The project has developed a web based curriculum unit structure by which teachers document developing curriculum units which target the effective integration and technology into core subject areas. In addition, teachers complete electronic growth plans which describe this ongoing effort and focus within the project to actively engage students in discipline based art activities using technology, and resources available over the Internet.

Goal 2: To provide students and educators equity in access to information and museum resources at the state and national levels

Goal 2 Example Activities: The project has developed a model web site for convenient access of the information and museum resources developed by all of the project partners. This web site can be accessed at:

http://communitydisc.wst.esu3.k12.ne.us.

Goal 3: To enable educators to effectively use appropriate technologies for constructivist teaching and learning across the curriculum

Goal 3 Example Activities: Educators within the project have participated in extensive inservice activities targeted at constructivist learning and interdisciplinary teaching across the curriculum. These have entailed summer institutes, periodic inservices during the regular year, and a variety of local efforts, such as "curriculum street fairs" within the schools.

Goal 4: To enable educators to implement effective curricula incorporating the arts and technology in core subject areas

Goal 4 Example Activities: Participating educators have also engaged in considerable inservice efforts related to the use of technology in teaching and learning, with a focus on the integration of the arts into core disciplines. A particular innovative example during this last year was a national ConferNet effort, which was a model on-line student conference offered for participating classes of K-12 students and teachers. A second academic on-line conference for students is being planned for the Spring of 2000.

Goal 5: To create a national network of educators to support the development and implementation of appropriate learning strategies integrating technology, and the arts with other core subject areas.

Goal 5 Example Activities: The project has been highly successful in creating a network of individuals assisting with the project. In particular, an extensive listserv process, special interest groups, and a three level national advisory board is in operation and is being utilized throughout the project. The members of the advisory boards are often asked to interact with project staff for the purpose of guiding the evolution of the project and providing feedback regarding the outcomes.

THE IMPACT:
The Community Discovered Project has had considerable success with both students and teachers in the project, and is evolving into a national model for the effective integration of technology and art into education. The ongoing evaluation process of the project uses multiple sources of information, and includes a comprehensive approach to data collection that is targeting information related to each project goal and objective. These data types include: 1) teacher survey data, 2) electronic data, such as listserv participation and electronic logs, 3) classroom observations, 4) teacher and student interviews, 5) student projects and portfolios, 6) teacher growth plans, 7) focus groups, 8) stakeholder surveys, and 9) teacher based classroom research initiatives.
All data is summarized and placed within a World Wide Web page format that is available for review by anyone interested, and especially project staff, participants, and stakeholders. The web site representing the evaluation portfolio is:

http://ois.unomaha.edu/cdeval/

The evaluation web site is fairly comprehensive and is organized using a variety of themes and graphics in order to present the evaluation information clearly. The evaluation team, composed of three education professors from the University of Nebraska at Omaha, and two assessment specialists from WestEd Laboratories, has documented the impact of the CD project within this web site. Some of this impact has included:

1) In-depth Participation: The project has already successfully involved over 300 teachers, 300 teacher partners, and 24,000 students, with in-depth technology and art integration experiences within the project.

2) An Impact on Student Achievement: The project has resulted in enhanced student achievement as documented by carefully controlled classroom studies involving over 600 students. These studies have demonstrated significant project impact through improved reading scores, mathematical patterning skills, writing fundamentals, art interpretation skills, and general attendance of the students.

3) An Excellence in Student Products: The project has collected a wide range of innovative student products which show the power of students working within technology based environments, including projects involving hypermedia, the World Wide Web, and virtual reality.

4) An Impact on Teaching Knowledge and Skills: Teacher knowledge has greatly improved within the project. Through surveys and interviews, 96% of the teachers report improvement in technnology, 99% report improvement in art integration, 85% report improvement in interdisciplinary teaching, and 90% report improvement in constructivism. In addition, a careful analysis of the teaching process through formal classroom observations, has documented that teachers are indeed involved in effective instructional techniques related to these four areas.

5) An Extensive Contribution to the Professional Literature: The Community Discovered Project has been aggressive in its contribution to the professional literature, and has already resulted in 6 professional refereed articles/papers, 2 graduate theses, and more than 20 refereed presentations at national conferences including well respected conferences such as the National Educational Computing Conference (NECC), the Society for Information Technology in Education (SITE) annual conference, the American Education Research Association conference (AERA).

6) A Model Web Based Environment: The project has developed an impressive presence and use of the World Wide Web. As mentioned, this presence is accessible at http://communitydisc.wst.esu3.k12.ne.us, and includes an extensive project web site, an on-line evaluation portfolio, databased curriculum units, and substantial listserv and conferencing. The project has also conducted the well respected ConferNet 99, the first ever national student conference conducted on the Internet. Museum partners also maintain impressive project related web sites, which include a variety of digitized works, virtual museum tours, on-line magazines, and a wide range of Internet based curriculum support materials.

A FINAL THOUGHT:

It is said that a good project will always continue to grow and evolve, and "The Community Discovered: The Search for Meaning Through the Integration of Art and Technology in K-12 Education" is now well established, growing systematically, and evolving fully in its final year of formal activities. The project has embraced advanced information-based technologies and has refined its plans as technology-based applications continue to evolve with emerging capabilities, such as new capabilities on the World Wide Web. The project is building upon its earlier successes, upon a strong organizational foundation, and with an aggressive commitment by its many partners.

As The Community Discovered project moves forward, perhaps most importantly, there continues to be a real team effort underway by all stakeholders in the project to positively effect the learning environment for all students. This teamwork is growing and becomes more solid during each successive year of the project. As any project desiring to stay on the "cutting edge", it is expected that The Community Discovered project will continue to evolve as new educational technologies and understandings become available. The project is a comprehensive one, and its use of a systematic implementation process and the incorporation of a careful evaluation plan are no doubt critical components in its effectiveness to date and promise of effectiveness in the future. The strong and full commitment by all partners to contribute to the overall success of the project will no doubt continue to provide a natural catalyst for success as the project strives to implement its very aggressive set of goals and objectives.

A Comparison of Static and Dynamic Media Types for Process Oriented Learning Tasks

Guttormsen Schär, S., Zuberbühler, H.J., Krueger, H.
Institute of Hygiene and Applied Physiology
Swiss federal Institute of Technology, Zürich, Switzerland
e-mail: guttormsen@iha.bepr.ethz.ch

Abstract: This paper presents an overview over an experiment, which investigated the effect of dynamic (e.g. animations) and static (e.g. pictures) media types for process oriented learning content. Teachers who want to apply new technology in education need guidelines in order to develop the presentations themselves, supervise programmers or to know what to buy. Many fragments for such guidelines do exist, our experiment is a contribution to build a consistent empirically based knowledge base in this area. A small advantage of animations for pictures was found, more attention should be given to the design of such presentations.

Introduction

Multimedia is a challenge for the educational field, insofar as consistent guidelines for how to apply the different media types for the presentation of learning materials are lacking. The tools for developing multimedia presentations are still not easily applicable for teachers. Hence, teachers may have the choice between not applying new technology, learning how to implement presentations themselves or organise the necessary productions with external resources. Whenever the two latter options are chosen guidelines about how to make high quality presentations are needed, either for supporting own development, to supervise a programmer or to know what to buy. This paper presents an experiment in which features relevant for the presentation of dynamic learning contents (processes) were compared. A former experiment investigated how to present static learning contents (principles) (Guttormsen Schär, Kaiser, & Krueger, 1999). We have taken a task dependent approach to media allocation, based on a general categorisation of the learning content as concepts, principles, facts and processes (Merrill, 1983). In the multimedia context, dynamic features could be animation, film, voice or simulation. Empirical guidelines for the implementation of multimedia for dynamic learning material are only slowly approaching. The reason is, on the one hand, that the tools and technical resources for the production of dynamic presentations are only recently easy to apply. On the other hand, the design of experiments in this area requires much effort, because the production of unique testmaterial (e.g. animations) is both time and resource demanding. Nevertheless, to realise the pedagogical potential of multimedia, there is a great need for such research.

Experiment

The general hypothesis was that process oriented learning material is better learned with dynamic presentations, in this case operational defined as animations. The experimental conditions are shown in Table 1. Unique animations of 5 different processes were produced; the static presentations were derived from the animations. The experimental situation was fully computerised and all the data was registered in a log-file. Operational definitions of learning performance are given below:

Visual: The recognition of logically correct pictures, under a selection of similar pictures with small errors.
Active: Complete incomplete sentences in which essential concepts or expressions were missing.
Passive: Choosing correct statements from a collection of both wrong and correct examples from the tasks.
Preferences: "Which of the presentation forms (/ tasks) did you like most?"

Experiment	Presentation form	Task
5 x 5 within group	Animation	Heart functions / ECG
Randomisation: form and task	Animation + voice	The protein synthesis
Subjects: 27 adult, both sexes	Animation + QT control	The Malaria cycle
Learning performance:	Picture + voice	Off-side rules in soccer
visual, passive & active	Picture + text	Solar eclipse

Table 1: presentation forms and tasks in the experiment

Results

Table 2 shows the effect of presentation form on the subjects learning performance. No effects of the control variables (sex, task order, computer knowledge, age) were found.

Performance	**Effects of presentation form** (* sign. below $p < 0.05$)
Visual knowledge	No effect
Active knowledge	No effect
Passive knowledge*	Animation + Voice & Picture + Voice > Animation & Animation +Control
Preference*	Animation + Voice > Animation & Animation + Control & Picture + Text

Table 2: Effects of Presentation Forms

Discussion and Conclusion

The benefit of dynamic presentation was smaller than expected. However, the fact that we found no difference between presentations with animation (without voice) and picture + text shows that movement possesses basic informational quality. The hypothesis is further supported in that the best learning effect was achieved with presentation forms including a dynamic factor (animation and voice). The pictures were carefully produced to represent the same information as the animations (e.g. movements were indicated with arrows). Hence, the relative good effect of pictorial information may reflect good picture quality more than low importance of animation. In conclusion, animations alone are no guarantee of good learning performance when pictures and voice can be produced with high information quality. Still, animated presentations were preferred by the subjects.

References

Guttormsen Schär, S., Kaiser, J., Krueger, H. (1999). Multimedia: The effect of Picture, Voice & Text for the Learning of Concepts and Principles. H.J. Bullinger & J. Ziegler (Eds.), *HCI International '99*, Vol. 1 (pp. 456-460), Munich: Lawrence Erlbaum.

Merrill, M.D. (1983). Component Display Theory. In C.M. Reigeluth (Ed.), *Instructional-design theories and models. An overview of their current status* (pp. 61-95). Hillsdale: Lawrence Erlbaum.

Time-Expanded Audio For Learning

Kevin Harrigan
Centre for Learning and Teaching Through Technology
University of Waterloo, Canada
kevinh@uwaterloo.ca

Research has been conducted on building tools that allow users to control the speed of audio when playing audio on a computer and some commercial products are beginning to appear on the market (Eloguent, 1999). The research to date has focused exclusively on time-compressed (i.e. speeded-up) audio with an emphasis on improving the user interface (Arons, 1997) and improving learning efficiency (i.e. learning per unit of time) (Harrigan, 1995a; Harrigan, 1999). The research has shown that audio can be time-compressed by approximately 50% without any loss of comprehension or retention and that learners do use the time-compressed audio if given the controls in the user interface. The research has also shown that using a known technique, called SOLA (Roucos & Wilgus, 1985), speech can be time-compressd without any significant change of pitch which is much preferred by learners over simply playing the audio faster which producing a change in pitch and what is often referred to as the "Mickey Mouse" effect.

This paper reports on the first experiments that have been conducted using SOLA to time-expand (i.e. slow down) audio without any significant pitch change. These preliminary experiments used subjects who had no special needs but the end use of this technique is envisioned to be for people with special needs such as those with acquired brain injuries.

Research Questions

The two questions we addressed were:

1) When time-expanded audio is played to learners at what point will they notice that the audio has been time-expanded? In other words, what is the Just Noticeable Difference (JND) of time-expanded audio.
   A) When the audio has been time-expanded simply by playing the audio .
   B) When the audio has been time-expanded using the SOLA technique.
2) What is the time-expansion percentage at which learners will not be able to understand the audio. In other words, the intelligibility level. This has typically been measured by playing speech segments to subjects at an accelerated rate and determining the point at which the subject cannot understand 50% of the speech segments (Harrigan, 1995b).

The Experiments

As stated, we intend to use time-expanded audio with people with special needs. However, in these initial experiments we used subjects who had no special needs as we felt we could gain two things (a) we could ensure that our software worked properly and (b) we could address some fundamental questions that may shed some light on issues related to time-expanded audio and may help us calibrate our future experiment. We were successful on both counts.

Experiments One: We had a speech file on our computer that was a help file from an application. We used the SOLA technique to create versions time-expanded by 5%, 10%, 15%, 20%, and 25% for a total of six files including the original. We then created a screen with thirty buttons labelled 1-30. As each button was selected one of the six speech files was played with each speech file being played five times in total. After selecting each button, the learner had to circle on a piece of paper whether the speech sounded normal or time-expanded. The results from the seven learners (N=7) showed that the average JND was 5.4 % with a SD of 3.9.

Experiment Two: Experiment two was identical to experiment one except that the audio files were created by simply playing the audio slower with a resulting change in pitch. The six learners (N=6) had an average JND of 9.2% with a SD of 2.6.

Experiment Three: In this experiment we had five files time-expanded using the SOLA technique by 38%, 58%, 84%, 100%, and 121%. Some calibration was done prior to the experiment in order to choose the appropriate compression levels. We had 25 continuous speech segments from a file in an educational multimedia CD that we had created. Segments were about six words each. As an example, the first speech segment was "it was important to open my mouth". We created a screen with 25 buttons. The six learner's (N=6) task was to click on each button in sequence, listen to the speech segment, and then write down the phrase that had been spoken. After the experiment the two investigators read each response and made a judgement as to whether they understood the phrase. The results showed an intelligibility level of 92% with a SD of zero. This means that all subjects understood the audio at 84% but not at 100%, The intelligbility is calculated as the middle point between these two levels (i.e. ((84+100)/2)=92). An intelligibility level of 92% means that a one minute file plays in 1.92 minutes (1 minute 55.2 seconds) which is almost twice the length of the original file.

Conclusion and Future Work

The results of the first two experiments clearly indicate that the SOLA technique is superior to simply playing the audio slower because when using the SOLA technique learners don't realize the audio is time-expanded until a higher time-compression percentage is used.

The results from the third experiment are close to what we expected. When audio is speeded-up it can be speeded-up by double (i.e. played twice as fast) before intelligibility begins to drop (Foulke & Sticht, 1969) and with this experiment we show that it can be slowed by almost double before intelligibility begins to drop. Since people normally speak at 150 words per minute (wpm) this means people can listen at rates up to 300 wpm and as low as almost 75 wpm. The results of this experiment confirm that using time-expanded audio has the potential to be used to half the speaking rate and thus time-compressed audio may be useful for people with certain special needs.

We now plan to continue our work with the following initiatives: (a) produce a system that can be used by the learners to control the speed of audio and test it with learners, (b) test our system with learners with special needs who might benefit from this system that supports time-expanded audio and (c) build a system that includes audio as well as video and test it with learners.

References

Arons, B. (1997). SpeechSkimmer: A system for interactively skimming recorded speech. *ACM Transactions on Computer-Human Interaction*, 4(1), 3-38.

Eloquent (1999). Eloquent Presenter! (computer software) (http://www.eloquent.com/).

Foulke, E. & Sticht, T. (1969). Review of research on the intelligibility of compression of accelerated speech. Pyychological Bulletin, 72, pp. 50-62.

Harrigan, K. A. (1999). DUKES: Creating real-time variable-speed speech for use in educational multimedia. In Proceedings of ED-Media'99 World Conference on Educational Multimedia and Hypermedia, 1360-1361. Charlottesville, VA: Association for the Advancement of Computing in Education.

Harrigan, K. A. (1995a). The SPECIAL System: Self-paced education with compressed interactive audio learning. *Journal of Research on Computing in Education*. 3(27), 361-370.

Harrigan, K. A. (1995b). The intelligibility of time-compressed digit-video lectures. In Proceedings of the Sixth International Conference on Human-Computer Interaction, 61-66. Tokyo: Elsevier.

Roucos, S. & Wilgus, A. M. (1985). High-quality time-scale modifications for speech. In *IEEE Proceedings of the International Conference on Acoustics, Speech, and Signal Processing*, (pp. 493-496).

Project DEED, Distance Education for Education Diagnosticians. Putting Available Technology to Work via Internet for Rural, Bilingual Sites Along the Texas/Mexico "Border Corridor."

Ralph M. Hausman, Ph.D.
The University of Texas at Brownsville & Texas Southmost College (UTB/TSC)
80 Fort Brown, School of Education, School Specialties Department
Brownsville, TX, USA 78520
rhausman@utb1.utb.edu

Abstract: Project DEED is a four-year internet based special education personnel preparation program funded by the U.S. Dept. of Education, Office of Special Education Programs (OSEP) as located at UTB/TSC. The project involves the preparation of practicing, bilingual teachers located in 8 rural sites to become educational diagnosticians, assessing students with possible disabilities. Instruction is accomplished through a combination of available resources, i.e., multimedia modules in synchronous format with videoconferencing, CD-ROMs, email, chat rooms and local mentors. Extensive time was required for the initial videoconference setup between all nine distal sites. Although there remain a variety of ongoing, technology related problems, evaluative data available on completion of the second year of the project supports the use of multimedia modules in conjunction with videoconferencing in the preparation of rural, special education diagnosticians.

Overview

Use of the internet for one-way instruction is not particularly new, neither has it been actively employed in an interactive manner to deliver multiple-course programs. However, it would seem to hold promise for content delivery in a manner acceptable to, if not preferred by, consumers in rural, geographically isolated areas. With the advent of T-1 fiber-optic lines connecting the local school systems throughout South and South West Texas in the past few years, the internet has been made available as a vehicle for distal instruction. The project to be described herein is considered innovative in that it is new to the geographical area and combines a variety of available, relatively inexpensive technological resources in a manner directly relating to the learning styles of the targeted population. The intent of the project is the production of a cohort of bilingual educational diagnosticians in an area in which there is a serious dearth (Hausman, 1997).

Project DEED, Distance Education for Educational Diagnosticians

Federal legislation (IDEA, 1990, 1997) mandates the comprehensive individual assessment of school age students, i.e., from three through 21 years of age, to establish eligibility for special services. A variety of school-based personnel have been developed in response to these mandates, among them educational diagnostician. The diagnostician's certificate involves specialty training on a graduate level in a wide range of areas related to assessment. IDEA also mandates nondiscriminatory evaluation in the students' native language. This poses a problem in that of the 3,748,167 students enrolled in Texas schools, 46.4% were White (not of Hispanic origin), 36.7% were Hispanic, 16.9% were other minorities. Thus, minorities comprised 53.6% of the student population in Texas public schools with Hispanics as the largest minority group. Yet, only 10% of the active diagnosticians had Hispanic surnames (and not all were bilingual). Along the Texas/Mexico Border Corridor, i.e., an area extending 50 to 70 miles North of the border along the nearly 900 miles of its length, the proportion of Hispanic youth soars to a significant majority of students, particularly in the Rio Grande Valley (Texas Education Agency, 1996).

Project DEED was designed to connect the UTB/TSC site, via the internet, with 8 distal-based school systems located in the Border Corridor up to 400 miles distant. The cohort consists of 20 certified bilingual individuals (2 males and 18 females) currently employed with the public school chosen as a site. Program delivery involves specially designed interactive multimedia modules (based on the QUEST utility package). The overall program was structured with reported preferred learning styles characteristics of Hispanic students in mind (e.g., Griggs & Dunn, 1995). For example, videoconferencing among all 9 sites during scheduled classes each week was selected to appeal to the traditional conceptualization of formal instruction, respect for authority, and need for cooperative or peer-based learning activities. The QUEST-based multimedia, interactive modules were also included to fit reported preferences for structure, vivid stimulus displays, variety and kinesthetic instructional approaches.

The QUEST utilities package (Allen Communication, 1998) was selected as the basis of module development in that it permits the combination of video clips, various illustration types, graphics animation, audio overlays, and text, all with preprogrammed instructions, into interactive modules designed for use over the internet. The modules consists of a compilation of frames containing color-coded text with specific concepts illustrated, and popup insets triggered to key underlined words or to provide in-text references. Extensive use of 'side bars' and animations has also found favor with the cohort members. Thus far, the module format that has been received most positively has included a brief overview of the focal topic, followed by simulation activities to allow learners to experience a variety of difficulties that, hypothetically, are experienced by students with disabilities. In addition, the content includes definitions (federal and state), terminology, student eligibility requirements, categories, history, legislation, and services associated with the specific topical area. Interspersed throughout the modules will be case studies or scenarios with questions similar to those included on the state mandated, certification examination. CD-ROMs mailed to the sites remain the preferred delivery system for high-security items such as test kit training units.

A variety of potentially useful videoconferencing systems were reviewed. The CU-SeeMe (1995) based ClassPoint and MeetingPoint software packages were selected due to the need for multipoint connections and as they were the most economical at the time. The primary problems we have experienced this first year of online classes have included (a) broaching a regional firewall (surrounding 5 of our 8 sites), (b) fine tuning the instructor (oncampus) setup (e.g., software as well as hardware), (c) arranging for site-based, site-supported technical staff to work together with the other schools systems technical staff members and (d) interconnecting differing computers and computer systems to function as an extended network. The forces of nature, including the effects of a hurricane also contributed challenges. Then, fine-tuning intersite connectivity is required to adjust to each of our university system's internet access upgrades, requiring extensive, readily available support from our Academic Computing department. Yet, the student's grades remain high, as does their reported sense of accomplishment.

Throughout the Fall, 1999, semester offering of the first online course (an introduction to special education), the sites used a conference telephone call and oncampus audio bridge to supplement the videoconferencing. Since March, however, our transmission delay time has significantly reduced as has the number of 'hops' reported between connections, and our audio quality has improved to the point that the conference telephone line serves only as a backup system.

References

Allen Communication. (1998). *Quest 6.0.* Salt Lake City, Utah: Author.

Griggs, S. & Dunn, R. (1995). Hispanic-American students and learning style. *Emergency Librarian*, 23(2), 11-16.

Hausman, R.M. (1997). *South Border Corridor special education needs assessment*. Unpublished report. Brownsville, TX: The University of Texas at Brownsville & Texas Southmost College.

Individuals with Disabilities Education Act (IDEA) (1990) Amendments of 1997. Public Law 105-17. U.S. Department of Education.

Texas Education Agency (TEA). (1996). Student enrollment, educational diagnosticians employed and respective demographics. E-mail request.

Acknowledgements

Project DEED, otherwise known as *Distal-Based Preparation of Education Diagnosticians Serving in Bilingual Contexts*, is funded by the U.S. Department of Education, Office of Special Education Programs, PR# H029E80051. 1998 – 2002.

Weaving a Web Without a Net:
Browser-based Educational Applications

Scott Heath
Bonfils Blood Center
717 Yosemite Circle
Denver, CO 80230-6918
scott@qm.bbmbc.org
http://www.bonfils.org/researchindex/

Daniel Ambruso, M.D.
University of Colorado School of Medicine
4200 East Ninth Avenue, Campus Box B-128
Denver, CO 80262
daniel.ambruso@uchsc.edu

Abstract: DHTML (Dynamic HTML) has the potential to deliver interactive hypermedia cheaply from a CD, without the courseware developer having to cook up solutions for all the cross-platform, rendering or navigation problems that the browser resolves. Visual, extensible HTML editors, and the talented group of people developing extensions for them, are building a development environment that might just make the HTML editor/browser combo a workable substitute for older Hypermedia authoring environments.

Educator's Dilemmas

The limited budget and political surroundings of educational researchers and developers often require us to do our own software engineering, or at least to know what we're asking a contractor to provide. This paper outlines some of the technical and pedagogical issues involved in this endeavor.

Design Methodology

We have found that a sound theoretical background and curricular analysis are essential to a worthwhile educational effort. We started with a modified implementation of Rand Spiro's Cognitive Flexibility Theory and soon incorporated elements from other Constructivist and Situativist learning theories. This paper will not attempt to summarize those theories, but merely to point out that we have not simply let the available technology shape our designs.

To CD or not to CD

Custom Browsers

Netscape and Microsoft both provide free customizing kits: NS-CCK and MSIE-IEAK (modifying a browser may be too involved to be practical, but often 3rd party vendors will do it for you). Information is available at:
http://home.netscape.com/download/cck.html and http://www2.microsoft.com/windows/ieak/en/default.asp

CD Production

Major browsers cannot run off a CD; browsers that are able to do so are usually not very good at Javascript or DHTML support. Therefore, your CD should include an option to install the browser of choice on the learner's computer. The many issues of providing multimedia content on CD-ROM are nicely summarized at this Web address:
http://www.phdcc.com/helpindex/cdroms.html

Persistent Storage

Cookies- Most browsers make something like this available, and it's the most obvious way you can put semi-permanent information on a computer (test scores, student info, learner-selections), but users also have the option of turning cookies off, and the learner might change computers.

Parent page globals-- If you declare a variable on a page that remains open but opens other pages in front of it, that variable remains useable by any of the other pages. This is a valid technique is some situations, and we use it at: http://www.bonfils.org/courseware/

Hidden form fields in frames-- If a standard frame appears beside your other pages, that frame can contain hidden fields with information generated by the learner's interactions. See the article at this Web address: http://developer.netscape.com/viewsource/goodman_nocookies/goodman_nocookies.html

Strings appended to link addresses-- Another possible technique, described in detail in the article at: http://developer.netscape.com/viewsource/goodman_url_pass/goodman_url_pass.html

CD as Server

CD speed equivalents

(this information was gleaned from various sources and is not authoritative; the point is that even the slowest CD is faster than the fastest modem.)

1x: 150 Kbytes per second (about three times faster than the fastest modem).
2x: 300 KBPS
8x: 1,200 KBPS
16x: 2,200 KBPS (comparable with a slow hard drive)
24x: 3,600 KBPS
Check this Web address for details: http://webopedia.internet.com/TERM/C/CD_ROM.html
Compare the T1 rate: http://www.ora.com/reference/dictionary/terms/D/Digital_Transmission_Rate_1.htm

Browser Wars

DOMinance

The Document Object Model is a way to categorize everything on a web page as a part of one big hierarchy of objects (like tables or lines of text). These program items can be given specific names and attributes. By referring to these items by name, and by responding to events (like 'mouseover' or 'dragdrop'), a program can make a web page interactive or "dynamic."

For more about the DOM, go to: http://webopedia.internet.com/TERM/D/DOM.html

Standards? We don't need no stinkin' standards!

The group that first designed and enabled the Web now calls itself the W3C, and it noticed that scriptable browsers used DOMs that bore only a passing resemblance to one another. So, in association with the ISO, an official, detailed, standard DOM has been prepared. MSIE 5.0 and Netscape 5 (as yet unreleased, but available in development form as Mozilla), both claim to use "most" of the W3C DOM.

Platform Issues

Rendering, type size

A difference in the way Windows and Macintosh machines draw text on the screen often results in Macs displaying type smaller than Windows machines.

Debugging the browser

Once a company feels it's Windows version is ready for release, it seems that, whatever shape the current Mac software is in, the Mac version goes out the door too. We have found that some functions that are fully implemented in the Windows version of a browser are not quite as well handled in the Mac version of that same browser.

Browser Plug-ins: Authorware, Shockwave, VRML, etc.

At the student's end, most major multimedia producers provide extensions to the browser that allow the student to view your web page's content from within their browser. However, you must be sure your server (not just their browser) can handle the files that contain the multimedia content.

Learning Objects: Communicating the Pedagogical Potential

Gary Hepburn
School of Education
Acadia University
Canada
gary.hepburn@acadiau.ca

Craig Place
Acadia Institute for Teaching and Technology
Acadia University
Canada
craig.place@acadiau.ca

Abstract: Learning objects are rapidly finding a place among the standard teaching tools upon which educators depend. Although they have the potential to enhance student learning, this potential may not be realized unless standards are developed to communicate information about the learning object and its educational role. In this paper, we will discuss a way that the educational role of learning objects could be communicated to educators who are considering its use in instruction. We propose a format that describes four key features of the learning objects relationship to the instructional context. The four categories of information are entitled concept, context, instruction and activity. Including this instructional information will facilitate the incorporation of learning objects into instructional contexts.

The IEEE Learning Object Metadata Working Group (1999) defines a learning object as any entity, digital or non-digital, that can be used, re-used or referenced during technology supported learning. This definition is broad, demonstrating that learning objects still tend to be ill defined and lack standards (Cox, 1999). For the purposes of this paper we will be defining them as digital media, designed to be used by educators and learners to achieve particular learning outcomes. Part of the reason for the increased interest in learning objects is that greater numbers of people are able to create them, as applications that were once the sole domain of multimedia experts become more accessible. While, on the one hand, the proliferation of learning objects is a positive development for education, on the other, the exisitence of large numbers of learning objects, created many different people using various development tools may result in mass confusion. Finding, assessing, and using a learning object may become so difficult and time consuming that few educators would see the value in doing so. The development of learning objects needs to be accompanied by a standard way of communicating information about them (metadata) so that they can be easily found, assessed and used. Part of what needs to be communicated needs to refer specifically to the ways in which the learning object can be incorporated into instructional contexts.

An example of a learning object could be "Strike Lines", a fundamental concept in the discipline of geology required to fully understand geology maps, mining and oil geology. The learning object would include a description of the significance of strike lines, put them in context relative to rocks, geology maps, contours and other related concepts or learning objects.

The instructional context

All educational media, digital or not, is best judged upon its ability to support student learning. For that reason, it is necessary to embed any discussion of learning objects within the language and conceptual framework of current learning theory. Constructivism (Cobb, 1994; von Glasersfeld, 1989) has been the most influential theory of learning in recent years. In addition to having been prominent in educational literature, it has become the standard perspective on learning put forth in many curriculum documents. Constructivist views on learning recognize that students are active constructors of their own knowledge. Students enter a learning situation with prior knowledge. It is upon this prior knowledge that new constructs are acquired by the learner. Sometimes the construction process is one of simply relating new constructs to existing ones, while at other times acquiring new constructs requires that exisiting ones be altered or replaced. Recognizing and facilitating the construction process is the work of the teacher.

When a learning object is used in the classroom it is important that the idea or concept that the learning object is intended to support be seen in relation to other related concepts. This provides a teacher with the conceptual landscape in which the learning object is located. Knowing the conceptual landscape helps the teacher appreciate the context in which the instruction takes place and the sort of linkages students need to make. Planning instruction requires this appreciation be used to in the development of instructional strategies aimed help students achieve the desired cognitive goals. Even when a good instructional plan is created and enacted, students frequently have difficululty constructing new understandings, especially when they conflict with their prior understandings. For this reason, learning activities for practice and follow-up must be carefully developed and administered.

Communicating the Potential

We suggest that measures be taken at the time when learning objects are produced to ensure that they are easily used in instruction. Part of the information given should refer to the instructional role of the learning object, taking into account many of the issues highlighted by a constructivist perspective on learning. Specifically, we propose that four categories of information accompany learning objects:

1. concept - a description of what the student will be learning from the learning object.

2. context - information on expected prior knowledge and links to other concepts and/or learning objects. The context may also describe applications of the concept.

3. instruction - details the way(s) that the learning object could be used in instruction.

4. activity - describes or includes activities in which a student could use the learning object to practice and perfect the concept as well as to assess their progress

On the basis of this information, we believe an educator would be able to make a decision about the ways in which any particular learning object could be incorporated into instruction. This information would support the usage of the the learning object for concept introduction, practice, and/or review. In addition to being informed of the educational role of a particular learning object, educators will be able to consider the relationships between various learning objects available for instruction. Conceivably, a web of learning objects could be designed to support students as they learn complex, interrelated concepts.

References

Cobb, P. (1994). Where is the mind? Constructivist and sociocultural perspectives on mathematical development. *Educational Researcher, 23*(7), 13-20.

Cox, K. (1999, May 18) Learning objects. WWW Tools for Instructors [On-line] . City University of Hong Kong. Available: http://www.dco.cityu.edu.hk/tools/newslett/learning1.htm

IEEE (1999). Learning Object Metadata: Base Scheme - v3.5 [On-line]. Available: http://ltsc.ieee.org/doc/wg12/scheme.html

von Glasersfeld, E. (1989). Cognition, construction of knowledge, and teaching. *Synthese, 80*(1), 121-140.

How to use Lotus Notes Learning Space and The Web in supervising your students abroad.

Wim Hessels
University of Higher Professional Education/
Faculty of Economics and Management/
International Business Department
Padualaan 101
P.O. Box 85029
3508 AA Utrecht
The Netherlands
W.Hessels@econ.hvu.nl

My presentation is about supervising students on their terms of probation abroad. For this aim I have developed several years ago an internet site in HTML. We have tested this site in co-operating with our students abroad. To improve this application I have developed a new tool in Lotus Notes/Learning Space. During the presentation I want to show and discuss the results and our experiences. With this presentation I hope to achieve the following aims:

1. To show how useful the Internet can be in education particularly to supervise the students on their terms of probation.
2. To get feedback and critics on our product.
3. To establish contacts with other colleagues in case of this subject.

Today's Situation

- All our students abroad have to send their reports to the supervisors.
- Nowadays they use the postal service or send a fax. Sometimes the documents Don't arrive at the workplacementoffice.
- When they are in trouble, they use the telephone for the communication with their supervisor. This method is very expensive.

Vision Statement

Students and supervisors need a good tool for their communication.
Using the Internet is the solution.

Goal

To create a possibility for the communication between students abroad and their supervisors at the university.

The solution

- First we have created a website with all the possibilities available for the students and their supervisors.
- Nowadays we are working with Lotus Notes/Learning Space

New Horizons in Distance Education:
Charting New Territory

Jeannine St. Pierre Hirtle, Department of Curriculum and Instruction, Sam Houston State University, USA,
edu_jsh@shsu.edu
Robin McGrew-Zoubi, Department of Curriculum and Instruction, Sam Houston State University, USA,
edu_rmz@shsu.edu
Christopher David Scofield, Department of Education, St. Martin's College, USA
scofieldtribe@home.com

Perspective

In a time when modern culture is linked by telecommunications technologies in ways never before possible, people transmit and process information, conduct business, collaborate in research, and engage in
social and political discourse in dramatic new ways (Kapor, 1998, Wriston, 1996). Amidst this context, many educators search for a cost-effective way to develop a technological infrastructure that can effectively serve the needs of their students. When their searches yield promising results, educators who attempt to initiate such infrastructures can become stifled by bureaucratic norms and historical values, or thwarted by political and economic crosscurrents within their institutions. Furthermore, the implementation of new technologies within higher education institutions--environments almost perpetually preoccupied with finances and funding--must be done with utmost economic efficiency. The development of new technologies must also support the diverse needs of student populations whose characteristics are continually transforming beyond those of the traditional student (Dalziel, 1997). For example, many contemporary students need flexible scheduling of classes and alternative ways to access and distribute information because they work and attend school. For these students, distance education is often heralded as an excellent way to help them obtain the benefits of higher education while balancing their non-traditional roles and responsibilities. Yet, ironically, the potential benefits offered by something as non-traditional and futuristic as distance education classes may be undermined by their incorporation of pedagogical techniques and traditions that are not consistent with the changing educational needs of society. If distance education classes merely entail the uploading and distribution of didactic lectures, quizzes and paper assignments, then they may be falling far short of their potential to serve contemporary students who want—and need— to become successful members of modern society. Today's highly interactive society demands that its citizens think critically, problem-solve, and see outside traditional paradigmatic structures (Cox, 1997, Frazier, 1997, and Boetcher, 1997), and educators should be preparing students in a manner consistent with the needs and demands of their society. Distance education in particular needs to provide the types and extent of interactivity consistent with the new global society. But the question is: Can distance education courses actually be aligned to pedagogical practices which serve the needs of a rapidly-evolving, technology-assisted, information-driven society?

Purpose of the Study

The purpose of this case study was to analyze a distance learning program designed to align technological methods and pedagogical practices to better meet the needs of its students. This study focuses on a block of secondary teacher education methods courses that employed web-based distance education. The methods courses were taught at a mid-size state university to sixteen post-baccalaureate students who were teaching in grades 7-12 on emergency certification during the 1998-99 school year. Strategies implemented to support the program's goal were:

- Professors created problem-posing curriculum that required students to assimilate information presented in their methods courses, synthesize it, and apply it within the context of

their own school or classroom.
- Professors created public cyber spaces for students to publish their work and to react to the work of their peers.
- Professors created public cyber spaces for students to debate, solve problems, and dialogue about current issues and concepts associated with the courses and their work.
- Professors' modeling of meaningfully integrated technology in order to support a problem-posing curriculum.
- Students' learning of requisite technological skills for engaging in class activities.
- Students' reflection on their learning through journals, conversations, and electronic portfolios.

Methodology

Informants for this study included sixteen post-baccalaureate university students teaching on emergency certification, two professors, and one graduate student/instructor. The students' electronically posted papers, projects, field notes, response logs, and forum responses were analyzed qualitatively looking for evidence of theory-to-practice connections reflective of the changing pedagogy. Course syllabi and instructors' field notes were analyzed qualitatively for evidence of professors' reflection about their own theory-to-practice . Sixteen end-of-course evaluations were examined for student satisfaction in meeting their learning needs according to the traditional university evaluation rubric.

Findings

Formative evaluations made at the close of Fall 1998 indicated student, instructor, and supervisor satisfaction with the methods' block. Students reported a high correlation between material studied and its relevance to their classroom practice. Students, professors and supervisors also addressed areas of concern and recommendations for improvement. The professors for the methods-on-line class published web pages to deliver information about the structure and content of the course, but the threaded message boards became the forum for students to interact with the class community, professors, and other students in the class. Threaded message boards served multiple instructional purposes in the Spring 1999 component of the block. They provided a mechanism for the professors and students to:
- Deliver information about the structure and content of lessons,
- Post expository assignments discussing the application of theory to classroom practice,
- Report primary data collected,
- Post lesson plans and construct instructional strategies,
- Summarize, evaluate, and reflect upon assigned readings from texts and journals,
- Present persuasive arguments on educational issues,
- Analyze educational issues and current events, and
- Simulate classroom practices through role play.

In a typical lesson, a professor posted:
- Information about the dates and times the assignments were due for any particular class
- meeting,
- Questions which guided student inquiry into the lesson,
- Introductory information about the topic and supporting links to sites on the web, which
- provided a basis for linking student prior knowledge to the topic to be studied, and
- Threaded message boards for students to respond to the readings, discuss their responses with
- each other, or post other instructional activities products.

Recommendations

- Educators must place learning within a problem-solving framework that compels students to synthesize the information acquired in their courses and apply it to real world scenarios.
- Educators must facilitate virtual communities of learners who work in small, collaborative

groups to achieve a common goal.

- Educators must create public cyber-spaces for students to debate, solve problems, and dialogue about current issues and concepts associated with their courses and their work environment.
- Educators must model how to meaningfully integrate technology to support a problem-posing curriculum.
- Students should learn technological skills as they are engaging in class activities.
- Student should have opportunities to reflect about their learning through authentic means such as journals, conversations, and electronic portfolios.

References

Boetcher, J. (1997) *Issues in distance learning*. Syllabus Conference, July-August, Sonoma State University, Sonoma, CA.

Cox, P. (1997). Cyberdegrees: Who needs a college campus? Just login and start studying. *Wall Street Journal*, November 19. p. R26

Dalziel, D. (1997). *New connections: A guide to distance education*. Washington D.C.: Instructional Telecommunication Council.

Fraser, A.B. (1997) *Managing courses on the world wide web*. Syllabus Conference, July-August, Sonoma State University, Sonoma,CA.

Kapor, M. (1998). In: *The merry pranksters go to Washington*, by Quittner, J. Wired, February.

Wriston, (1996) The Future of Money. *Wired*. October.

Development of a Web-Based Instructional System for Emerging ScientificTechnologies: The Vanderbilt Microarray Shared Resource, a case study.

William T. Holden, M.S., ICL.
Cell Biology
Microarray Shared Resource
Vanderbilt University
United States
William.Holden@mcmail.vanderbilt.edu

Mark K. McQuain
Biomedical Engineering
Vanderbilt University
United States

F.R. Haselton, PhD.
Biomedical Engineering
Vanderbilt University
United States

Robert J. Coffey, M.D.
Cell Biology and Medicine
Vanderbilt University
United States

D.W. Threadgill, PhD.
Cell Biology
Vanderbilt University
United States

Abstract: We are developing an online interactive Web-Based instructional module, which provides our user community with basic tools to understand microarray technology. Additionally, providing basic theories associated with microarray technology may allow the user community the necessary means to appropriately and innovatively apply the technology. We describe a longitudinal learning environment designed to educate the novice undergraduate and practiced researcher. Preliminary studies of senior level undergraduate students suggests that such a system will enhance the learning experience of current technologies as they move from development in the lab to useful research tools. This case study, exemplifies a novel use of the web to expeditiously disseminate information and training in emerging technologies.

Graphical Representations of Convergence in Web-based Educational Computer Conferencing: A Prototype

L. Hopperton, R. Rupp, M. Campos, B. Fisher, L. Harasim, M. Luk, C. Ostler, & C. Xin
Virtual-U, Simon Fraser University

Introduction

Graphical representations of the structure of information are not uncommon on large, World Wide Web sites. But because of the continued addition of notes in evolving computer conferencing, coupled with the labour intensive activity of continually creating and updating these navigational, conceptual maps, these site maps have not been adapted to evolving, computer supported discussions. These systems actively support idea divergence but are limited in providing hypertextual tools that support idea convergence and structuring (Harasim, 1990). This limits their ability to scaffold the development of mental models of a domain of inquiry based upon progressive reconsideration and synthesis of content.

The research and development team of the Virtual-U project has developed a prototype of a graphical representation of convergence, VU-ROC, for online learning environments. The prototype shows promising results for the construction of an active, message mapping system for online learning. It is designed to be an external support tool that will encourage reflective thinking by illustrating the structures of existing knowledge and the dominant hubs and conceptual triggers over time within the corpus of information. While computationally based and dependent upon user-specified categories, it is relatively user passive, requiring only reflection upon the nature of a note after it is written. It is intended to scaffold the developing mental models of students by mapping the relationships between notes as they are entered thereby illustrating and stimulating convergent thinking.

The VU-ROC model used 27 actual notes from a college seminar on two poems by Blake, "The Lamb" and "The Tyger", which present omplementary visions of the nature of God and creation. Figure 1 presents a full message map of the Blake seminar. By clicking on any node within the message map, the full note text is brought onto the screen along with a small representation of the notes to which it directly refers. This allows students to browse through hubs of information in a simple, intuitive manner.

The legend for notes appears on the left-hand side of the screen. This acts as a reminder to students about the nature of any given entry. In the visual window, a selection box indicates the note that a student has selected by pointing and clicking. The visual relationship of this note to its referents is highlighted using darker lines. Unread notes are solid colours while read notes are in outlined colours. The text of the selected note appears at the bottom of the screen. Tabs allow users to manipulate the representation in the graphical display window.

Using Groc

Following the writing of a note, when the student is ready to post their entry, they are required to specify the note categories using a simple drop-down box in which students point and click their choices. Drop-down boxes contain optional reminders of literary periods and note types that are pre-set by the course instructor.

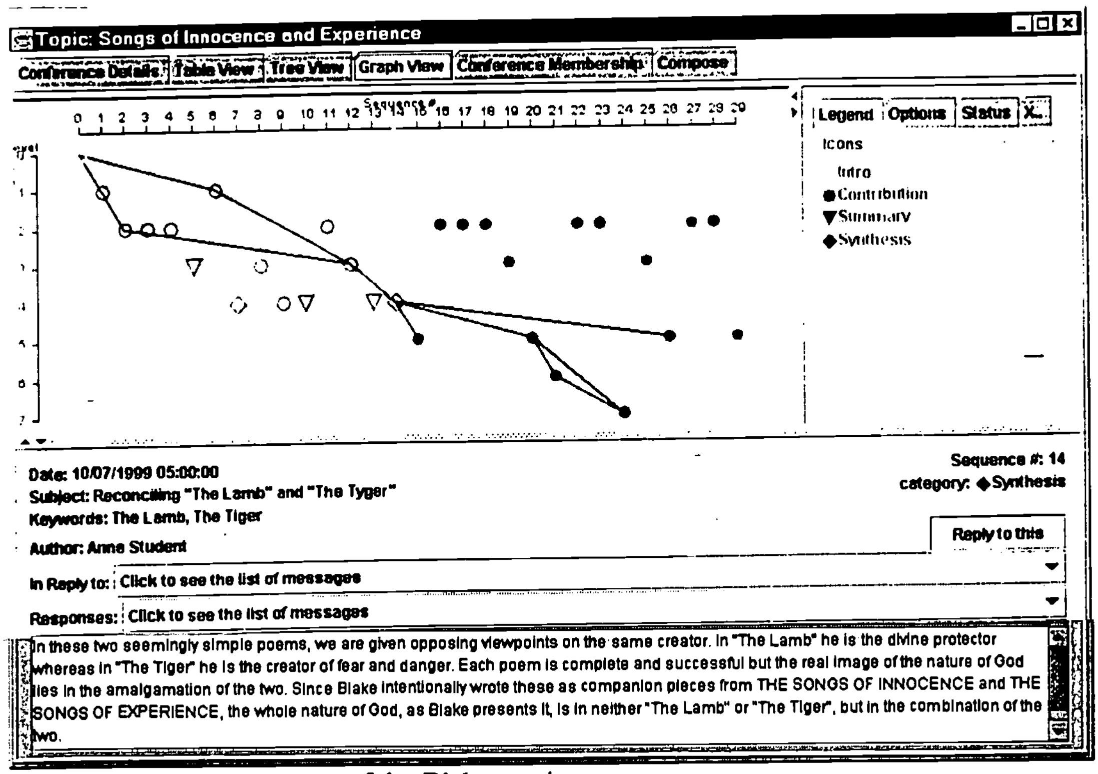


Figure 1: Full message map of the Blake seminar

Discussion

Current development is focused on the full semester conference, and this will be followed with full field tests. It is anticipated that a beta test version of the prototype will be ready for these field tests by 2001.

The application of computer generated, graphical information management and structuring tools are positive and useful additions to educational computer conferencing systems. These tools facilitate the process of progressive reconsideration of course-based ideas, and, potentially, support the inclusion of external resources such as web pages. Knowledge synthesis, as demonstrated through the linking of conference entries, can be brought to bear upon multiple domains of inquiry, and so requires successive re-juxtaposition, re-examination, and re-interpretation of ideas by students.

The full text of this paper can be found at
http://virtual-u.cs.sfu.ca/vuweb/Vuenglish/papers/papers.html

Teaching and Learning with STYLE

(Situated Technology Yielding Learning Enhancement)

Barbara K. Iverson
Columbia College Chicago
Journalism (New Media)
600 S. Michigan
Chicago, IL 60605
Biverson@popmail.colum.edu

Abstract: The paper discusses the STYLE (Situated Technology Yielding Learning Enhancement) program where unique on-the-job faculty development in technology skills, integrating technology into post-secondary classes, and promoting learning-centered classrooms in one logical, easy to implement and assess innovation. Currently, STYLE is a FIPSE-sponsored program at Columbia College Chicago. We discuss qualitative and quantitative evidence of program success. The model can be adapted across a continuum of existing technology configurations that exist in post-secondary education settings today.

The Teaching with STYLE Model

At the heart of STYLE is a faculty developed interactive, non-linear collaborative project to be created by two different classes according to a flexible plan created by the faculty involved in the paired collaboration aimed at the transformation of the learning environment (Tinto, 1998.) Instead of following the familiar form of learning communities wherein the same students take two concurrent classes taught by different teachers who communicate about their learning objectives and teaching in general, STYLE is a loosely coupled simulation of the modern workplace (Iverson & Torriera, 1999.) The learning community formed in STYLE collaborations is made up of a pair of classes with different students and teachers. One is a traditional class, such as a liberal arts class, where lecture is a prevalent teaching method, and there is little, if any integration of technology into the classes. The other is a technology -oriented class, such as New Media projects, or Multimedia Producer that are "technology heavy" and "content light." The technology teacher serves as a leader in using tech to collaborate, and as a research tool in the classrooms. Often the content teacher has many ideas about what they want to do with tech in the classroom, they simply lack experience and expertise. Experience has shown that the tech teacher comes to the collaboration believing they are using tech fully in their teaching, but they may discover from their teaching collaborator new ways tech facilitates learning and communication beyond its uses as a production tool (Iverson, 1999.)

STYLE synthesizes several simple but important ideas about learning, pedagogy, and technology into an easy to implement model that introduces project-based collaboration across departments and disciplines. A benevolent "Trojan Horse" approach is used to get faculty to use various digital tools and technologies by focusing on teaching tasks, not skills learning per se. The model improves learning, increases faculty digital skills, and helps integrate technology into the fabric of teaching, avoiding the less effective "bolt on" approach to technological integration in post-secondary settings.

STYLE is based on an emergent understanding of human learning (Schank, 1992; 1994) and of what works (Jonnessen, et. al, 1999), that is "praxis" (theory in practice) in higher education. Its simple premises are:
1. Learning is more meaningful if learners are engaged. Active learning is more engaging than passive learning. Time on task is a potent predictor of achievement.

2. Learning is a social activity for students and faculty alike. Communication, collaboration and teamwork provide an effective setting for teaching and learning.
3. Situated learning about any subject, including learning to use technology, is more effective for faculty as well as students.
4. Technology enables us to provide necessary passive learning (formerly transmitted via lecture) outside the classroom (via on-line technologies) and to use in-class, face-to-face for communication and active learning activities. Witnessing knowledge in action, and working as knowledge organizers, rather than being passive knowledge consumers makes students better learners.
5. Encouraging students in sustained perspective taking (as in creating interactive, non-linear versions of their work) promotes higher order thinking and learning, as well as fostering the appreciation of diversity of opinion.

Implementation

Teaching with STYLE collaborations retain a set of objective unique to the content class, a set unique to the technology class but include a shared set of learning objectives that involve teamwork and communication centered around the collaborative project. The shared objectives, scope, and form of the project are designed by the participating faculty with input from participating students. They vary from semester to semester. Each class also engages in a variety of other assignments related to and separate from the shared projects.

In some institutions it is difficult to add new classes to the curriculum. The STYLE approach allows updating of existing courses and integrating facilitating technologies into these classes. It avoids proliferation of new courses and the "bolt-on" technology syndrome that results from mandates to use tech in teaching.

The ease with which web sites can be created using modern WYSIWG HTML editors makes projects like this possible in a range of institutions that may not have high-end technology classes. Through FTP, use of a project site, and other facilitating technologies that encourage asynchronous communication, new forms of information and virtual collaboration are possible. The inter-class communication requirements of STYLE can be met with the use of a range of tools, from simple and ubiquitous shareware to high-end proprietary packages, as fits a given setting. Faculty seeking to implement STYLE can begin with a shared set of PowerPoint-like presentations and e-mail and evolve to the use of GroupWare, DHTML, and more sophisticated tools as suits their needs. The point of STYLE intervention is not the product, but the process.

The faculty in the collaborations differ in their skills with digital technology. Generally one faculty is more technologically savvy than the other is. This is where the "Trojan Horse" approach comes in. It is in the interest of both faculty that they can communicate easily and conveniently. They help each other in using specific software and hardware in specific settings to accomplish their shared tasks and goals. Results of a digital skills survey given before and after project participation shows that faculty develop their skills as a result of the project. This is more effective in encouraging the transfer and retention of learning than the pullout workshop model.

There is flexibility built into STYLE collaborations because institutional and bureaucratic impediments to collaborations like this include scheduling issues, length of classes, and resource issues, etc. The ideal collaboration involves classes that have overlapping meeting times so as to provide for face-to-face meetings. This is preferred in every evaluation we have conducted. However, STYLE can work even if the classes meet on different days because of its reliance on simple electronic collaboration tools (e-mail, FTP directories, project web sites, and threaded discussions.)

Results

It is often problematic, to compare achievement between the STYLE program and traditional classes. In order to look at the effectiveness of the model as a method of improving teaching, we use the whole class as a unit of analysis, and focus on changes in the psycho-social learning environment of the classroom that result from collaborative learning strategies. We look for changes in the class' sense of cohesiveness, cooperativeness, democracy, diversity, and satisfaction. These factors are stable and robust in large-scale research studies of cooperative and collaborative learning in pre-computer times, and are correlated with academic achievement (Fraser & Walberg, 1984.) Faculty significantly enhance these aspects of the classroom learning environment through instructional grouping, project-based assignments, and an increase in student participation, communication and collaboration, in the projects, and our quantitative and qualitative results show this. This signals success for the teaching with STYLE model.

The exciting thing about STYLE collaborations is that we document program effects from anecdotal and open-ended questionnaire data but we triangulate from data based on assessing the classroom learning climate, and by assessing the project products as well. Summary data is viewable at http://acweb.colum.edu/users/biverson/ed_media2000/. The projects themselves are viewable at http://digdesign.colum.edu/fipse.

In conclusion, we discuss how to match up the current hardware and software and expertise available with the kind of projects that can be best accomplished in any setting. The key point is that the collaboration learning objectives and the five premises of STYLE listed in the beginning of the paper are most important. Fit the project-based collaboration to the tools at hand. Using e-mail and threaded discussion, and having a website or even a simple networked and thus accessible site where you post work for clients to observe will put you on the road to success. Faculty using the "each one, teach one" method to work together, and modeling this kind of on-going learning for students set the process in motion. Process is what should be emphasized in adopting STYLE in your teaching, not products, either the technical ones used for making work, nor the outcome project of the collaboration. Our evaluation results, pulling from what participants say, and what they do show the program is effective and holds promise for promoting active learning, providing effective on-the-job faculty development, and in integrating a range of technologies as tools to facilitate learning and communication into classroom practice.

References

Tinto, V. Colleges as Communities: Taking Research on Student Persistence Seriously. The Review of Higher Education 21.2 (1998) 167-177.
URL: http://muse.jhu.edu/journals/review_of_higher_education/v021/21.2tinto.html

Iverson, B. K. & Prados-Torreira, T. Liberal Ed meets High Tech: Interdisciplinary Collaboration to Improve Instruction. World Association for Case Method Research and Application Conference, Extremadura, Spain, July 5-7, 1999, in press.

Iverson, B. K. Making New Media in Everyday Classrooms. Presentation at Lilly Atlantic Conference, Towson College, Baltimore, MD, April, 1999.

Schank, R.C. Goal-Based Scenarios. The Institute for the Learning Sciences,Northwestern University, Evanston, Illinois., Technical Report #36 December 1992.

Schank , R. Engines for Education website, 1994 URL: http://www.ils.nwu.edu/~e_for_e/

Jonnassen, D.H., Peck, K. L. & Wilson, B.G. Learning with Technology: A Constructivist Perspective. Prentice Hall, Upper Saddle River, N.J.,1999.

Fraser, B.J., G.J. Anderson, and H.J. Walberg. (1991). Assessment of Learning Environments: Manual for Learning Environment Inventory (LEI) and My Class Inventory (MCI). Perth, Western Australia: Curtin University of Technology, Science and Mathematics Education Center.

Designing a Media Management System to Match Your Needs: A Systematic Approach

John M. Jackson, M.Ed.
Office of Medical Education
University of Virginia School of Medicine
United States
jjackson@virginia.edu

Abstract: This paper describes the reasons to consider developing a customized media management system, along with the disadvantages of these systems. A step-by-step system for designing, developing and evaluating a customized media management system is described.

Overview

Most web based educational systems develop begin with a single project in mind. As new projects evolve, bits and pieces are borrowed from previous projects, and over time the overall system can become quite complex, and difficult to maintain. At a certain point a critical mass is reached: either more resources have to be allocated to maintain the current way of doing things, or a more efficient system must be developed. The goal of this paper is to describe a way of systematically choosing and developing an efficient database-web resource management system to meet your specific needs.

A web-database resource management system offers several advantages of "hard coded" HTML pages. Resources such as pictures, sounds , movies and teaching cases can be indexed with metadata so that they may be easily searched and reused in multiple projects. Web based forms can be developed so that textual content can be easily edited, separating the creation of content from design and delivery, allowing authors to focus on content, not technology. Sites can easily have a consistent look and feel through the use of templates, with content being served up dynamically via a database. Updating a single template can then update an entire site. E-commerce and other transactional system can be implemented. Faculty can track student progress and performance through a series of exercises. Correspondence between faculty and students can be facilitated and archived for later analysis. Some off-the-shelf systems offer these features as pre-designed widgets that can be customized with a minimum of programming, or a custom system can be built from the ground up. Either approach maintains content in a database, which makes migrating to new delivery technologies like DHTML or XML fairly painless.

On the other hand, these database-web systems typically require a higher level of technical expertise to plan and develop than HTML only sites. Adding new features to these systems usually requires a programmer, instead of a web designer. And when a bug appears in a templated page, it typically is repeated again and again throughout a whole site. The overall system becomes more complex, with more opportunities for technical problems. We'll look at how each of these factors plays out in choosing or creating your own system.

Developing a Media Management System

The process of choosing and designing your own resource management system involves these steps:

1. Needs analysis – Clearly define the current and projected production and delivery issues.
2. Review available tools – Given your needs analysis, review options. Narrow the field to three or four that best match your needs.
3. Test drive – Get trial copies of the "final four" products identified in step two and build a typical application. Develop a formal evaluation checklist to compare the outcomes of your test drive.
4. Review outcomes – Your evaluation may have unexpected results. Does adopting a new technology change your operations plan?

5. Develop Budget and Implementation Plan – Project your costs and get approval, if necessary. Develop a stepped implementation plan with target dates for each part of the transition.
6. Evaluate the outcomes – Did you accomplish what you expected?

Let's next look at each one of these steps in detail and examine what can be involved in each.

Needs Analysis
Each institution will have different needs, but a common one is the ability to reuse resources such as images, sound clips, chunks of text, teaching cases, and movies, in different ways on different projects. We found ourselves with thousands of images that had the potential of being used across many disciplines—if anybody could find what they needed. As a result, our top priority became a sharable image/sound/movie database. We also had thousands of practice quiz questions, which were difficult to update in HTML. So our second priority was a question database with easy access by faculty for editing. You may have similar needs, or ones that are completely different.

Review Available Tools
There are hundreds of tools currently on the market, from simple image databases to turnkey management systems from the likes of Oracle and IBM, to specialized course management systems. Some of these systems can be learned in a day, while others require programmers earning $80K a year. With your needs analysis in hand, choose the 8-10 more promising tools for your project. Read everything you can find in print and on the web and talk to people using those products. Monitor the support newsgroups for the tools. Create a checklist of your desired features and narrow the field to the best matched three or four.

Test Drive
With trial copies, build the same application in your "final four", one that you would actually use. We built an image database and an evaluation system using multiple choice questions. Can it handle the required security? Can it handle the number of users you project? Is setting up a new project a breeze or a nightmare? Are there good support options available? Is there a clear migration path to more powerful system as your needs increase? Use these and your own questions to formally compare each of the products. Identify the best choice(s).

Review Outcomes
So you think you have chosen the best tool for your situation. Now you should take some time to mull over the possible outcomes. Will existing staff be able to meet the new challenges? What training will be necessary? How will your clients react? Is it worth the investment given the projected outcomes? Take time to talk again to people using the product and find out their likes and gripes. In short, perform a reality check before moving ahead.

Budget and Implementation
Draw up a formal budget that includes not only software tool cost, but also staff, training, support, and hardware. Develop a-step-by step plan on how you will migrate to the new system. What components will be required first, second and third? Include adequate time for testing of the new system by staff and clients before rollout of each phase. Take you initial time estimates and double them.

Evaluate Outcomes
Take time to review your accomplishments after six months and a year. Has the process evolved as you expected? Have you met the goals identified in your initial needs analysis? Is your team happy? Are your clients happy?

After this stage the next step is…. do it all over again! With the pace of technological change you may actually be faced with a whole new set of problems and opportunities that require going through this process again. But using the systematic approach described above, good planning, and a little bit of luck, you will have chosen a system that will grow with you into the future.

Encouraging New Conversations In Software Design.

Glenda Jacobs
School of Communication
UNITEC Institute of Technology, Auckland NZ
gjacobs@unitec.ac.nz

Duncan Meyer
Long Bay College, Auckland NZ
duncan@chalksoft.com

Abstract This paper describes and critiques current user-designer feedback channels, and suggests why and how these could be augmented, particularly in educational settings. It is argued that current feedback mechanisms exclude the majority of users. Although academics remain sceptical, increasing numbers of software designers in New Zealand are recognising lost opportunities for client support as well as customization and improvement of services, and are pursuing new paradigms for designer-user communication.

Introduction

Mechanistic'sender-receiver' models of the communication process provide a superficially convincing representation of the interaction between computer users and their PCs, with the computer application seeming to show communicative behaviour similar to that of a human partner.

While acknowledging this seemingly 'social' interaction with the technology, however, it is easy to undervalue the real (if asynchronous) communication relationship that exists between software designers and their users. The design process involves, in effect, the construction of a delayed 'conversation' between designer and user, where the users' needs are anticipated and predicted, and appropriate responses are provided to meet them. However, in this relationship, only the designer/sender is actively aware that communication (albeit indirect) is taking place, while the user/reciever participates in the process without having to recognize it as communication at all.

The result is communication that is one-sided. Despite 'Know thy user' being accepted as axiomatic by modern developers, occasions for actually getting feedback from users are limited. For many developers, the only such occasions would occur during usability testing, ending shortly after system implementation (Pausch, Conway & DeLine 1992, Petersen C, 1996; Saltzman & Rosenthal 1994).

Adequacy of Existing Feedback Channels

One needs to distinguish, at this point, between Product Support Desks that exist for users who simply need help operating a piece of software, and channels that allow for queries about, commentary on and criticism of various features of a software product. One is tempted to assume that, for users who want to engage in the latter, emailing or telephoning the developers would be the obvious option. Consequently, a survey to assess the usefulness of existing user-designer feedback channels was conducted at UNITEC Institute of Technology, four Auckland secondary schools, and at the Chalksoft educational website. A summary of the results follows (Detailed results can be found at www.chalksoft.com/questionnaireresults).

Overall, 88% of respondents had never contacted the developers of the software they used. Reasons for not contacting developers were given as follows (respondents were allowed to choose more than one reason): It never occurred to me (72%); It would be too much trouble to try to get hold of the developers (52%); I have nothing I would like to tell the developers of the software I use (51%); Software developers don't have time for users like me (26%); It would be too much hassle to try to explain myself (9%). In addition, fifty-eight percent of the respondents who had never contacted software developers did not know how to go about doing so.

These results suggest that, at least in the limited educational context of this survey, the majority of users are unlikely to take advantage of (or in some cases even know about) the channels currently available to them for communicating with the designers of the software they use, the main reasons being that the possibility of, (and to a lesser extent the need for), such a 'conversation' does not occur to them, and that finding appropriate channels would be simply too much trouble.

Current Channels for User Feedback

Recent demonstrations of interest in ongoing user feedback by major companies include dialogue boxes which appear when the application detects an error condition (eg Netscape, Muzak) and the provision, within the application, of a link to a company web page or a trouble-shooting discussion forum (eg Blackboard). However, the weakness of the former lies in that the user has no control over when feedback is possible. In addition, there is the nigh-impossibility of users being able to identify and then describe accurately in retrospect their exact sequence of acts preceding an error message.

A weakness of the discussion forum option lies in the assumption that users have the confidence and the vocabulary to make their difficulties or suggestions public. This is particularly untrue of many teachers, whose use of computers is intermittent (but not unimportant) and who do not regard themselves as part of the computing inner circle (Dawes, 1999, Pate, 1999). It also does not address the problem of non-expert (but not necessarily unintelligent) users having to explain in writing what they mean or want, while not knowing what is relevant to achieving their goals (Sellen and Nichol 1990, Pausch, Conway & DeLine 1992).

Design Solution

The authors of this paper have designed a feedback feature that addresses these obstacles. Although useful in any organisational context, it has been designed for inclusion in the authors' educational software, and is as a result aimed at educators in particular.

The feature provides the user with the opportunity at any time when using an application (not only when the application encounters an error condition) to click on an 'AUTHOR' button permanently on the screen. This calls up a feedback form, addressed to the software developers, with space for the user to write down any comments about the programme's performance. What makes this feedback form unique, however, is that it automatically adds to the user's message a complete history of the user's choices since the session was started. This does away with the need for the user to explain what he/she was doing at the time a given problem arose.

The advantage to the user is access to software developers in the midst of the routines, breakthroughs and breakdowns that define typical use. With increased demands being made on faculty to manage their own instructional technology, this not only provides increased support, it also recognises the user as a 'dialogue partner' (Anderson 1999) rather than merely a consumer. The advantage to the developer, on the other hand, is "backtalk": that is, feedback not only from what users say, but from what they actually do (Brown & Duguid, 1992). Developers can also easily check and reproduce phenomena reported by their users. When the application is installed, moreover, the user has the opportunity to add individuals or groups (eg IT support) to the mailing list, so that they too can keep a tally of the sort of problems or issues users are encountering.

Consequences of Implementation

Since the software feature described in this paper is itself still in the beta-testing phase, it remains to be seen whether users find the possibility of immediate feedback practical, and whether developers find the ensuing response worth the effort. It would further be interesting to observe whether such a feature adds to or detracts from users' 'social/dialogue' mental model of their interaction with their technology.

Meanwhile, what this paper advocates is an exploration of the wider communication opportunities, the new 'conversations' (Winograd, 1986) that are becoming possible during routine software use. To this end, this paper argues that software applications can, in addition to their primary functions, become feedback channels that allow shared responsibility for the success of user-developer communication.

References

Bass, L. and Dewan, P. (1993) *Interface Software* England: John Wiley..

Baeker, R., Gridin, J., Buxton, W. and Greenberg, S. (eds) (1995) *Readings in Human-computer Interaction*. San Fransisco: Morgan Kaufmann.

Bell, S. (1999) What makes an e-business successful? *Computerworld NZ* June 28 pp21-27.

Cooper, A. (1995) *About Face* California: IDG Books.

Dawes. L (1999) "First connections: factors influencing the acquisition of network literacy by teachers during the introduction of the National Grid forLearning" Unpublished paper.

Kammersgaard, J (1988) Four different perspectives on Human-Computer Interaction. *International Journal of Man-Machine Studies*, 28. pp 343-62.

Laurel, B (ed) (1990) *The Art of Human-Computer Interface Design* Wokingham: Addison-Wesley.

Mandel, T (1997) *Elements of User Interface Design.* New York: John Wiley.

Nass, & Reeves, (1996) *The Media Equation* Cambridge:University Press.

Pate, J (1999) ITFORUM discussion, 2 September.

Pausch, R., Conway, M. & DeLine, R. (1992) Lessons learned from SUIT, the Simple User Interface Toolkit. *ACM Transactions on Information Systems* vol 10 (4) 320-344.

Petersen, C (1997) Focus on Usability *http://www.smartisans.com/focusab2.htm*.

Pettus, D (1999) The Internet Economy *TUANZ Topics* May, p 19

Preece, J and Keller, L. (1990) *Human-Computer Interaction* Cambridge: University Press.

Preece, J, Rogers, Y, Sharp H, Benyon, D, Holland S & Carey T (1994) *Human-Computer Interaction* Wokingham: Addison-Wesley.

Saltzman H & Rosenthal, S (1994) *Software By Design* Oxford: University Press.

Sellen, A and Nichol, A (1990) Building User-Centred Online Help. In B Laurel *The Art of Human Computer Interface Design* USA: Addison-Wesley.

Tapscott, D & Caston, A (1994) *Paradigm Shift* New York: McGraw Hill.

Winograd, T (1996) *Bringing Design to Software* New York: Addison-Wesley

Winograd, T & Flores, F (1986) *Understanding Computers and Cognition* New Jersey: Ablex

International Group Work: New Roles for Interaction?

Diane P. Janes
Distance Education and Technology
University of British Columbia
Vancouver, British Columbia, Canada
diane.janes@ubc.ca

Abstract: In 1997 a partnership was created between the Monterrey Institute of Technology (ITESM)'s Virtual University and the University of British Columbia (UBC). This partnership resulted in the development of a Certificate in Technology-based Distributed Learning, a series of five graduate courses launched internationally in the fall of 1997. This paper and presentation will explore the international project work and online collaborative experiences of a group of international students registered in a web-based, graduate-level distance education course offered by UBC and its partner, ITESM.

Background

On June 21, 1997 the Virtual University of ITESM and Distance Education and Technology signed an agreement for the development and delivery of five courses in technology-based distributed learning (Bates, 1999). This became the post-graduate Certificate in Technology-based Distributed Learning (http://itesm.cstudies.ubc.ca/info/).

Consisting of five graduate-level courses, the Certificate was launched in September with the first course, Designing, Developing and Delivering Technology-based Distributed Learning, opening in September 1997. This was followed by Selecting and Using Technology for Distributed Learning (winter, 1998), Planning and Managing Technology-based Distributed Learning (fall, 1998), Social Issues in Technology-based Distributed Learning (winter, 1999), and Research and Evaluation Issues in Technology-based Distributed Learning (September 1999).

Designed using international collaboration, team meetings were held and decisions were made, via videoconferencing and email. The course technologies included: print – textbook and selected readings delivered to students in their package; a Web Site – comprised of study guide, original teaching materials, online discussion groups (in both English and Spanish), online resources (online articles, journals, access to the extension library), a bookmark database (dynamic due to student input), student and instructor biographies; e-mail; and on one course (Selecting & Using TBDL) a specially-designed CD-ROM (Bates, 1999)

In addition to discussions and an international café, the program also invited international guest visitors, often the authors of the texts or readings, to conduct weeklong discussions with the students.

Social Issues in Technology-based Distributed Learning

Social Issues in Technology-based Distributed Learning was offered to students for the first time in 1999. Team-taught, the course had an enrolment of 38 students from 10[1] countries while its partner University (with its own Spanish-speaking instructors) had a concurrent enrollment of 100+ students from Mexico, Chile and Venezuela. Over the 13 weeks of the course, the students engaged in a number of online and interactive activities designed to increase their contact with each other. Three short papers discussed the social issues and technology-based learning issues raised by the course readings and analyzed using several frameworks. The online 'Brainstorm', which

[1] The 10 countries represented were Australia, Botswana, Canada, China (Hong Kong), Finland, France, Germany, Mexico, the United States, Yugoslavia.

followed the short papers, had the students identifying the issues they felt needed to be discussed in the course. Immediately after the brainstorming period, students were divided randomly into groups. Each group (consisting of 3 international students) was assigned the task of deciding on what issue, or part of an issue, raised by the brainstorm and set out by the framework, they wanted to research and present to the larger, full class. The final assignment was a formal paper, which analyzed and reflected on an issue raised by the course.

Collaboration and Leadership in International Groups

The observation of this course and its students with respect to collaboration and leadership within international groups was quite valuable for the instructors and the student/participants. Interestingly, many of the issues that seemed to be prevalent could be considered issues in f2f collaboration (Janes, 1999). Areas that required consideration included

- 'disappearance' and 'silence' of team members for long periods of time when decisions were necessary within the group;
- the encouragement of some of the more 'quiet' group members by some of the more 'vocal';
- the recognition that 'lurking' does not mean lack of engagement with the ideas or the learning
- the need to respect the 'time' it takes to collaborate online, to achieve consensus without having met the person or persons you are working with; and
- to respect, at all times, the points of view of the group and to create a 'safe' environment for discussion, disagreement and compromise

> *I learned a lot about the collaborative learning process...This certainly has been important for me and dramatically extended my understanding of the complexity of TBDL [technology-based distributed learning] in the real world.* Article posted by Student T

> *...Groups. Again, a completely different experience than other ones! It's amazing the juggling that goes on. In a way, I rather liked that we were assigned to groups because it's more true to life. It's very time-consuming to organize groups virtually. Personalities came through which humanized the process for me. Two things were difficult for me. (i) some members didn't make contact for ages, so I even wondered if they were still there; (ii) Sometimes feedback was needed asap and some group members seemed to vanish just then. We resorted to a lot of communication via email as some of us had difficulty with web and interaction was critical...* Article posted by Student K

Conclusion

This course was the first offering of an online course that was complex in design. While the course designers and instructors anticipated many of the outcomes (Bullen & Janes, 1998), this course was a testament of the dedication and interest of its participants. From all corners of the world and from many and varied backgrounds came a group willing to tackle some of the most current and interesting topics with respect to teaching, learning, technology and society. Many of the techniques and strategies for international group work come from those who have experienced this phenomena and who come to the challenge from a common sense perspective, a healthy respect for those involved and a willingness to try a new way of interacting.

References

Bates, A.W. and Escamilla de los Santos, J.G. (1997). Crossing boundaries: Making global distance education a reality. *Journal of Distance Education*, (XII) 1/2, 49-66.

Bullen, M. & Janes, D. (1998). Tutor and student: Online graduate teaching and learning in an international context. *14th Annual Conference of the Canadian Association for Distance Education*. CADE, Athabasca, AB. 191-192.

Janes, D. (1999). Techniques and strategies for international group work: An online experience. *5th International NAWeb'99 Conference*, Fredericton, N.B.

Multimedia Case Studies for Behavior Disorders: A Comparison of Perceptions of Usability Between Majors and Nonmajors

Lewis R. Johnson
Louis P. Semrau
Department of Special Education
Arkansas State University
State University, AR 72467
ljohnson@kiowa.astate.edu

Gail E. Fitzgerald
School of Information Science and Learning Technologies
University of Missouri-Columbia
Columbia, MO 65211

Abstract: This presents the findings of a study of the use of a hypermedia program, Perspectives on Emotional and Behavioral Disorders, with undergraduate students in introductory courses in special education (SE). Upon completion of the chapter on BD we examined 1) patterns of usage created by audit paths, 2) perceptions of program quality, and 3) perceptions of feasibility of use between non-special education (NSE) majors and SE majors.

Instructional programs using interactive hypermedia case studies have been created and demonstrated to be an effective tool in preservice training of individuals preparing to work with children and adolescents with emotional and behavioral disorders (Fitzgerald & Semrau, 1996). The instructional approach used in this interactive hypermedia material strives to develop cognitive flexibility for problem solving within an ill-structured knowledge domain. There was some concern that learners who may have little background information or interest in the area of special education are at a disadvantage. Therefore, we were concerned that the use of a hypermedia program on a topic in special education by NSE majors may place students at a great disadvantage and result in negative opinions of the program and consequently reduced usage of the program.

Research Questions

Do major and nonmajor preservice teachers: 1) utilize the hypermedia training program differently with regard to engagement time; 2) have different perceptions of the quality of the hypermedia training program, and 3) have different perceptions with regards to the feasibility of using the hypermedia training program?

Participants

Non-special education major students (n=34) enrolled in the undergraduate class, The Exceptional Student in the Regular Education Classroom, and special education majors (n=19) enrolled in their initial special education program course, Introduction to Exceptional Children, participated in this study. All participants were trained in using the interactive program on CD. None of the students had prior special education course experience. The hypermedia program used in this study was Perspectives on Emotional and Behavioral Disorders - Zach (Fitzgerald & Semrau 1999).

Measures and Results

Total Elapsed Program Engagement Time

Using audit trail data provided by the AStudent@ disk, the researchers computed a total number of minutes in which each student used the training program. The mean elapsed time for NSE majors was 110 minutes, while the total elapsed time for SE majors was 134 minutes. The difference between the two groups was not significant. The total engagement time was substantially less than the mean of 420 minutes reported by undergraduate students who had completed foundational courses in special education, behavior management, assessment procedures, and instructional strategies as reported by Fitzgerald and Semrau (1996).

Perceptions of the Value of Using the Multimedia Training Program

Five items from the Multimedia Training Program Survey (MTPS), created by the authors of the program, were used to investigate the students' perceptions of the usefulness of the multimedia program for teacher training in emotional and behavior disorders: (e.g. I feel this program was a productive use of my time because it added to my knowledge). For each item the student responded on a scale of 1-5 with 1=strongly disagree to 3=don=t know to 5=strongly agree. Responses for each of the above were summed and divided by the number of items to form a score for Perceptions of the Value of Use which was used in the data analysis. Special education majors had significantly more positive ($p = .02$) perceptions of the training program (mean = 4.06) than the NSE major students (mean =3.72). Both groups thought the program offered a positive learning opportunity and was effective in accomplishing its instructional objective. In exploring the data for relationships beyond those stated in the purpose, we found a weak positive relationship between a student's program engagement time and perception of program value ($r = .234$).

Perceptions of the Feasibility of Using Multimedia Programs for Teacher Training

Three items from the Multimedia Training Program Survey (MTPS) were used to investigate the students= perceptions of the feasibility of using the multimedia program for teacher training with SE and non-SE majors in emotional and behavior disorders: (e.g. 14. I became confused while using the multimedia training program). Using the same scale as described above and correcting for the negative wording of the items, a mean was determined and subtracted from 5 to form a score for Perceptions of the Feasibility of Use which was used in the data analysis. There was no significant difference between the SE majors' (mean = 2.70) perceptions of the feasibility of using the program and NSE majors' (mean = 2.71) ($p = .970$). Both groups viewed the program as somewhat difficult to use and mildly frustrating for use in teacher training. A weak negative relationship was found between a student's program engagement time and perceptions of feasibility ($r = -.082$). A moderately positive relationship between a student's perception of program value and perception of feasibility ($r = .371$).

Discussion

With multimedia programs becoming more readily available for use in teacher education, instructors must carefully select programs which meet the content and skill needs of students, present information in a manner which is perceived as useful, and be feasible to use by the student outside of the formal structure of the classroom. We know that case-based hypermedia programs are well received by students with background knowledge of the content being taught by the program Fitzgerald & Semrau, (1996); therefore this study was designed to explore how learners responded to a hypermedia learning environment in content in which they were novices. While there was a significant difference between the ratings, both groups of students perceived the training program to be a valuable learning experience. Also, both groups of novice learners rated the program as Adon=t know@ when asked to rate the program on the feasibility of using the CD-based program for instruction. Based on the students' perceptions of feasibility, it is imperative to support student use of hypermedia programs with in-class instructor or peer-led guided activities.

References

Fitzgerald, G. E., & Semrau, L. P. (1996, October). Hypermediated learning: Learning styles, path analyses, and knowledge outcomes. Paper presented at the meeting the Association for the Advancement of Computing in Education, Ed-Media, Boston, MA.

Fitzgerald, G. & Semrau, L. (1999). Perspectives on emotional and behavioral disorder-Zach: A problem solving program for teachers. [interactive computer program]. Jonesboro, AR: Arkansas State University.

Spiro, R., Feltovich, P., Jacobson, M., & Coulson, R. (1991). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. Educational Technology, 31(5), 24-33.

Transforming Active Learning Exercises for Distance Education

Nancy J. Johnson, Assistant Professor, MIS
Metropolitan State University
730 Hennepin Avenue
Minneapolis, MN 55403-1897
Johns024@tc.umn.edu

Abstract: Developing and using active learning exercises in classroom settings works well to engage the learners, but the instructor's challenge is to take those same exercises and make them meaningful in a distance education model. This paper describes several techniques used by the author in a creative problem solving course redesign.

Creative Problem Solving Course Redesign

Teaching creative problem solving requires some creativity on the part of the instructor. Rote lectures have never been optimal learning experiences, nor are they conducive to teaching creativity. In the design of the course, the first challenge was to get the students to loosen up and understand paradigm boundaries that are often self imposed. During the semester, the exercises were chosen to demonstrate specific uses and points of creativity techniques for problem definition, alternative identification, evaluation of alternatives, planning/implementation, change management, and monitoring.

Problem Definition

The exercise to demonstrate self imposed paradigms requires 25 inflated balloons and at least 8-10 people. In the class room the students are formed into two circles, and not allowed to say anything to each other or ask any questions. Two students are designated as observers and balloon helpers. The students are given the instructions to not let the balloons hit the floor. Then five or six balloons are tossed inside the circle. After they toss them back and forth for a minute, the rest of the balloons are tossed into the circle. Some of the students figure out they can hold the balloons, pop them, push them into the other circle, or rub them on their heads to generate enough static electricity to stick the balloons onto the walls. At this point, some students start declaring that these tactics aren't fair. The instructor stops the exercise, and asks them to observe what happened and why. The observers describe the tactics used, and the means of non-verbal communication employed. They eventually come to the realization that the 'rules' were self imposed and the instructor had set no limits on actions to keep the balloons off the floor. The instructor then asks them to relate the strategies for balloon management to the behaviors at work. Tossing the balloons to the next circle is similar to passing off bad work or problems to another department.

When this exercise was given to the distance ed learners, they were asked to gather a group of family or friends to do the exercise, and act as the instructor/observer. Then each student posted his/her observations to the interactive area of the WWW based class management software. The groups included family members from 2 to 80, a cub scout pack, a coffee group from work, and a group of friends in a bar. The results were consistent, and the comments among the students lively.

Problem Solving Strategy

This assignment was about designing a new monetary system for a small, island country in the South Pacific. First the students had to identify all the paradigms associated with currency as used in the US (shape, color, denomination, media, uses, ownership proof, durability, portability, and drawbacks). This provided students with experience with other monetary systems to bring in samples and provide descriptions. Many students did WWW research on money/currency prior to the class and brought in the printouts. The consistent response was that no-one had ever considered that all currency wasn't just like the US system worldwide. Then the students were divided into groups of 4 or 5, given paper and crayons, and sent off to design a new monetary system that could be used by the islanders and the tourists visiting the island. Although the exercise write up named the island Freedonia, only one student out of 250 over 5 years was a Marx Brothers fan and recognized the name. The usual solutions are for chip embedded plastic cards that draw down on an account established with an island bank, with a hole in the card for a plastic chain to wear around tourists necks or pin to bathing suits (and a solar powered energy source on the island so the card readers would keep working).

Translating this exercise for the distance ed format was relatively easy. Each student did his/her own WWW research and personal research for other currencies, then submitted a list of paradigms for US currency. The class was then divided into groups, and they collaborated via e-mail and fax for designing a solution. The group posted their solution on the interactive area of the WWW class management tool. Some students even drew solutions and scanned them into the site for other students to view.

Process Mapping

This exercise is based on a common student experience of getting advisor approval, registering and paying tuition for a class, and getting books. The students first list all the steps they go through, and all the departments of the university that are part of the process. The students are given pads of sticky-paper notes on which they list each process step individually. They post the steps on a white board or large piece of paper by department, and draw in lag times to determine elapsed cycle times for each step. Then the students are asked to redesign the process using on-line WWW registration, fee payment and book ordering and recalculate cycle times and the effects on each department involved. The costs and benefits are estimated for the current and proposed processes. The students also have to identify opportunities for fraud and where security was needed. This exercise usually stimulates questioning as to why the university doesn't do all this right now, which leads to a good discussion on impediments to achieving perfection in the real world.

Converting this exercise to distance ed teams was more challenging because the WWW tool did not have a site amenable to using sticky paper notes for posting. The teams used faxes with each other, and assigned process streams to each member. The results were posted on the interactive site in words, unless a team member had a scanner available. The results were similar though, because the students had experience with both traditional in-person classes and distance ed classes. The distance ed students were more ingenious in devising ways to break into the system to subvert it, as well as identifying security risks.

Tips and Tricks for the Development, Delivery and Management of Online Courses

Jonathan Kadis
Utah State University
Multimedia and Distance Learning Services
3075 Old Main Hill
Logan, Utah 84322-3075
jonkad@mdls.usu.edu

Abstract: Distance education programs throughout the world continue to grow in size and scope. As online courses escalate in size and numbers, educational leaders say content and customization is the key to successful learning and not the numbers of students served. Understanding best practices in distance education via tips and tricks for development, delivery and management of online courses will be central to the future of this industry.

Innovative Online Course Ideas- Tips and Tricks

Background
USU currently offers over 70 fully online courses and two masters degree programs. In the past year we've developed nearly 100 courses with web supplements. We've delivered over 100 courses via digital satellite to over 90 sites across the intermountain west. We have had over 3000 students registered for courses this past semester and expect nearly 6000 this coming semester. Multimedia and Distance Learning Services and the Faculty Assistance Center for Teaching provide workshops, instructional design, video production, web development, engineering, electronic classroom support, etc.

Online Course Questions
What are some of the issues, strategies and best practices in developing online courses?
What are some of the innovative uses of emerging technologies?

Problem Identification:
Is your organization fragmented? Are faculty moving in multiple directions? Are you struggling with rapid technological changes? Is there a lack of focus? How do you cope with the myriad of software applications?

How We Began...
We started by doing our own programming, looking at and using many software applications such as Web Course in a Box, Learning Space, WBT, Blackboard, Syllabase, etc. We eventually settled on WebCT as our core program.

What We Did...
We pulled together the various organizations involved in online course development across campus. We then looked at and narrowed the hardware and software technology we were using. Our third step involved offering appropriate training to faculty and staff. We completed our initial efforts with a focus on student learning assessments.

Tip 1 Instructional Design Steps
1. Analyze, 2. Design, 3. Develop, 4. Implement, 5. Evaluate

Tip 2 Conversion Process
Design appropriate templates/architecture. Specify content/media needs. Author/customize interactions. Develop a content outline. Convert multimedia assets. Test and maintain applications. Create a pilot project.

Tip 3 E-Learning (Elliot Masie- Techlearn)
Incorporate the following in your online courses; Engagement, Curiosity, Simulation and Practice, Remediation, Coaching, Peer Learning, Social Dimensions, Action Learning, Performance Support, Intensity, Assessment and feedback, Teaching Culture.

What Should You Do?
Take baby steps, engage your students and unify your efforts- work with others- don't give up

Tricks
EMAIL Overload- Online courses can generate lots of emails. Technical issues, assignment clarification, content issues, turning in assignments, etc.
Use bulletin board instead of Email. Then you only have to answer the question once. Tell your students to read them first before asking a question. Compile and use this for future sections. (FAQ)

Getting Started Section- Use tutorials (how to use tools, WebCT, etc), downloading and installing plug-ins, getting latest browsers, could be part of the first lesson.

Frequently Asked Questions – You know most of the questions you get asked, keep track and compile them after the first class, put them online and consider using a discussion group.

Clear Assignments and Objectives- Clearly state objectives, clearly state what is expected to complete the current lesson, keep pages consistent and don't hide them deep in the course pages.

Example of good objectives-
Read chapter 2 in your textbook (pages 19-32)
Carefully study the important concepts
Watch the videos on vibrating systems
Be able to determine the frequency of vibration for simple harmonic motion of different systems.
Be able to describe the motion of complex vibrating systems as harmonic or non-harmonic.
Take the self-test by clicking on the "self-test" icon at the top of the page.

Printable Documents-
Create online learning, not online reading, use Adobe Acrobat, format clean printable HTML pages, stay away from dark backgrounds with light text, they don't print well.

Student Loneliness-
Have them introduce themselves to you and the class in a discussion group, do collaborative projects in small groups, provide a chat room and provide a list of students in the class. (Email)

Quizzing-
Provide a sample quiz online so students can gain some experience using the testing interface and technology.

Summary
"The society that will be successful in the future will not be the nation-state or community that can accommodate a steady stream of students, but that nation that can lift the level of learning among all its students rapidly and repeatedly,…higher education ought to be focused on content, not hardware." Gov. Michael O. Leavitt

The following book citation is an excellent resource for understanding key elements of online course development-

Building Learning Communities in Cyberspace
- Authors: Rena M. Palloff, Keith Pratt
- Publisher: Jossey-Bass, San Fransico
- www.josseybass.com
- ISBN: 0-7897-4460-2

VISUALIZATION OF SYMBOLIC INFORMATION: EMPOWERING STUDENT INTROSPECTION

Paul Juell
Department of Computer Science
North Dakota State University
Fargo, ND 58105
juell@plains.nodak.edu http://www.cs.ndsu.nodak.edu/~juell

Abstract

We are developing 3D visualizations for use in AI classes. This paper presents the process of developing visiaulization for symbolic information for classroom use. The basic process is to: determine the questions the user should be able to ask, determine what information will help in answering the questions, find a representation to present the information, prototype the visualization in VRML and build tools to allow students to build the visualization. The emphasis is on how to visualize symbolic information rather than numeric data. The visualizations are to aid in presenting and understanding complex symbolic based material. We are using them to present the internal processes of the AI techniques. The visualizations are presented as interactive 3D worlds. The worlds are written in VRML and accessed by the Web. This combination allows easy distribution of models for the students to inspect and control. The students use the tools to build visualizations of their own programs. The response to visualizations and the visualization building tools has been positive. The author feels they have significantly improved the student understanding of concepts.

Introduction

Visualizations can help in the process of understanding classroom material, techniques and processes. This paper presents suggestions to aid in developing visualizations for a class. The focus of this work is on symbolic information rather than quantitative information. Traditionally visualizations have been used with quantitative information [Tufte 83]. The Visual Program project http://www.ndsu.nodak.edu/instruct/juell/vp [Juell August 1999] [Juell March 1999] is working on improving the tools that can be used in an Artificial Intelligence class. This project has been developing visualizations to aid in the understanding of various AI techniques. This paper presents the analysis and recommendations that produced our best products. The process includes the following stages:

- Determine the question(s) you want the viewer to be able to answer.
  Each visualization allows someone to see some patterns and hides other. For the visualization to be useful and valuable, you need to address the particular questions that are useful in the situation being studied.
- Determine the information you want to show.
  Limit the information to that which is salient to the questions you want answer. Ignore bookkeeping and internally used information. This will result in simpler and clearer visualization and make the rest of the process simpler.
- Design and prototype the visualization.
  Once you have a goal of answering a question and the information you are going to use, build a prototype of the visualization.

  - 2D Diagrams
    We start our projects with a 2D design. Symbolic information can be specified by character strings positioned in 2 dimension space on paper. We then consider replacing the strings with graphics. We are interest in showing the operations of a process, so one dimension is normally time. For several problems, we have then used a mapping of the state space for the other dimension.
  - 3D Diagrams
    We then consider how to use 3D to better show data and information. 3D diagrams can be more attractive than the 2D images. In addition, we found the extra dimension important because of the high number of dimensions in our original problems. Visualizations work by allow the eye to

see patterns. For symbolic information, using a tall box for each symbol can allow the eye to see repeated patterns in spatial location. If the data is presented so that the eye identifies important patterns, this presentation can allow the user to convert the data into information.

   - Interactive Diagrams
     We use interactive diagrams to aid active learning. Most of our work uses 3D worlds created in VRML [Hartman and Wernecke 1996]. The VRML allows the presentation of movies and allows the viewer to control flying through the images. In addition, motion can be supported directly in VRML or by adding JAVA applets.
   - Layering of Information (hot links, layered displays)
     Traditional visualization techniques can add additional dimensions of information to the picture. You can map information into false colors, sizes and other information overlayed on the icons in the images. In addition, you can link the items to other images and pages.

- Instrument the program/process at the symbolic level.
  We want the students to build visualizations of their own programs. To do this, we need to provide tools which will create the visualizations for them. They run their program. Its output is then processed to build the visualization. To make this work, the program is instrumented to capture data to be converted into the visualization. The instrumentation code needs to capture the state information of the state space search. It is very hard to reconstitute this state information later. The code may have to make explicit state information which is implicit in the program.

Example - State Space Navigation

A small example may clarify some of the points. A typical example of a state space search is the river crossing problem. We built a visualization for this, with a goal of addressing "where does the time do in a blind backtracking search"? For one dimension we used spatial information about the boat and the people. We used three positions: the side the people start at, a position in the middle of the river and the river side the people want to reach. At each of these locations, we placed objects representing the people and the boat. The father, the two sons and the boat were each represented by a different sized block. We tried to stay with very simple objects because we felt a small amount of detail, would allow the viewer to more easily see patterns. For the other dimension (for the 2D example) we used time. One image then showed all of the steps of the search. In the process of developing our visualizations, these images underwent a number of changes to improve the overall usability of the image. One problem we repeatedly had, was that improving the esthetics of the images often, in the author's opinion, made it less likely that that the useful patterns would be visible in the final image. Once acceptable prototype of the visualization was developed, an instrumented program was prepared and a tool was developed to produce the visualization. This combination was then used by the students for their programming assignment.

Summary

We have presented the process we are using to develop abstract visualizations. These visualization are intended to be used in class to aid in understanding complex concepts. These guidelines have helped us to produce a variety of visualizations. We have used these in the classroom and as parts of homework projects. The students were very positive in their response to the visualizations. The author has noticed that questions asked by students changed following the use of the visualizations. The questions now represent a higher level of thinking. The questions before were mainly "what does this line of code do?" and now they are frequently "how does this effect the visualization we are creating?" We feel the above notes give a good start in developing visualizations for symbolic information. We also believe these visualization are important in allowing students to explore and understand a wider scope of information about the material presented in the class.

Bibliography

Hartman, Jed and Josie Wernecke (1996). The VRML 2.0 Handbook: Building Moving Worlds on the Web. Reading, MA: Addison-Wesley Publishing Co. Silicon Graphics, Inc.

Juell, P., Developing Visualizations for AI Course Use, The International Symposium on Intelligent Multimedia and Distance Education (ISIMADE'99) in Baden-Baden Germany, (ed)George Lasker, The International Institute for Advanced Studies in Systems Research and Cybernetics, August 2-7, 1999, pp101-106, 1999.

Juell, P, Educational Opportunities using VRML in the AI Classroom, M/SET 99, International Conference on Mathematics/Science Education & Technology, San Antonio, Texas, March 1-4, 1999.

Tufte, E.R., The Visual Display of Quantitative Information, Graphics Press, 1983.

Acknowledgment: These development efforts are funded by the National Science Foundation under grant DUE-9752548.

Tips and Tricks for the Development, Delivery and Management of Online Courses

Jonathan Kadis
Utah State University
Multimedia and Distance Learning Services
3075 Old Main Hill
Logan, Utah 84322-3075
jonkad@mdls.usu.edu

Abstract: Distance education programs throughout the world continue to grow in size and scope. As online courses escalate in size and numbers, educational leaders say content and customization is the key to successful learning and not the numbers of students served. Understanding best practices in distance education via tips and tricks for development, delivery and management of online courses will be central to the future of this industry.

Innovative Online Course Ideas- Tips and Tricks

Background
USU currently offers over 70 fully online courses and two masters degree programs. In the past year we've developed nearly 100 courses with web supplements. We've delivered over 100 courses via digital satellite to over 90 sites across the intermountain west. We have had over 3000 students registered for courses this past semester and expect nearly 6000 this coming semester. Multimedia and Distance Learning Services and the Faculty Assistance Center for Teaching provide workshops, instructional design, video production, web development, engineering, electronic classroom support, etc.

Online Course Questions
What are some of the issues, strategies and best practices in developing online courses?
What are some of the innovative uses of emerging technologies?

Problem Identification:
Is your organization fragmented? Are faculty moving in multiple directions? Are you struggling with rapid technological changes? Is there a lack of focus? How do you cope with the myriad of software applications?

How We Began...
We started by doing our own programming, looking at and using many software applications such as Web Course in a Box, Learning Space, WBT, Blackboard, Syllabase, etc. We eventually settled on WebCT as our core program.

What We Did...
We pulled together the various organizations involved in online course development across campus. We then looked at and narrowed the hardware and software technology we were using. Our third step involved offering appropriate training to faculty and staff. We completed our initial efforts with a focus on student learning assessments.

Tip 1 Instructional Design Steps
1. Analyze, 2. Design, 3. Develop, 4. Implement, 5. Evaluate

Tip 2 Conversion Process
Design appropriate templates/architecture. Specify content/media needs. Author/customize interactions. Develop a content outline. Convert multimedia assets. Test and maintain applications. Create a pilot project.

Tip 3 E-Learning (Elliot Masie- Techlearn)
Incorporate the following in your online courses; Engagement, Curiosity, Simulation and Practice, Remediation, Coaching, Peer Learning, Social Dimensions, Action Learning, Performance Support, Intensity, Assessment and feedback, Teaching Culture.

What Should You Do?
Take baby steps, engage your students and unify your efforts- work with others- don't give up

Tricks
EMAIL Overload- Online courses can generate lots of emails. Technical issues, assignment clarification, content issues, turning in assignments, etc.
Use bulletin board instead of Email. Then you only have to answer the question once. Tell your students to read them first before asking a question. Compile and use this for future sections. (FAQ)

Getting Started Section- Use tutorials (how to use tools, WebCT, etc), downloading and installing plug-ins, getting latest browsers, could be part of the first lesson.

Frequently Asked Questions – You know most of the questions you get asked, keep track and compile them after the first class, put them online and consider using a discussion group.

Clear Assignments and Objectives- Clearly state objectives, clearly state what is expected to complete the current lesson, keep pages consistent and don't hide them deep in the course pages.

Example of good objectives-
Read chapter 2 in your textbook (pages 19-32)
Carefully study the important concepts
Watch the videos on vibrating systems
Be able to determine the frequency of vibration for simple harmonic motion of different systems.
Be able to describe the motion of complex vibrating systems as harmonic or non-harmonic.
Take the self-test by clicking on the "self-test" icon at the top of the page.

Printable Documents-
Create online learning, not online reading, use Adobe Acrobat, format clean printable HTML pages, stay away from dark backgrounds with light text, they don't print well.

Student Loneliness-
Have them introduce themselves to you and the class in a discussion group, do collaborative projects in small groups, provide a chat room and provide a list of students in the class. (Email)

Quizzing-
Provide a sample quiz online so students can gain some experience using the testing interface and technology.

Summary
"The society that will be successful in the future will not be the nation-state or community that can accommodate a steady stream of students, but that nation that can lift the level of learning among all its students rapidly and repeatedly,...higher education ought to be focused on content, not hardware." Gov. Michael O. Leavitt

The following book citation is an excellent resource for understanding key elements of online course development-

Building Learning Communities in Cyberspace
- Authors: Rena M. Palloff, Keith Pratt
- Publisher: Jossey-Bass, San Fransico
- www.josseybass.com
- ISBN: 0-7897-4460-2

The Evolution of Online Learning to a Digital Broadcast Environment

John Kahler, BS Comm
WHYY, Inc.
150 North Sixth Street
Independence Mall West
Philadelphia, PA 19106 USA
jkahler@whyy.org

Roger D. Mitchell, EdD
WHYY, Inc.
rmitchell@whyy.org

Bill Weber
WHYY, Inc.
bweber@whyy.org

Tom Murray, MA
Delaware County Community College
901 South Media Line Road
Media, PA 19063 USA
tmurray@dcccnet.dccc.edu

Doug McConatha, PhD
WebStudy, Inc.
Box 2452
Bala Cynwyd, PA 19004
dmcconatha@webstudy.com

Abstract: This paper will review the progress of work being done by a consortium of higher education institutions, working with a public broadcasting television station and commercial courseware developer to create and deliver courses in the converging environments of the Internet and broadcast digital television. The experience of moving traditional broadcast telecourses to an online courseware package will be presented, along with the opportunities and challenges faced as digital television broadcasting technology evolves.

Introduction

WHYY, the Public Broadcasting Service affiliate in Philadelphia, Pennsylvania, established and hosts the Delaware Valley Distance Learning Consortium to address the common distance learning needs of the region's higher education institutions. Under the leadership of Delaware County Community College, Camden County College and Community College of Philadelphia, the WHYY Home College Service broadcasts over five hours of telecourse programming daily, during overnight hours. Students enrolled at DVDLC institutions videotape the programs for convenient viewing, complete assignments and receive college credit for their work.

With the growth of the Internet, and recognizing the pedagogical opportunities online courses present, WHYY and the DVDLC began a cooperative venture to deliver courses on the World Wide Web. In addition, all United States television broadcasters are under mandate from the Federal Communications Commission to transition to digital television broadcasting. Along with the larger convergence of media types and delivery methods, this presents an opportunity to develop next-generation courses that repurpose current content using converging technologies.

WHYY is the central technology provider, licensing the courseware and integrating the courseware servers into the WHYY Technology Center. WebStudy, Inc., a Philadelphia region company, supplies the courseware, WebStudy. WHYY provides technology support and faculty training. WebStudy supports the courseware and the faculty and student help-desk. Consortium institutions offer their courses, enroll students, and are responsible for the quality of the courses and establishing content ownership. Beta testing of the courseware began with fall semester in 1998.

Early Experience

In fall 1999, Delaware County Community College began building "hybrid courses," using the curriculum already developed for telecourse-based courses. Hybrid courses include media streams of broadcast telecourses, traditional reading and writing assignments, and interactive asynchronous forums. In January 2000, three courses, English Composition I, English Composition II and Geology, were offered to DCCC students in the Philadelphia region, either as traditional telecourses or as hybrid courses. Students in the hybrid courses have the choice of viewing lower quality streaming media or higher quality broadcasts. An additional test group of students from outside the Philadelphia region was enrolled in the courses, but not able to receive the telecourse broadcasts. Other DVDLC members are offering courses using WebStudy with content unrelated to the broadcast telecourses.

The Future

Digital television is a work in progress. The technology promises high bandwidth distribution combining the advantages of broadcasting with the interactive and data features of online learning. Digital television is a broadcast signal with an effective datarate of approximately 19 megabits per second. Like today's analog television, the datastream can be received by anyone in the broadcast area. Many types of data, including high definition television, multiple channels of standard definition television, packages of data delivered like a CD-ROM, datastreams that accompany broadcasts or stand alone, Web pages, pre-delivered content - essentially anything that can be delivered in digital form, can be in the datastream. While the technology is still in its early stages of development, digital television receiver cards are available that can be installed in home PCs. Manufacturers are designing "set top boxes" that include an operating system and the necessary hardware and software to decode, store and display digital broadcast data, either in real time or acting as home servers. A relatively low bandwidth Internet connection will allow data to be returned to central servers, either in real time or on a scheduled basis. Each device will have its own unique identifier, similar to an IP address, allowing content to be directed to a subset of users.

We are investigating many ways to use the datastream. Hybrid courses now streamed on the Web could download to the student's "digital television device," an advanced set top box with capabilities of a computer, so the student could work off line, CD-ROM style, with updated content delivered when necessary. Content, including "television quality" video, could be pre-delivered to the student when bandwidth is available, using the device as a local cache. Using the low bandwidth Internet connection, real time interaction can occur, and work can be submitted to the instructor in the background. The "digital television device" will be standards based, with a common interface, significantly reducing support issues. The experience will be like "turning on the television," though not like television as we know it today.

References

Carvin, A. (1998) *Digital Television: A New Tool for Education*. Online: http://edweb.gsn.org/teled98/speech.html

Harris Corporation. (1998) *Media Guide to Digital Television*. Online: http://dtvexpress.org/facts/facts.htm

Weber, B. (1999) *Philadelphia PBS Station WHYY Launches New $25M Digital Broadcast Facility—Part I.* Online: http://www2.digitalbroadcasting.com/content/news/article.asp?DocID={EBA44A2D-5998-11D3-9A5F-00A0C9C83AFB}

Weber, B. (2000) *Philadelphia PBS Station WHYY Launches New $25M Digital Broadcast Facility—Part II.* Online: http://www.digitalbroadcasting.com/Content/News/article.asp?DocID={5A177725-8937-11D3-9A68-00A0C9C83AFB}

Computer-based Interactive Qualitative And Quantitative Knowledge Maps Applications Model in College Business Courses.

Alex Kajstura, Ph.D., M.B.A.
Daytona Beach Community College
P.O. Box 2811
Daytona Beach, FL 32120, USA
e-mail: kajstua@dbcc.cc.fl.us

Abstract: This paper shows how concept maps, a tool utilized rather widely these days, can be advanced to new horizons using computer-based approach. The author discusses general structure of concept maps, their use as dynamic instructional tools, and then presents a model for implementation of computer-based concept maps in college-level business courses. Most advanced concept maps are generated using multimedia authoring software and can be either qualitative or quantitative in nature. Such computer-based concept maps, located either on a computer in a classroom or on the Internet, are a very powerful and unique tool contributing to other learning techniques and assessment methods.

Concept Maps: An Introduction

A concept map is defined as a graphical knowledge representation that hierarchically links concepts. Novak (1984), a leading authority on concept mapping in education, proposed that different learners structure their new current and new knowledge in a variety of ways, therefore validating use of concept maps in teaching and learning. If the instructor's role is to guide the learner in creating new meanings and deeper levels of conceptual understanding, then concept mapping can be an effective instructional and assessment tool to use in undergraduate lower division business courses. Knowledge is accumulated in a continuous fashion, and developing connections between prior and new knowledge is critical to the learning process.

In a traditional concept map design, the most general or most important concept is placed at the top of map, and concepts on lower levels are subsequently more detailed. Key concepts are connected by links that have descriptive words on them explaining the relationship between concepts. Concepts maps, by their visual presentation, have traditionally been used as very effective vehicles for organization of concepts within the domain. Traditional concept maps were of "paper and pencil" type, and were used mainly to organize qualitative or conceptual knowledge. Thus, in rethinking course curriculum at the undergraduate level, the number, organization and plan for the systematic development of concepts are worthy considerations in terms of curriculum restructuring necessary for improved student performance.

As concept maps evolve, there are variations in their development, discussed by Shavelson et al (1994), including free-form versus hierarchical, concepts' position on the map, collaborative effort by a group of students. These variations provide for greater instructional flexibility as well as for more diverse learning experience. In the last decade, a noted increase in interest in and use of concept maps has resulted in the identification of many valuable instructional purposes for mapping.

A Model for Implementation of Computer-based Concept Maps in College Business Courses

An advent of computers, word processing and flow-chart software, as well as later developments in multimedia authoring software enables instructors to push the limits of usefulness of traditional concept maps far beyond "pencil and paper" representation. It is worth noting that in this respect the following stages of software development can be identified:

1) Non-dedicated word-processing or flow-chart software allowed for passive creation and use of computer-based concept maps
2) Software dedicated to generating concept maps results in production of more responsive and interactive computer tool
3) Multimedia authoring software for fully interactive knowledge building and assessment using computer-based/multimedia concept maps.

This article presents initial approach undertaken in implementation of concept maps in college-level business courses, and creates a model suitable for implementation in any business courses for computer-based knowledge building and alternative assessment using concept maps. Since this represents significant evolution of concept maps, we will refer to them as *(c)omputer-(b)ased qualitative and quantitative (k)nowledge (m)aps* (CBKM).

Software

For the purpose of this model, software from above mentioned stages 2) and 3) is used. Software dedicated to generating concept maps such as Inspiration ® (or comparable) is used by students almost exclusively. Instructors use Inspiration® for knowledge maps presented or developed during classes. These presentations are very effective and lead to interesting interactions when presented on a large projector screen. The set of standard knowledge maps as well as the ones developed during classes is uploaded on the Internet under the course's Web page.

Multimedia authoring software such as Authorware® by Macromedia (or comparable) is used by instructors to prepare highly interactive software used by students in- and/or out-of-classroom to build new knowledge, form linkages, and to build critical thinking and analytical skills. Multimedia authoring software enables instructors to provide students with an interactive study tool that provides them with an instant feedback, where each one of superordinate or subordinate concepts, linkages and propositions is a hyperlink providing immediate response or guidance. In addition to having such developed and customized software place on computers in business computer labs or individualized study labs, this software can be made available on the Internet.

Conclusions and implications.

Computer-based, qualitative and quantitative knowledge mapping is a tool that can be used by both instructors as well as students to meet the challenge of planning, organizing, teaching and learning. Computer-based knowledge mapping assists students in fulfilling quality outcomes in learning business. Used traditionally, concept maps provide concrete visual help to organize information to be learned. Business instructors for lower division courses at colleges who have been exposed to this tool are finding that they provide a logical basis for deciding which main ideas to include in a course. Computer-based knowledge maps can be as large as the entire course, one or more unit, or even a single class period.

It has been shown before that traditional concept maps are valid vehicles for documenting and exploring conceptual change (Wallace & Mintzes, 1990). This proposed model of computer-based qualitative and quantitative knowledge maps that is currently used as a pilot in a limited number of chemistry classes, in conjunction with authors experience in practical using concept maps, have provided convincing evidence that many instructors would be able to present more continuous learning experience for their students, who in turn would benefit from CBKMs as described above. Computer-based knowledge maps can be a powerful tool, that contributes to the other learning techniques and assessment methods, and addresses both knowledge and its organization.

References

Novak, J. & Gowin, D. B. (1984). *Learning how to Learn.* Cambridge: Cambridge University Press.
Novak, J.D. (1979). *A theory of education.* Ithaca, NY: Cornell University Press.
Shavelson, R. J., Lang, H. & Lewin, B. (1994). On concept maps as potential "authentic" assessments in business. *CSE Technical Report 388*: CRESST University of Santa Barbara, CA.
Wallace, J. D. & Mintzes, J. J. (1990). The concept map as a research tool: Exploring conceptual change in biology. *Journal of Research in Business Teaching.* 27(10) 1033-1052.

Field Dependence/Independence and the Needs of Students in a Web-Based Instructional Environment

Dolores Karolick	Michael Whyte	Doris Carey
U.S. Air Force Academy	Azusa Pacific University	University of Colorado
2354 Fairchild Drive, #2A14	901 East Alosta Ave	School of Education
USAFA, CO 80840	Azusa, CA 91702-7000	Colorado Springs, CO
dorri.Karolick@usafa.af.mil	mwhyte@apu.edu	dcarey@brain.uccs.edu

Research on field dependence/independence in the learner reveals a number of interesting factors about preferred learning modalities. The field independent learner is most typically intrinsically motivated, for example, while highly field dependent people, who are more socially oriented, are motivated by external rewards. Additionally, and more important for the design of on-line instruction, field dependent learners require and prefer more structure, direction, and support from authority figures and colleagues than field independent learners.

Field independent learners are able to discriminate key concepts in the material to be learned or analyzed to construct a "big picture" of the material with little auxiliary assistance. Field dependent learners, on the other hand, prefer to proceed step by step and are most likely to benefit from outlines and advance organizers to have the context constructed for them.

Fortunately, measuring field independence/dependence is uncomplicated. The Group Embedded Figures Test (GEFT) measures the cognitive style dimension of field independence and field dependence. The GEFT consists of 18 complex figures. Individuals must find a simple embedded geometric figure that is hidden in a complex one (Donlon, 1977; Thompson & Meloncon, 1987; Willard, 1985 and Witkin, Oltman, Raskin & Karp, 1971). The figures are easily picked out by field independent learners; field dependent learners have more trouble isolating the figure from its background. The GEFT can be administered in under one-half hour and can help instructors identify students' tendencies towards field dependence or independence.

In the summer of 1999, we taught a graduate level class that was conducted entirely on line. That is, we had no face-to-face meetings with students and conducted all communication through e-mail, chat rooms, bulletin boards, and web sites. This was the first Web-based course conducted in the department, and therefore we knew this experience would be the first of its kind for all of our students. We found that 12 of the 16 students enrolled in the class were field independent.

Our approach to design of the site, course requirements, course activities, and communication came from a constructivist perspective (Duffy & Cunningham, 1996; McManus, 1996). The site was divided into twelve primary sections; Welcome, Navigating this Site, Course Overview, Calendar of Events, Syllabus, Grading, Outcomes and Criteria, Class Project Topics, Sample Project, Participant menu, Bulletin Board-Chat-Surveys, and Resources. Being aware of the literature concerning field dependence/independence, we purposefully designed the site to provide for the needs of both types of learners, giving detailed instructions, examples, and templates in more than one context to provide maximum support for all field dependent individuals. For example, we provided two locations that specifically detailed all course requirements in locations that were identified by traditional names, Syllabus and Outcomes and Criteria. Likewise, due dates for class assignments were identified in multiple locations; Calendar of Events and under each Outcome section. We included a resources area, giving detailed instructions on obtaining email accounts, designing a web site, and accomplishing a web search.

One of the course requirements was that students prepare a web page that summarized findings of an extensive search for information on a topic they selected from a provided list. Since this was not a class in designing a Web site, students were given the opportunity to attempt development of the site by themselves, seek out the assistance of an individual they knew with experience in Web site creation, or send all graphics and text files from Word files and we would place the materials on the course Web site for them.

The record of students' interactions with the instructors reveals interesting interaction patterns. While all students were a bit apprehensive at the start of class, Field independent learners tended to proceed with comfort and confidence very quickly. Field dependent learners' questions and messages increased significantly in number over those from field independent learners and tended to express discomfort or fear about navigation, competence, and about the formal structure of their own web page, even though the template was available at all times. Research also reveals differences between field dependent and field independent learners' satisfaction with collaborative learning. A study conducted by Whyte, Knirk, Casey, and Willard (1991) investigated satisfaction and achievement factors among students paired for a learning experience. Pairs included two field independent learners, two field dependent learners, and mixed pairs. The results indicate that mixed pairs achieved the highest results, followed by pairs of field independent learners and then pairs of field dependent learners. Field dependent learners, who have a higher likelihood of preferring social interaction, were most satisfied with collaboration. Field independent pairs showed dissatisfaction with pairing for collaboration.

Inclusion of collaborative projects and on-line chats in WBI is often incorporated into class design. During the WBI class we taught, we placed four to five students in working groups for the purpose of sharing their summaries, discussing common problems in project completion and resources, sharing common experiences on specific questions revealed in the summaries, and conducting on-line chats to discuss the issues. This group work was accomplished through both synchronous and asynchronous means. The learner experiences in a group setting, indicated that field dependent individuals relied on feedback from their peers significantly more frequently than did field independent individuals. The statistics from these observations will be shared in the presentation.

We propose to present the results of these two studies, participant experiences, guidelines for improving the Web-Based Instructional learning experience from a perspective of page design, determination of graded events, and communication issues for both types of learners.

References

Donlon, T. F. (1977). A Practical Assessment of Field Dependence/Independence. Paper presented at the annual meeting of the New England Educational Research Association, Manchester-Bedford, NH. (ERIC Document Reproduction Service No. ED 139 827)

Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), Handbook of research for educational communications and technology (pp. 170-198). New York: Simon & Schuster Macmillan.

McManus, T. F. (1996). Delivering instruction on the World Wide Web. Available: http://ccwf.cc.utexas.edu/~mcmanus/wbi.html

Thompson, B. & Melancon, J. G. (1987). Measurement Characteristics of the Group Embedded Figures Test. Educational and Psychological Measurement, 47, 765-772.

Whyte, M. M., Knirk, F. G., Casey, R. J., & Willard, M. L. (1990-91). Individualistic versus Paired/Cooperative Computer-Assisted Instruction: Matching Instructional Method with Cognitive Style. *Journal of Educational Technology Systems*, *19*(4), 299-312.

Willard, M. L. (1985). An Investigation of the Effects of Cooperative Learning and Cognitive Style in Teaching Word Processing Skills to Adults. Unpublished doctoral dissertation. University of Southern California.

Witkin, H. A., Oltman, P. K., Raskin, E., & Karp, S. A., (1971). A Manual for the Embedded Figures Tests. Palo Alto, CA: Psychological Press, Inc.

OR-World – Using Learning Objects in a Hypermedia Learning Environment

Leena Suhl
University of Paderborn, FB5, DS & OR Lab
Warburger Straße 100
33098 Paderborn, Germany
Fon: +49 5251 60 37 23 / Fax: +49 5251 60 35 42
E-mail: suhl@uni-paderborn.de

Stephan Kassanke
University of Paderborn, FB5, DS&OR Lab
Warburger Straße 100
33098 Paderborn, Germany
Fon: +49 5251 60 37 21 / Fax: +49 5251 60 35 42
E-mail: kass@uni-paderborn.de

Abstract We live and learn in a world filled with information. To prepare students and employees for the competition and globalization of tomorrow's world, universities and enterprises are faced with an increasing need of up-to-date information and learning material at reasonable costs. Because of the fast changing requirements of professionals, lifelong learning is required in practically all areas, especially those related to information technologies. The objective of the project OR-World is to respond to today's increased education need and develop a World Wide Web based framework for sharing high-quality learning material between universities, educational institutes, self-learners, and interested companies, in various countries.

Project Description

Although the World Wide Web has experienced an unprecedented growth during the last five years, its potentials are by far not used optimally yet. In the world-wide digital network, teachers and learners do not have to be physically present at same place and time in order to be in contact and interact. The availability of electronic communication and network-structured, hypermedia content opens up completely new ways of higher education in universities and education centers. The project OR-World has been proposed in the European 5th Framework Programme and will be funded by the European Community (EC). The goal of the project OR-World is to achieve innovations in areas such as hierarchic structuring of content modules and flexible thematic combination (metastructure) of content modules, use of case studies within a learning network, and distributed self assessment and grading. The project consortium consists of seven partners, four universities and three companies.

A central goal of the project is the development of a user-friendly, World Wide Web based framework to generate hypermedia content for distributed, collaborative learning. The framework can be used to create learning environments that enable education and training centers to share reusable learning objects and maintain integrated learning services. With the term "learning objects" we refer to any digital or non-digital entity, which can be used, re-used or referenced during any learning activity, according to IEEE-Standards (IEEE 1999). An important issue when dealing with learning objects is granularity. In the project, we will work on several granularity levels. This means that the general framework will support the following building blocks to be used in constructing flexible, reusable learning environments:

- a *media element*, refers to text, animation, simulation, video or audio sequence,
- a *learning element* comprises one or more media elements,
- a *content module* consists of one or more learning objects, and is understood as a node in the hypermedia network,
- a *thematic metastructure* defines guidelines how to use content modules to build thematic structures relevant for a specific study goal; such a structure can be put together in individual ways, thus adapting to different combinations and profiles.

Thus, a teacher can set up his or her own content modules and offer them to others via the Internet. We suggest to build a consortium of trusted members, who want to work together, thus extending their own learning materials offering in a meaningful way. Above these content modules, various thematic networks can be built, which represent larger learning units, like a course or guided tour. The reusability will make it possible to create a "web of networks" using the same building blocks but setting different viewpoints and preferences. The objects at each hierarchy level are tagged with metadata to facilitate their flexible use in different contexts. The framework will be usable in a multilingual environment. It will support networked communication between tutors and learners outside the classroom. The framework will provide a general structured environment to input any (structured or semi-structured) contents. A certain level of structuring of the learning material is a prerequisite for applying the framework. Teachers will be able to use the framework in creating their own specific learning environments where they can combine their own learning objects with those generated by others. Thus, there will be a metastructure above the hyperspace of learning objects allowing multiple views on a certain subject area.

Project Objectives

Within the project, use of the framework will be demonstrated with contents of the subject area Operations Research/Management Science (OR/MS). However, the framework itself will be content-independent and usable to teach most content areas. It will be suited for using by a consortium of teachers (or learning institutes) who are willing to share material and are convinced about the quality of all partners, thus allowing a flexible extension scheme by each member without bureaucracy. Furthermore, if several universities and companies adopt the framework and methodology, they will be able to share a learning environment and strengthen their co-operation, thus providing high-quality teaching and learning materials. The project OR-World itself gives an example of sharing a learning environment, it involves four universities from three different countries, all offering courses in joint central subject areas.

Case studies are a well-known interactive teaching and learning method, not only in business and management, but also in various other fields, like engineering, law, agriculture, etc. (Erskine 98). OR-World will offer a concept and toolset to facilitate the use of cases in a virtual, distributed learning and teaching environment. Over one hundred years, the case method has proven to be successful; we aim to bring the method over to the environment of computer-supported distance learning. However, we do not believe that cases can be used totally without personal communication between learners and instructors. Thus, a goal of the project is to develop new guidelines and tools in order to achieve an optimal organizational form for the use of case study teaching within the virtual network.

Another objective of the project is to carry out a large-scale experiment to promote European integration and to develop a European identity for the subject. Thus the participating four universities and three companies will work closely together, each providing specific individual strengths either in the area of emerging digital technologies or content production and structuring. The learning objects will allow new schemes for virtual collaborative learning to be tested in cooperative joint university-industry education frameworks.

Because the initial standard Web markup language HTML does not support efficient structuring, retrieval, and linking among very large amounts of documents, more general technologies, such as the extensible markup language XML and XSL, are emerging. XML responds to a strong need to separate content of a document (text, graphics, video etc.) from its logical structure (content table) and representation (formatting on the screen or printer). The project OR-World will use XML on each granularity level to describe the elements and hierarchic structure of the learning hyperspace. The IEEE Working Group P1484.12: *Learning Objects Metadata Working Group*, is currently working on standards for describing learning objects in terms of metadata. According to the working group, "This standard will specify the syntax and semantics of Learning Object Metadata, defined as the attributes required to fully/adequately describe a Learning Object. Learning Objects are defined here as any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning. Examples of technology supported learning include computer-based training systems, interactive learning environments, intelligent computer-aided instruction. The proposed metadata scheme will be used in the OR-World project to facilitate the re-use of existing material.

To demonstrate and test the power of the OR-World concept, we will implement some contents from the interdisciplinary area Operations Research/Management Science. The exemplary implementation will comprise the whole functional spectrum including multilingual content components, distributed learning, self assessment, and grading.

References

Erskine (1998): Erskine, Leenders, Maufette-Leenders: Teaching with cases. Richard Ivey School of Business, Univ. of Western Ontario, 1998.
IEEE (1999): Learning Objects Metadata Working Group, http://ltsc.ieee.org/wg12/index.html.

Transforming Traditional Curricula: Enhancing Medical Education through Multimedia and Web-based Resources

Mike Keppell & Gregor Kennedy
Biomedical Multimedia Unit, The University of Melbourne, Australia
email: m.keppell@medicine.unimelb.edu.au, g.kennedy@medicine.unimelb.edu.au

Peter Harris
Faculty IT Unit, The University of Melbourne, Australia
email: p.harris@physiology.unimelb.edu.au

Abstract: This paper describes the transformation of a traditional medical curricula into a problem-based learning technology-enhanced educational setting. The use of Information Technology (IT) is an important feature of the new curriculum. Case-based medical problems are delivered to students in a tutorial setting via TopClass over the Web. Additional learning resources such as Web sites, image banks, practical experimental simulations, self-assessment tests, Shockwave learning modules and multimedia modules are also accessed via the computer. This paper outlines the critical attributes of this educational context, and then discusses the web-based and computer facilitated learning (CFL) based aspects of the curriculum.

Educational Context

Traditionally, the medical course at The University of Melbourne has been taught using a discipline-based approach. In the early years of the course, students undertook discrete subject blocks from the pre-clinical departments of Anatomy and Cell Biology, Biochemistry and Molecular Biology, Microbiology and Immunology, Pathology, Pharmacology and Physiology. Exposure to clinical scenarios *in situ* came later in the course (predominantly in years 4-6), after students had gained an understanding of the basic sciences relevant to medicine. Internal review mechanisms and student feedback in recent years highlighted a number of deficiencies in the traditional course. These included insufficient integration between basic and clinical science, insufficient attention to communication skills, problem solving skills and social aspects of health, an overload of biomedical detail and unnecessary duplication of content. In an effort to incorporate current theories of medical education a new medical curriculum was introduced in 1999. The pedagogical model for the new medical curriculum incorporates elements of Problem-Based Learning (PBL) and Self-Directed Learning (SDL) (Koschman, Kelson, Feltovich & Barrows, 1996). The primary focus of learning in Semesters 2-5 will be medical problems (referred to as 'Problems of the Week') which are presented to students in small group tutorial settings. Key features of the new curriculum are the horizontal integration across disciplines and the vertical integration of clinical situations with basic scientific material (Keppell, Elliott, & Harris, 1998).

The use of Information Technology (IT) is an important feature of the new curriculum. IT is utilised to deliver medical content in three ways. These include the use of a Learning Framework (TopClass); the web-based problem of the week embedded in TopClass and multimedia stand-alone modules. The TopClass Learning Framework provides a central access point for students to enter the on-line course work, complete self-assessment tests, view class announcements, participate in discussion groups and send and receive messages from teachers or peers. The problems of the week are delivered to student tutorials over the web via TopClass. At the completion of the first year of the medical course 18 problems of the week have been designed, developed and implemented. Approximately 160 problems of the week are required throughout the entire medical curriculum. Self-directed learning resources, in the form of multimedia teaching and learning modules, are also required to support the core content of the problems. Approximately 40 modules are currently under development and it is envisaged that 80 modules will be required to support the curriculum (see http://www.medfac.unimelb.edu.au/bmu/projects/survey.asp). This paper will describe and demonstrate the features of *one* Problem of the Week and *one* computer facilitated learning (CFL) module. Through this demonstration, the way in which IT, interactive multimedia and web based resources are being used to support the new integrated curriculum will be shown.

Computer-based Problems of the Week

The problem of the week begins with the "trigger". The aim of this photograph or video sequence is to set-the-stage for the student by providing a visual of the hypothetical patient and the circumstances surrounding the case/problem. In development we attempt to match the appropriate media type (video, Shockwave movie, photograph) to the nature of the medical condition or context which needs to be displayed. For example medical triggers which need to portray a medical condition such as myasthenia gravis need to show the progressive nature of the fatigue that occurs in skeletal muscle. Consequently video is the most appropriate media type for illustrating this progressive nature. Other medical triggers which need to demonstrate distinctive changes in a sequence can be portrayed through a series of photographs using a Shockwave movie. In other medical triggers a single photograph is sufficient for conveying the context and the necessary information required for beginning the problem-based learning approach. Following the trigger, students are instructed to list information about the patient, identify the presenting problems, list possible causes of each problem (hypotheses), provide a rationale for each hypothesis, prioritise the list of hypotheses and then determine what other additional information (physical examinations, laboratory tests, etc) is required to differentiate between the hypotheses. During this process students are given supporting information in the form of a history, past medical history, physical examination, progress, investigation results. An example of a problem of the week for the medical curriculum is shown at:
http://www.medfac.unimelb.edu.au/Med/examplePOW/trigger.html

Multimedia Modules

An important aspect of our approach is the emphasis on interactive CFL modules. These multimedia teaching modules are used extensively in the new course as learning resources in areas that students have traditionally had difficulty understanding or in areas where the use of media, such as video, audio or animation is particularly appropriate to demonstrate a concept or principle. The emphasis of these teaching modules is on *complementing* the learning objectives of the problem of the week.

For example, we have designed and developed a multimedia module which examines the communication process between doctors and patients and focusses on integrating biological, psychological and social factors in clinical diagnosis. When investigating a patient's complaint (such as chronic tiredness) the body language and emotional response of a patient is often as important as his or her verbal response. Video is an ideal medium to capture both verbal and nonverbal responses and to portray these for students. The module we have developed allows medical students to listen to a doctor's questioning method and to see how question tone and wording affect a patient's reactions and demeanour. Students are able to view a patient's response and answer questions about their perceptions and undertanding of the clinical interview. The introduction of this module into first year medicine should begin to sensitise students to the complexities of the communication process between doctor and patient. It is hoped that this will enhance their own clinical interactions in the long term. The presentation associated with this paper will demonstrate this module as an example of the types of interactive multimedia that are being used to support the new curriculum.

References

Keppell, M., Elliott, K. & Harris, P. (1998). *Problem based learning and multimedia: Innovation for improved learning of medical concepts.* In R.M. Corderoy, (Ed.) Australian Society for Computers in Learning in Tertiary Education. Ascilite '98 Conference Proceedings. (pp. 417-424). University of Wollongong, NSW.

Koschmann, T., Kelson, A. C., Feltovich, P. J., & H. S. Barrows (1996). Computer-supported problem based learning: A principled approach to the use of computers in collaborative learning. In Koschmann, T. (ed.) *Computer Supported Collaborative Learning: Theory and Practice in an Emerging Paradigm.* Mawah, NJ, Lawrence Earlbaum.

A Cenceptual Framework for Web-Based Authoring System

Badrul Khan, The George Washington University, USA

After reflecting on the various factors critical to open and flexible learning environments, Khan (1997) developed a Framework for Web-based learning. Various WBL factors are clustered into the following eight dimensions: pedagogical, technological, interface design, evaluation, management, resource support, ethical and institutional. AuthorWeb - a comprehensive authoring system is rooted in the WBL framework. The inception of AuthorWeb's development began with a vision of providing a tool that would assist educators, trainers and course developers to create meaningful online courses without prior skills or knowledge in instructional design, computer programming and issues critical to distance learning environments. AuthorWeb's development process benefits from the input of various substantiated perspectives, including instructional design, cognitive and educational psychology, curriculum development, distance education, innovation and change, telecommunication, database, artificial intelligence, software engineering, and media production.

Function Design of Adventure Game for Education Considering Developmental Psychological Feature of Elementary School Students

Hyeong-Joo Koh
Department of Computer Education,
The Korea National University of Education
Kangnae, Chungwon, Choongbuk, South Korea 363-791.
E-mail: hudoc@comedu.knue.ac.kr

Seong-Sik Kim
Department of Computer Education,
The Korea National University of Education
Kangnae, Chungwon, Choongbuk, South Korea 363-791.
E-mail: seongkim@cc.knue.ac.kr

Abstract: These days, a variety of educational methods using computer games have been studied to increase interests regarding the study using adventure game for educational purpose. If a part of learning contents of elementary school students is developed in courseware of adventure game way rather than conventional CAI way to apply it to the class of the students, learning effect is likely to improve greatly. From the viewpoint of developmental psychological features, elementary school students are much interested in courseware of game way. As a result, the study suggests function design of adventure game for educational use considering developmental psychological features of elementary school students.

Adventure game

Definition of concepts

Adventure game may be classified with contents and methods in respect of software. The one, who enjoys the game, takes proper action of accidents or problems depending upon the game's story to resolve them and reach final destination. The game shall include contents of adventure or rare events. Furthermore, there exists only one kind of order and solution, which should be followed to solve the event.

General features of adventure game

General features of adventure game may be analyzed as follows:
1) There exists only one solution based on preset scenario.
2) Most of time background occupies unknown world.
3) A hero shall never die.
4) There exists a sequence of scenario to solve an event.
5) Graphic, music and other multimedia effects are used.

Essence of computer game

Roger Gaiyo, a French sociology scholar, has classified a play as four kinds(See Fig.1) Horizontal axis means "Does intention of a player?", while vertical axis does "Is there a rule?".

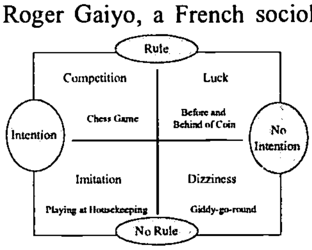


Fig 1. Four kinds of plays

The game is said to be a summary of four kinds of the plays that Roger Gaiyo has defined. In other words, the elementary school students concentrate on the game because it includes a variety of competitions to allow them to enjoy imitation, luck and dizziness at the same time while playing the game. Such a fact can be understood as follows: When each scene of the game, which can draw attention of elementary school students, is analyzed, it mostly includes four kinds of play factors evenly. Nonetheless, elaborate arrangement of competition, imitation, luck and dizziness does not always stimulate interests of the students to become an educational game.

They are continuously so mad on good games for educational purpose without boring feeling thanks to following reasons: 1) continuous supply of stimulus enough to create motivation, 2) the stimulus considering educational accomplishment that includes qualitative change. In other words, to design a good game, quantity of the stimulus shall be effectively supplied, and furthermore quality of the stimulus shall properly change.

Function design of adventure game for educational purpose

Factors of adventure game for educational purpose

The computer game may be used in various ways depending upon purposes and contents of learning, while adventure game for educational purpose can be used more effectively in the learning contents requiring empirical situation. The learning contents may be presented to students naturally through empirical situation to let them learn effectively through their experience.

Factors of adventure game for educational purpose shall be understood as the ways of not only developmental psychological features but also computer game to improve their study efficiency and make use of the game as an effective media. Major factors of the game are:

1) The game shall be easy to make use of it through easy and convenient visual design, and shall be equipped with various kinds of events to let students be interested in it. Furthermore, it shall include various kinds of educational strategies and study methods.

2) They shall be allowed to learn different game stage depending upon individual difference. The game's process shall include curriculum and training procedure.

3) Outcome of education shall be shown in accordance with development of the game by stages.

4) Conditional and unconditional divergence function shall allow each user to play game depending upon his or her feature.

5) Flexible extent of permission of exactness is to be given against a user's response.

6) Progress of the game shall be recorded, managed and maintained.

7) If possible, cooperative game through network shall be done.

8) They have to learn "social nature" while playing a game for multiple players.

9) The game shall maintain its activities continuously, and furthermore shall be rewarded or punished depending upon outcome of their actions.

10) Students shall be allowed to repeat to play a part of the game that they want to do.

11) Elementary school students are easy to give up or express strong rejection when they are unable to play game smoothly or do not understand it enough. As a result, they have to be given Help or Tip menu to help them solve problems.

Functions for adventure game for educational purpose

1) Mouse

□ Movement

- Rotation mode: 360°rotation, adjacent area, up/down and left hand/right hand.
- Movement mode: Walking and running each one step forward.
- Jumping mode: Jump over obstacles forward.

□ Selection

- Move mouse to change its shape and select or pick up an object.
- Select a variety of options.

2) Keyboard

□ Enter user's information. □ Supply an abbreviated command key.

3) Help mode

They may select "Be quiet", "Common" and "Talkative" of the game environment to let Help mode to give a suitable tip while playing game.

4) Zoom-in and zoom-out mode: The mode enables a player to watch surrounding area, environment or objects carefully. 5) Chatting with other characters.

6) Interactive mechanism mode: The mode enables a player to pick up, collect or make use of an object.

7) Time and space movement: A player is allowed to move under a variety of time and space zones.

8) Bonus and penalty: When a character faces a certain situation, he or she is given bonus or penalty to carry out job in easy or difficult way.

Completing Design Concepts for Lifelong Learning

Huberta Kritzenberger, Michael Herczeg
University of Luebeck, Institute for Multimedia and Interactive Systems
Seelandstr. 1a
D-23569 Luebeck, Germany
{Kritzenberger, herczeg}@imis.mu-luebeck.de

Abstract: Lifelong learning denotes learning as a process, which continues after leaving school. This perspective has a far-reaching influence on conceptual design models of educational software. It regards learning as one aspect of work and opens the way to including concepts from industrial psychology into software design. This paper will discuss factors influencing the learning process, such as burden, demand level or motivation, and the resulting consequences for the development of educational software.

Lifelong Learning

Lifelong learning denotes that learning does not end after finishing school or university. More and more people have to attend courses in further and continuing education to keep their knowledge level and market value or to gain knowledge for another kind of professional work. Situations demanding for learning will be pervasive in people's life and in consequence the division between education, work life and leisure time will fade.

Learning is one aspect of work

Understanding lifelong learning as a permanent process also involves the perspective on learning as one aspect of work. This view allows us to integrate concepts from industrial psychology into conceptual models shaping the design of educational software. Industrial psychology has a holistic view on human nature. Humans are supposed to search for self-realization and autonomy, which should be supported by changes in work places and organizational structures in order to enlarge the individual's area of responsibility. It involves personality development, formed in the individual's tackling with challenges provided by solving the tasks at work.

Industrial psychology deals with aspects of qualification. Learning tasks are viewed as a sort of chain, where burden and demands alter with effects on the change of mental states. In order to initiate successful and effective learning processes it is most important to find an adequate demand level, which causes positive mental states like happiness, motivation, increase in performance and, in the long distance, even qualification and positive development of personality. On the other side, inadequate demand levels cause negative and undesirable mental states, e.g. a feeling of tiredness, drop in performance, frustration, and even psychosomatic illness.

Lifelong Learners

It is a challenge to develop educational software, which is adaptable to burden and demand level. Software designers have to find concepts and techniques to make software as flexible and interactive (Fischer 1996) as to adapt to altering demand levels. One step into this direction is to orient teaching strategies to the characteristics of groups of learners, which may be deduced by taking into consideration the context of learning and the purpose. One can distinguish different learner groups. For example, learner group 1 wants to do basic studies in the domain in order to pass exams and earn diploma. The learners want to study all modules relevant to the curriculum, need guided tours to differ relevant from irrelevant knowledge with respect to passing exams. Learner group 2 does not want to go through all the knowledge modules offered in the database, but wants to study only some modules for task-oriented knowledge acquisition. Often a current problem or a knowledge gap is the starting point for learning. Learner group 3 is characterized by exploring the knowledge domain according to personal interests. The behavior of learners in this group is comparable to browsing libraries, reading books and magazines.

Conceptual Modeling

The important role of the conceptual model for the development of educational software has been strengthened by didactics as well as by software-ergonomics (Herczeg 1994). With this background in mind, we want to ask what kind of conceptual models do developers of educational software have in mind.

Theories of Learning and Teaching

Theories of learning and teaching, which are mainly derived from psychology, normally shape the conceptual models of educational software developers. Examples are behaviorism, cognitive information processing, theories on constructive and situated learning. In the early phase of computer-based training, dominated by behaviorism, reinforcement, serial ordering, small chunking were seen as the basic mechanism enabling learning processes. Information processing approaches focused on cognitive aspects of knowledge representation like conceptualization or schemata. Other theories strengthen the vital role of experience for the learner's perception and activities in knowledge construction, which change cognitive structures (Bonner 1998), stressing the importance of communication and social negotiation as inevitable for learning processes to occur.

Task Analysis

Learning theories focus on either behavioral or on cognitive aspects of the learning process. However, software-ergonomics claims that conceptual modeling should also take into consideration the domain, the user's skills and experiences, certain cognitive aspects (like memory capacity, laws of perception etc.), and also the task and the context of completing the task. Especially task and task contexts have been neglected by current psychological theories. Task analysis intends to reveal relevant characteristics of the learner and her or his task (Herczeg 1999). Some aspects of the learner's task have been discussed in the section on lifelong learners. The three groups mentioned above may further differ according to aspects like previous knowledge, learning style and motivation. For example, not the aspect of being motivated is important, but the reasons that cause motivation. That is, the distinction between intrinsic and extrinsic motivation, as intrinsic motivated learners will hardly ever need external stimuli, whereas others do.

Summary

Regarding lifelong learning as one aspect of work enriches developer's conceptual models with concepts from industrial psychology. An important aspect is task analysis in order to shape the task according to demand levels. Task orientation means that interests and engagement are caused by characteristics of the task itself. The conditions are to give a person as much control as possible over the subtask and over the devices for task completion. Furthermore, the task has to be structured in a way that the level of burden and demands is adequate. Too simple or less structured tasks will result in monotony or disappointment. More research on this subject is needed in order to develop educational software with a more holistic model of the learner, and by the way improving job and learning conditions, and last but not least preventing illness.

References

Bonner, J. (1988): Implications of Cognitive Theory for Instructional Design. Educational Communication and Technology Journal 36, pp. 3-14

Fischer, G. (1996): Making Learning Part of Life. Beyond the "Gift Wrapping" Approach to Technology. Presentation on the NSF Symposium "Learning and Intelligent Systems", June 26th. URL: http://www.colorade.edu/UWRP/cyber/fisc.html

Herczeg, M. (1994): Software-Ergonomie. Addison-Wesley-Longman and Oldenbourg-Verlag

Herczeg, M. (1999): A Task Analysis Framework for Management Systems and Decision Support Systems. In: Proceedings of AoM/IaM. 17th International Conference on Computer Science. San Diego, California, August 6-8, 1999, pp. 29-34

Letting Adjunct Migrant Faculty in from the Cold: Assisting Adjunct Faculty with Technology

Karen Krupar and Clark Germann
Metropolitan State College of Denver

krupark@mscd.edu
germannc@mscd.edu

Abstract: This presentation addresses the debate between quality of instruction issues of adjunct versus full time faculty. With an almost 40% increase in the numbers of contract and adjunct faculty in all institutions in the past decade (Hancock, 1998), very real questions need to be raised about the technology development of this cohort of faculty and their abilities to transmit critical technology skills and information to university/college students.

Introduction

While considerable efforts are being made to provide professional development opportunities with the full time faculty (Jacobsen, 1998; Nance & Strohmaler, 1998) very little is being done to provide information, skill training, and experiences with technology for adjunct faculty development. As J. Digranes reports (1995), " Adjuncts frequently receive less institutional support including e-mail accounts, computers, technology training...than their full time colleagues"(p. 162). The impact of this lack of training in technology is felt by students who "are dumped in a lab almost as though it were a 'babysitter' with the inexperienced and ill trained adjunct trying to maintain order" according to Steve Leone (1997, p. 8).

Purpose. This paper/ presentation examines the documented level of competencies in technology of a large group of adjunct faculty at an urban college and describes a professional development program in technology training that enhances these faculty's ability to use technology in their classrooms to improve student learning.

Review of the Literature

Limited research documenting the adjunct faculty's knowledge and competency in applying technology to the classroom exists in the literature. This is largely because institutions as well as researchers have refused to acknowledge the growing role of this group of faculty and their subsequent influence on teaching and student learning. Like their full-time counterparts, adjuncts exhibit varying degrees of knowledge about technology. To test the specific knowledge (cognitive and application) of adjunct faculty at the institution, a survey was constructed and delivered to a sample of the adjunct faculty (10%), full time temporary faculty (10%) and full time faculty (10%). The following data reflects the significant differences between the faculty responses to survey:

- Despite a significant difference in the degree of importance placed on knowledge of the Windows 95 Operating system for all three levels of faculty only 6 (adjuncts) claimed to have no knowledge of this basic operating system.
  The adjuncts were more inclined to not see the importance of Excel software.
- A majority of all three types of faculty said that MSWord was extremely important, a program that they used constantly. However, of the 8 people who said is wasn't important, 7 were adjuncts.
- There is a general proficiency in MSWord for adjunct instructors. MSPowerPoint like MSExcel was split between those who liked and used the program and those who didn't. Its perceived importance matched the existing skill level among adjuncts surveyed.
- Ability to use Web browsers is generally viewed as important, although a nine adjunct said they never used them.
- Conducting searches for research was considered extremely important by adjuncts. 50% in them claimed to have excellent to mid-range abilities. Of those who didn't have excellent to mid-range skill, majority-adjuncts(38%)).

- Half of the adjuncts felt creating Web Pages was important. 50% said it wasn't important.80% of the adjuncts said they had little to no experience with this competency.
- Over 70% of the adjuncts had no experience with Web applications at all.
- The use of currently available classroom systems was viewed as important by the majority of adjuncts. Those who said it was unimportant were predominately adjuncts (80%).. Eighty-eight percent of all adjunct faculty claimed no experience with this application.
- Using multimedia applications was also viewed as important by adjuncts. Approximately 80% of the adjunct faculty had not experience with this application.

Of the three groups surveyed in this study, adjuncts demonstrated the fewest competencies in technology. In many cases, they had little opportunity to develop those competencies through their attendance at professional development workshops, seminars, classes that emphasized these technology skills. There are fewer rewards for these faculty to make extra assignments that involve technology applications in their courses.

The Plan for Addressing this Need

To address the lack of technology professional development of adjunct faculty, our institution applied for and received $508, 000 U.S. Department of Education Title III grant. It provides technology training (among four other areas) for the 650 adjunct faculty at the institution.

Population and Research Model is a simple pre-test, intervention, post test design research model provides the organizing function for this grant. Each year approximately 10% of the adjunct faculty enroll in the program of workshops, technology fellowship program and other grant supported activities. For the first year, sixty adjunct faculty participated. All adjunct faculty provided two forms of baseline data, student evaluations for two semesters (from 1998 to 1999) and one peer observation data from the same time period.

Technology Competencies is used to determine what technology education for adjunct faculty was needed, the grant staff developed a survey on technology skills. The survey paralleled that instrument used by the college's Technology Task Force and its Academic Technology unit for full time faculty at the institution. Calibrated by its close similarity (questions) to those asked in the AAHE "Flashlight" project, the instrument developed for adjunct faculty requires knowledge of types of software, hardware and applications of technology to curricular, classroom management of instruction and technology infusion.

Based on this survey, six technology workshops were built for the second year of the grant. In September a workshop plan and training schedule was developed. Instructors were secured from among the full time faculty and technology staff. Since many adjunct faculty find it difficult to attend workshops even when these kinds of professional development aid their knowledge base and make them more valuable instructors at the institution, migrant adjunct faculty have difficulty attending training (Geppa, 1993). Multiple sections of each workshop had to be arranged to accommodate the adjunct faculty's schedules. Since some of this faculty cohort are already experts (early adopters) in technology, effort was made to use these faculty to assist other adjunct faculty in the development of advanced training in technology Seven adjunct faculty were selected from those participating who had recommended technology expertise. These adjuncts were given an additional contract to work 40 hours during the academic year in small group training sessions with adjunct faculty needing technology assistance.

Each adjunct Technology Fellow had to develop a Technology Assistance Plan covering goals, goal management and measurable outcomes that was negotiated with the dean of the school in which the adjunct's discipline was housed. Each adjunct produced 40 hours of documented technology work for which the adjunct was paid $1000. Several of the adjuncts included goals addressing the finalizing of courses on-line. Other adjuncts specified training for their adjunct colleagues on a variety of topics including Web Authoring, Researching on the Internet and Multimedia presentations. Other (2) adjuncts set up one-on-one sessions with other adjuncts in their academic divisions (sciences and humanities). It is evident that adjunct faculty need more assistance in both learning specific technology programs and in applying the technology into their coursework. The technology fellowship program using the "Train-the-Trainer" model is yielding some remarkable results including increased numbers of faculty invested in using the technology in the classroom in research, assignments on the web, and the development of five additional on-line courses including ones in biology, speech communication and sociology.

In conclusion, adjunct faculty who increasingly instruct large numbers of undergraduate students need to invest in faculty development activities, in particular technology training. Usually interested in their own development, institutuions need to make such training readily available (multiple sections) to adjuncts and encourage (reward) them for building competencies in it to improve their students' learning.

Cognitive Issues for Learning and Performance from Multimedia Interfaces: Implications for Design

Maria Lorna A. Kunnath
Ed.D. Candidate
University of Central Florida
Orlando, Florida
mak05307@pegasus.cc.ucf.edu

Abstract: The paper discusses factors that affect users' learning and performance when they interact with a computer interface. Research in Instructional Systems, Cognitive Science, Human Computer Interaction and Design and Human Factors show an overlap of findings. All disciplines contribute to understanding how the human and the machine relate to one another and offer some very useful insights in our quest to producing better designs for multimedia learning systems.

Cognition

Perception

Research in interface development has shifted from perceptual and motor issues to cognitive issues such as perception (Aspillaga, 1996; Winn, 1993), attention (Taylor, 1992), selective encoding (Taylor, 1992; Paivio; 1991; Hodes, 1994), contiguity effect (Mayer, R. & Sims, 1994), and concurrency of information (Paivio, 1991) with implications to learning and performance (Blattner, 1994). These factors influence a person's ability to process the visual and verbal information on a computer screen. Research has shown that a well-designed presentation of information with consideration to a person's cognitive resource positively correlates with improved learning, retention and performance. During 'perception' vision is not yet ruled by attention because the viewer is confronted with processes occurring rapidly and simultaneously

The eye therefore, merely retains what it visualizes. For designers it is important to know what these perceptual processes are because any change in the instructional message can lead the user to unconsciously misinterpret the message. One of these early perceptual process is stimulation change, i.e. change in vision from light to dark and vice versa. Another perceptual process is the figure-ground which explains why users tend to create figures against a background. During the design, the designer should make clear distinctions between the figure and the ground by maing the boundaries of an area very clear, coloring or filling the bounded area and judging the completeness of the figure.

Objects are perceived as complete shapes on the basis of their arrangement and the way their geometric boundaries follow simple alignment. Similarly, objects that line up, in a straight line or on a curve are grouped together (Winn, 1993 A viewer is attracted to the simplest organization of the parts of the display explained by the concept of emergent property . In conformance with the Gestalt principle of close proximity or spatial proximity i.e., parts of a message that are perceived as being close together will be processed as one. Various views have proliferated on where the eyes tend to focus in a group of images. Winn (1993) cited the work of Kinchla and Wolfe (1979) espoused a middle out approach. Others hold that people choose to view an image which is more dense and detailed. There are others who believe that perceptual organization naturally orients towards the horizontal-vertical overriding the perceptual factors of focusing attention, interpretation and behavior. Visual elements such as shape, space, size, color and location are processed according to their properties. Perceptual Grouping or Similarity Grouping, categorizes similar and different. Aspillaga cited Kawabata's work to emphasize that the density and orientation of elements affect their perceptual grouping. This research proves that perceptual grouping and layout uniqueness account for higher recollection (Aspillaga, 1991; Bundensen, 1990 & Gropper, 1991 as cited in Aspillaga 1991). Defined as the size of the image relative to the visual angle, a person's unique visual perception will ultimately determine where he focuses and gives attention to group/s of images (Winn, 1993).

Attention

A key component in learning and communication, attention has limited capacity for performing several processes at one time since it requires the use of cognitive resources of apprehension, temporary storage, elaboration of information and the use of short term memory. Short-term memory and processing speed are limited resource since it is serial, slower and draws heavily on long-term memory. Being selective, both resources do not need irrelevant information. For a multimedia interface designer it is important to determine which parts of the message should be emphasized because the cognitive mechanisms guiding attention determines where the user focuses attention. Parts of the message that stand out due to contrasting qualities are brightness in color, size, shape, typestyle and motion. Color in black and white is effective. Similarly, red will stand out because of its single unique feature (Nakayama, & Joseph, 1998) in a field of green distractors. Speed of presenting information affects depth of processing. Researchers conflict in their advice on the best rate of presenting information so that a user has enough time to decode, interpret and acquire the message. Some (Bellard, Taylor, Canelos, Dwyer & Baker 1985 as cited in Winn, 1993) recommend seven seconds of processing time. But researchers such as Hannafin recommend learner control which is contradicted by others who recommend that learners must be adviced on how to proceed with the lesson. Providing the appropriate sequence of attending to information through the use of graphic devices such as arrows and lines will assist in guiding the eyes towards this information because the eyes tend to follow lines and contours. Being a medium for attention getting, multimedia can be used creatively by designers to gain, hold, control, and direct learner's attention (Taylor, 1992). After attention is given to the instructional message, the learner tends to focus on information that is perceived to be important. Through a process called selective encoding (Hodes, 1994), this information processing is strengthened. Through the use of elaboration strategies e.g., image generation, the user is able to meaningfully process and learn the instructional material. Hodes emphasized the significance of presenting clear, well-planned, and organized visual information to facilitate selective encoding and elaborative processing.

Schemata and Mental Models

Schemata is a person's organized network of prior knowledge. It is often said that the more sophisticated a person's schemata, the better one is able to assimilate, arrange, construct, and reconstruct prior information with new information. In the same light, one who has acquired an elaborate and diverse schemata possesses better metacognitive skills i.e., one is able to regulate his/her cognitive processing and monitor information needs. Anderson, R. & Spiro, R. (1978) conducted a study on schemata as scaffolding for representing information in connected discourse and found that food from categories determined to be part of people's restaurant schemata were better recalled by students who read the relevant narrative. When faced with new information, a person matches that information with slots in his schema and if it matches, it is learned and remembered. If not, it is considered insignificant. Mental models are based on schemata but possess both the figurative representational attributes of schemata and the dynamic properties of representation systems

Concurrency of Information

Dual Code Theory DCT holds that verbal and non-verbal systems are processed independently yet interconnectedly (Paivio, 1991). An extension of the dual code theory, contiguity effect holds that learners build referential connections faster when verbal and visual materials are presented contiguously than when they are presented separately (Mayer & Sims, 1994). In a verbal/visual presentation, the learner constructs a mental representation in his/her working memory of the verbally presented material and a mental representation of the visually presented material. The process of going from an external to an internal representation is called building representational connection or, verbal encoding and visual encoding as the case may be. As a result of all three viz., verbal encoding, visual encoding and referential connections, the user responds favorably to tests of retention and transfer which results in better problem-solving transfer and performance.

List Of Reference

1. Anderson, R., Spiro, R. & Anderson, M. (1978). Schemata as scaffolding for the representation of information in connected discourse. American Research Journal, 15(3), 433-440.
2. Aspillaga, M. (1991). Screen design: location of information and its effects on learning. Journal Of Camputer-Based Instruction 18(3), 89-92.
3. Aspillaga, M. (1996). Perceptual foundations in the design of visual displays. Computer in Human Behavior, 12(4), 587-600.
4. Ayersman, D. & Minden A. (1995). Individual differences, computers and instruction. Computers in Human Behavior, 11(3-4), 371-390.
5. Blattner, M. (1994). In our image: interface design in the 1990's. IEEE Multimedia, Spring 1994.
6. Blattner, M. & Dannenberg, R. (1992). Introduction: the trend toward multimedia interfaces. In Blattner, M. & Dannenberg, R. (Eds.), Multimedia Interface Design (pp. xvii-xxv). New York, New York: ACM Press.
7. Computer-Based Instruction. 18(3), 89-92.
8. Eberst, R. & Brittianda, K. (1993). Preferred mental models for multimedia based interfaces. Journal of Man-Machine Studies, 38, 767-785.
9. Grabinger, S. (1989). Screen Layout Design. In Proceedings Of Selected Research Papers Presented At The Annual Meeting Of The Association For Educational Communications Technology, Dallas, TX, pp. 96-103.
10. Hapeshi, K. & Jones, D. Interactive multimedia for instruction: a cognitive analysis of the role of audition and vision.
11. Hodes, C. (1994). Processing visual information: implications of the dual code theory. Journal of Educational Psychology, 21(1), 37-43.
12. Hoogeveen, M. (1997). Toward a theory of the effectiveness of multimedia systems. International Journal of Human Computer Interaction, 9(2), 151-168.
13. Mayer, R. (1997). From Novice to Expert. In Helander, M., Landauer, M. and Prabhu, P. (Eds.), Handbook of Human-Computer Interaction (pp. 781-795). Amsterdam, the Netherlands: Elsevier Science.
14. Mayer, R. & Sims, V. (1994). For whom is a picture worth a thousand words? Extensions of a dual coding theory of multimedia learning. Journal of Educational Psychology, 86(3), 389-401.
15. Nakayama, K. & Joseph, J. (1998). Attention, Pattern, Recognition and Pop-Out in Visual Search. In Parasuraman, R. (Ed.), The Attentive Brain, (pp 279-298). Cambridge, MA: The MIT Press.
16. Paivio, A. (1991). Dual coding theory: retrospect and current status. Canadian Journal of Psychology Outstanding Contributions Series, 45(3), 255-287.
17. Roth, S. and Hefley, W. (1993). Intelligent multimedia presentation systems: research and principles. In Maybury, M.T. (Ed.) Intelligent Multimedia Interfaces (pp.13-59). Cambridge, Massachusetts: The MIT Press.
18. Sims, R. & Sims, S. (Eds.). (1995). The importance of learning styles, understanding the implications for learning, course design and education. Westport, CT: Greenwood Publishing Group, Inc.
19. Taylor, D. (1992). Choosing a display format for instructional multimedia: two screens vs. one. In Proceedings Of Selected Research And Development And Development Presentations At The Convention Of The Association For Educational Communications Technology And Sponsored By The Research And Theory Division, 762-785.
20. Winn, W. (1993). Perception Principles. In M.Fleming & W.H. Levie (Eds.), Instructional Message Design: Principles From Behavioural and Cognitive Science. (pp. 55-126). Englewood Cliffs, N.J. Educational Technology Publications.

Learner Perceptions, Learning Styles, and Learning Strategies: In an Asynchronous, Open, Text-based, Task-Oriented, and Gender-mixed Web Environment

In-Sook Lee
Sejong University
98 Gunja-dong, Gwangjin-gu
Seoul, Korea
Inlee@sejong.ac.kr

Abstract: A learning-oriented web environment is a place of highly demanding learner control. The current research appraises learners' perception of and learning styles and strategies in a web-based learning environment. A few laggards' pains buried under the majority who well adjusts oneself should be recognized and resolved. There is a strong need for instructional efforts to maintain the proper levels of learning and instructional demanding. In contrast, deliberate efforts are demanded in order to induce active discussions and interactions among learners. In addition, this research shows significant gender differences in the categories of expression strategy and information processing strategy, in which males showed stronger abilities and positive attitudes without exception. The findings are not entirely surprising, since they replicate many of the existing findings from the areas of communication, linguistics, and sociology and more.

Introduction

A learning-oriented web environment is a place of highly demanding learner control. In this environment, learner issues are the core element for success (Bonk & Dennen, 1999). The web environment has been expanding to educational communities worldwide; however, it is not clear whether all and every learner will benefit equivalently from this new learning technology. So far, insufficient attention could be found in the literature concerning learning strategies in the web. In addressing this question, the current research (a) appraises learners' perception of and learning styles in a web-based learning environment, and (b) determine whether online learning strategies varied by gender.

The learner-oriented environment requires learners to make decisions by themselves during this process and, therefore, requires a high level of self-regulation and metacognitive abilities in the learning. Substantial numbers of literature inform the important roles of learning strategies for learning performance and some researchers worked on the learning strategies in the cyber context. Burge (1992) and Eastmond (1992) found the fact that learners transfer many of learning-to-learn approaches from other traditional learning context to cyber setting. At the same time, however, they also identified cyber environment request learners idiosyncratic ways of learning strategies of dealing the nature of cyber environment. Lyman (1998) stressed that cyber learners need to develop learning strategies called, 'information literacy' in order to take benefit especially in a resource-based learning environment through the Internet.

The Research

Subjects were 156 undergraduate students – 35 males and 121 females- from a medium size university in Seoul, Korea. They were from three different educational technology courses. The web system in this research was utilized mainly to facilitate discussion among learners, to submit assignments, to provide feedback from instructors, and to provide additional learning materials. Especially, the web used for the purpose of discussion was operated with asynchronous, open, text-based, task-oriented, and gender-mixed features.

Two different surveys with 42-items questionnaire were implemented and the survey data were computed by mean scores, chi-square and t tests. At the first week of the semester, 14 items survey was conducted in order to find out subjects' information literacy level. A 28 items survey questionnaire was conducted during the last week of the semester to determine learning styles and strategies.

Findings and Conclusions

The findings of this study, taken together, suggest various ideas regarding instructional strategies for better online instruction. A few laggards' pains buried under the majority who well adjusts oneself should be recognized and resolved. It could be a starting point to find out some answers about what common characteristics those learners share, how to identify them, and how to support them, and so on. We also need to consider feedback systems that will satisfy learners' high expectation and concurrently avoid instructors' working overload. There is a strong need for instructional efforts to maintain the proper levels of learning and instructional demanding. Most practitioners agree that an online environment intrinsically has a high potential of producing learning and instructional overload. Nonetheless, there is a rare perception that this quality may exhaust learners and instructors and, as a result, seriously hinder learning performance. It is desirable and yet easy to demand learners to share with others information and learning outcomes. In contrast, deliberate efforts are demanded in order to induce active discussions and interactions among learners.

It seems clear that males tended to use computers more at least in their daily life and to have stronger experiences with the Internet than females. This research shows significant gender differences in the categories of expression strategy and information processing strategy, in which males showed stronger abilities and positive attitudes without exception. The findings are not entirely surprising, since they replicate many of the existing findings from the areas of communication, linguistics, and sociology and more (Ebben, 1994; Hatton, 1995; Herring, 1993; Herring, 1994; Herring, Johnson, & Dibenedetto, 1992; Kramarae & Taylor, 1991; McDowell & Schuelke, 1998; Selfe & Meyer, 1991; Spender, 1995; Tannen, 1991). The current research also confirms that awareness of gender differences in learning strategies is critical to know its potential effects on learning process and outcomes. Currently dominating modes of cyber courses demonstrate structures and functions in favor of males. However, it should not be taken for granted but we have to move toward a gender-equal cyber learning environment. This can be achieved by including instructional design and implementation which might more respond to learning strategies in favor of females. Of greatest potential that leads to gender inequality in a cyber learning environment is its text-based, public, and information overload natures.

References

Bonk, C. J. & Dennen, V. (1999). Learner issues with WWW-based systems. *International Journal of Educational Telecommunications, 5* (4), 410-417.

Burge, E. J. (1993). *Students' perceptions of learning in computer conferencing: a qualitative analysis*. Unpublished doctoral dissertation, University of Toronto, Toronto. Canada.

Eastmond, D. V. (1993). *Adult learning of distance students through computer conferencing*. Ph.D. dissertation. New York: Syracuse University.

Hatton, D. (1995, Nov). *Womyn and the "L": A study of the relationship between communication apprehension, gender, and bulletin boards.* Paper presented at the Annual meeting of the Speech Communication Association (81st, San Antonio, TX, November 18-21, 1995). ED 397 454.

Herring, S. C. (1993, April). *Gender and democracy in computer-mediated communication. The Electronic Journal of Communication* [Online], 3(2). Retrieved January 21, 2000 from the World Wide Web: http://www.cios.org/getfile/Herring_ v3n293.

Lyman, B. G. (1998). Learning strategies for the Internet: Playing Catch Up. *Educational Multimedia and Hypermedia, 1998,* Association for the Advancement of Computing in Education, Freiburg, Germany.

Integration of Varied Cognitive Activities in a Multimedia Environment. The PHYLOGENE Example.

Dominique Lenne, Monique Dupuis, Jean-François Rodes, Naoum Salamé
Institut National de Recherche Pédagogique
France
dominique.lenne@inrp.fr, monique.dupuis@ac-versailles.fr, JFRodes@wanadoo.fr, naoum.salame@inrp.fr

Abstract: This paper describes PHYLOGENE, a multimedia open environment we designed for evolutionary biology teaching and learning. The progressive approach of evolution it implements, relies on a set of biologic, anatomic, morphologic and molecular data and allows different articulated activities from observation to evolutionary trees construction, including comparison, selection and classing of animal species and characters. All these activities provide the students with multiple entries at different teaching level.
The main feature of PHYLOGENE is that it combines on one hand an hypermedia environment enabling navigation among documents describing species and their characters, and on the other hand, analysis tools enabling to select, class and organize the hypermedia explored data. It provides thus as well knowledge exposition as learning activities that encourage an active involvement of the learner. We argue for the interest of such multimedia open environments in science learning.

A lot of software tools can be of great interest in learning about life evolution, but most of them only offer a particular approach. We describe in this paper PHYLOGENE a multimedia open environment that integrates varied cognitive activities to allow a global approach of evolution.

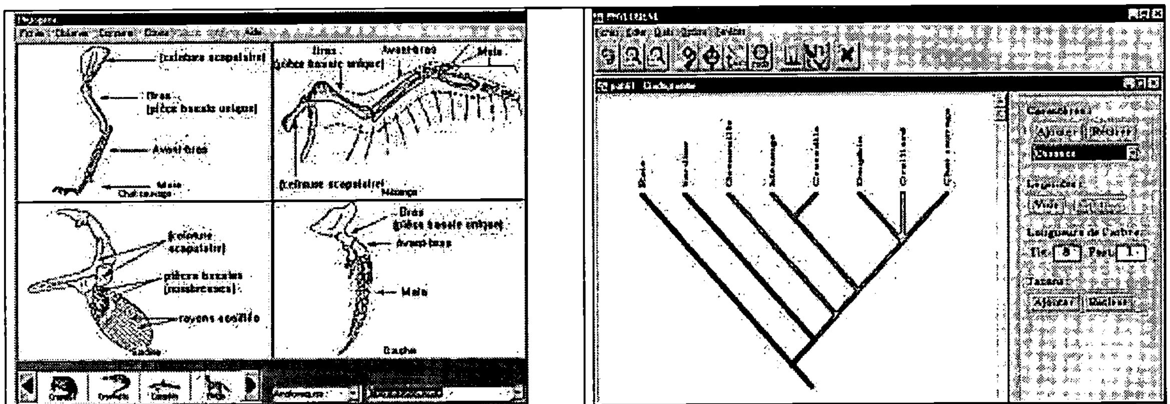
Learning the Concept of Evolution

Evolution of life is a fundamental concept in the understanding of a great number of biological phenomenon. This concept relies on various kind of knowledge relative to Earth history, biochemical process at the origin of life, living organisms development conditions and stages, species apparition and extinction (biological crisis and crossing off), species relationships. Therefore evolution is central in the biology curriculum organization at all school levels.
At these different levels, varied cognitive abilities are required from the students. At the beginning, they are centered on a global recognition of macroscopic characters. Then they have to analyze (in a qualitative or quantitative way) details or data able to constitute arguments to reconstruct evolution and to integrate selected information in a global representation such as an evolutionary tree. Finally, they are led to integrate new knowledge in the framework of evolution theory, taking into account the current debates.
Though some software tools can be useful in the learning of evolution related concepts (Jones et al. 1997), none of them provides an integrated approach. That led us to design a multimedia open environment called PHYLOGENE, allowing such an integrated approach by giving access to the different kind of knowledge implicated in the study of evolution and by enabling different cognitive activities (Dupuis et al. 1997).

Description of PHYLOGENE

In order to support a global approach of life evolution, PHYLOGENE has the main following features :
- It allows to combine different abstraction levels through different kind of activities,
- Different entry points are possible , taking into account the nature of the question to study and the students school level (middle school, high school, university),
- Students can choose freely the species and characters they want to study.

One of the major goals is to let the student be active by solving problems, while following a naturalist approach (morphologic and biologic data). Unlike other tools, the tree structure is not pre-established and the species characters are not all evolutionary characters.
PHYLOGENE is thus organized in different activities exploiting a database of species :



Comparison of species characteristics	Tree construction

Figure 1: Two activities of PHYLOGENE

- Observation activity allows to study the animal morphology, to discover some of its biologic characters (habitat, diet, fertilization, social structure) and anatomic characters (breathing organ, locomotor organ, skull, extra embryonic membrane) characters.
- Comparison activity (Fig. 1) allows to display simultaneously up to four species images or characters sketches. New species and new characters can be easily taken into account.
- Grouping and classing from a range of species gives the possibility to choose a subset of species and characters, to fill a table with the observed characters states and then to build a hierarchical classification on the basis of these states.
- Trees constructing (Fig. 1) can be realized on the basis of a table or a classification. Trees can be constructed step by step in a MacClade like way (Madison), by choosing the positions and grouping together of thc branches.

The main feature of PHYLOGENE is that it combines on one hand an hypermedia environment enabling a navigation among species and their characters and on the other hand analysis tools enabling to select, class and organize the data explored in the hypermedia. It provides as well knowledge exposition as learning activities that encourage an active involvement of the learner, allowing discovery learning (Van Joolingen 1999). We think that such hybrid tools are well adapted in experimental science learning.
PHYLOGENE has been experimented with success in a few middle school classrooms. It will be distributed in the course of the year 2000. A scientific and pedagogical documentation will go with it and additional data will be found on our web site (http://www.inrp.fr/Acces/Biogeo/accueil.htm).

References

Dupuis, M., Goujet, D., Lenne, D., Rodes, J.-F. (1997). Une approche progressive de l'évolution de la vie à partir de données anatomiques, morphologiques et moléculaires avec le logiciel PHYLOGENE, *Informatique et communications dans l'enseignement des sciences de la vie et de la Terre*, INRP, Paris.

Jones, T., Myers, P., Espinosa, R. (1997) "The Animal Diversity Web", *ED-Media'97*, Calgary.

Maddison and Maddison, *MacClade 3*, Sinauer and associates, Sunderland, MA.

Van Joolingen, W., (1999). Cognitive Tools for Discovery Learning, *International Journal of Artificial Intelligence in Education*, 10.

How does one evaluate the effectiveness of electronic learning in a South African context?

Context

Significant aspects of the context include the following. The University of the Western (http://www.uwc.ac.za/) has adopted the mission to – "Assist educationally disadvantaged students gain access to higher education and succeed in their studies". Consequently, the university has provided access to students from previously disadvantaged communities. As a consequence our classes are ethnically and culturally diverse. Moreover, the quality of the educational experiences of these students also vary widely. From such a heterogeneous student population, one infers that a rich learning environment, that accommodates individualisation, flexibility and self-paced learning, would be ideal. Over the last few decades computer assisted learning has been suggested as a resource to meet such needs. The technological infrastructure at the institution is still underdeveloped, but it is improving rapidly. Despite the enormous inequalities of the past, the recently established democracy brings the promise of rapid progress. Such a context requires rigorous evaluation of the impact of the new technologies on education in order to ensure that our society reaps the maximum benefits and avoids possible pitfalls (Reeves ,1998).

Rationale for evaluation

What is evaluation and how is it related to research? Evaluation is defined here as: the systematic acquisition and assessment of information to provide useful feedback about some object (Trochim, 1999). The object in this case is technologically enhanced learning. The generic goal of evaluation is to provide useful feedback to various stakeholders that influences decision making at various levels. Evaluation, the same as research, is concerned with the collection and analysis of valid and reliable empirical data. The two may, therefore, utilise many of the same methodologies. However, because evaluation takes place within an organisational and political context, it requires sensitivity to multiple stakeholders as well as managerial and political factors (Trochim, 1999). In addition, in practice the relationship between evaluation and the actual decisions taken is not a simple one. Thus, the question arises is evaluation necessary?

Reeves (1997) argues that there are at least four reasons for the lack of useful evaluation of CBE. Firstly, consumers of technological innovations for education uncritically accept the advertised claims of the producers of the technology. Secondly, evaluation of CBE has often been reduced to a numbers game. Thirdly, evaluations that have been previously conducted lacked utility and impact. Fourthly, the inappropriate reliance on traditional empirical evaluation methods that compare an instructional innovation with another approach, frequently led to disappointing results. He, therefore, proposes fourteen pedagogical criteria for evaluating various forms of CBE in order to obtain more valid and useful evaluations.

Quality learning

The key outcome of this project should be an improvement in the quality of learning by our students and teaching by our academics. The Multimedia Computer together with its sophisticated software is merely a means to this end. Laurillard (1993) argues that a mix of teaching and learning methods will always be the most efficient way to support student learning, because only then is it possible to embrace all the activities of discussion, interaction, adaptation, and reflection that are essential for quality learning. Entwistle (1996) stresses the importance of research into student learning for improving tertiary teaching.

Methodologies

Nightingale and O'Neill (1994) recommend Action Research as an approach to enhancing the quality of learning in higher education. It is adopted as a broad approach because of its focus on improving practice rather than merely proving theories. It is seen as a self-reflective spiral that involves planning, acting, observing and reflecting with further iterations of the same cycle. Trochim (1999) discusses, four strategic approaches to evaluation: scientific-experimental models, management-oriented systems models, qualitative/anthropological models and participant-oriented models. He also points out that, although vigorous debates may rage among the proponents of these schools, one should borrow from each as the need arises.

Action research defines the broad approach within which more specific research techniques will be employed. For many reasons a pure experimental design is unlikely to be fruitful. Ethical, practical and technical considerations, all render controlled experimentation inappropriate (Entwistle 1996). Both qualitative and quantitative techniques will be employed as deemed appropriate. Specific techniques used, include: surveys and questionnaires, interviews, student achievement under different regimes. In brief, careful observation of students involved in CAL; supported by surveys and questionnaires as well as detailed interviews will be employed to provide the raw data.

Case studies

Case studies of efforts to introduce computer supported education and its effects on student learning will be presented. Some questions to be explored are -

How do students interact with CD-ROM delivered material?
What factors promote or hinder their learning when using this medium?
How should CD-ROM be used without compromising quality of learning outcomes?
Does technologically delivered learning materials live up to its promise?

References

Entwistle, N. (1996). Improving University Teaching through Research on Student Learning. Centre for Research on Learning and Instruction. University of Edinburgh.

Laurillard, D. (1993). Rethinking university teaching: A framework for the effective use of educational technology. London: Routledge.

Nightingale, P, and O'Neill M. (1994). Achieving Quality Learning in Higher Education. Kogan Page.

Reeves, T.C. (1997) Evaluating What Really Matters in Computer-Based Education
At http://www.educationau.edu.au/archives/cp/reeves.htm

Reeves, T.C (1998). Rigorous and Socially Responsible Interactive Learning Research.
At http://www.aace.org/pubs/jilr/intro.html

Trochim, W.M. (1999) The Research Methods Knowledge base.
At http://trochim.human.cornell.edu/kb/index.htm

Using Technology to Teach Linear Algebra

Lawrence E. Levine
Department of Mathematical Sciences
Stevens Institute of Technology
Hoboken, NJ 07030
llevine@stevens-tech.edu

Abstract: An introductory mathematics course in linear algebra was taught using laptops and Scientific Notebook. Computer technology was utilized as an integral part of presentation as well as learning and testing to the extent that the instructor did not write one thing on the board the entire semester. This approach has implications for other disciplines besides mathematics.

Introduction

Stevens Institute of Technology has required its students to purchase a PC since 1984. This requirement has now been replaced with a requirement that all students purchase a laptop. To prepare for the switch from PCs to laptops, last year Stevens set up a laptop classroom so that faculty could experiment with teaching in a new environment. The author used this classroom to teach an introductory one-semester course in linear algebra.

Scientific Notebook

The author has used Scientific Notebook (SNB) for several years in the second year mathematics sequence taught at Stevens. SNB is a word processing package that incorporates a Maple kernel. This Maple kernel allows one to perform a wide variety of mathematical operations. A particularly nice feature of SNB is that one can use the Maple kernel without typing any code. One simply types the mathematical expression and then clicks on the appropriate operation to be performed. SNB then performs the operation.

Structure of the linear algebra course

SNB was used to prepare a complete set of lecture notes. The notes incorporated in-class exercises to be worked on during the lectures. Thus each class meeting was a combination of lecture and hands-on doing. When the instructor was lecturing, laptops were required to be closed, whereas when the students were working on the exercises, the laptops were open. The class moved seamlessly between the two environments of a "standard" classroom and a computer laboratory. Homework had to be done using SNB. **No written work was accepted.**

Use of the Web

Notes for each class were posted on the Web. A feature of SNB is that one can put a tex file on the Web, and then download by simply clicking on it. Thus each lecture began with the instructor downloading the lecture from the Web to his laptop and then projecting it for the class to see.

All homework assignments were also posted on the Web. In addition, solutions to homework problems and exams were put on the Web site. A good portion of the quizzes and exams were also given over the Web. The Web served as a crucial resource for the course. To see what was actually done go to http://attila.stevens-tech/edu/~llevine/ .

Exams and Quizzes

Many of the short quizzes and portions of all exams were designed so that the students had to use SNB to solve the problems. These had to be downloaded by the students, worked on, and then uploaded to a site. The exams and the final were in two parts: one part to be done with paper and pencil, and the other part requiring use the Maple kernel in SNB to solve the problems. Having a networked laptop classroom made this approach possible.

Engaging the student in the teaching/learning experience

One of the goals of a good educational experience is to engage students in the teaching/learning experience. Active learning is certainly more desirable that passive learning for a wide range of reasons. However, within the classical lecture format it is often difficult to get students actively involved in what is going on in class. Given the approach taken in this linear algebra course active student involvement became the rule rather than the exception.

Advantages of this approach

Integrating the use of computer technology into this one semester linear algebra course in the manner described above had the following advantages:

- Students learned to use sophisticated mathematical software as a tool in mastering mathematics.
- Mastery of linear algebra entails being able to perform many arithmetic operations. Students often make mistakes while performing these operations. Using software judiciously avoids this problem and allows the student to concentrate on the underlying concepts.
- A laptop classroom is actually two classrooms in one: with the covers of the laptops up it is a computer laboratory, whereas with the laptop covers down one has a "standard" classroom.
- The active learning described above is certainly a major advantage of this approach.

Problems encountered

- The time investment required preparing for and teaching such a course is considerable.
- Preparation of exams that incorporated the meaningful use of SNB required considerably more thought and time than preparation of "standard" exams.
- Some students found it difficult to deal with a mathematics course in which writing was not a key component.
- There were a number of technical difficulties encountered vis a vis the hardware.
- Many of the short quizzes and all of the exams had a computer component. This component was downloaded from a server, worked on by the students and then uploaded to the server upon conclusion. Thus security was very much an issue.

Applicability to other courses

The approach taken with this linear algebra course can certainly be used to teach other mathematics courses as well as courses in other disciplines. Indeed it is this author's opinion that using such an approach would enhance the learning experience for many students.

However, this approach does have limitations. The linear algebra course had 28 students in it. There was also a teaching assistant present during all classes. Thus two people were necessary to handle a class or 28. The class size could have been increased to perhaps 40 without foreseeable problems. However, this is probably the upper limit for such a course. The point is that this approach will not work with a lecture class of say eighty or a hundred.

Conclusions

Students were asked to complete surveys on the web a couple of times during the semester. The vast majority of students liked the course, but there were a few who were very unhappy with the approach. Approximately 90% of the students indicated that they would be willing to take another course that was given in this format. Perhaps the overall conclusion to be drawn is that while some students will always be unhappy with a course that employs the extensive use of technology, the vast majority will benefit greatly from courses that judiciously employ technology as part of the teaching/learning experience. The challenge is for faculty to find meaningful ways to incorporate this technology into their courses. This is far from a trivial challenge.

Towards an Intelligent Authoring Shell on Reuse

Kam Wing Li
School of Computer and Information Science
University of South Australia
Australia
li@cs.unisa.edu.au

Warren James
School of Computer and Information Science
University of South Australia
Australia
warren@cs.unisa.edu.au

Abstract: An authoring shell that supports the reuse of teaching material should not only allow the author to search for the existence of the material and retrieve it. When there are too many "matched" items, an authoring tool should be able to identify those that are relevant and create a suggestion list to the author. When there are "no matched" item, an authoring shell should be able to suggest a list of materials that are closely related. This article describes how an Intelligent Authoring Shell (IAS) can provide suggestions to a teacher at authoring.

Introduction

To enable reuse, IAS has employed database repository method (Sarti and Marcke 1995) to store useful information of each piece of teaching materials, activities and lessons. Along with database repository method, IAS also uses learning objective as the key to reuse teaching materials (Kam Wing and Warren 1998). Learning objective has two main components: an *object* and a *keyword*, the letter drawn from a learning objective. An *object* is a concept, or skill, or entity that is described in a learning objective. *Keyword* is the verb being using in the learning objective. With *object,* we can search for the existence of a related teaching material/activity/lesson. With *keyword*, we can know the purpose and usage of each piece teaching material/activity/lesson. Therefore, learning objective is the backbone for IAS to enable reuse.

IAS has three main modules: *keyword module*, *strategy design module* and *course design module. Keyword module* and *strategy design module* are bases to provide intelligence in IAS. Reuse of teaching materials and providing intelligent suggestions to a teacher on reusing teaching materials take place in *course design module.*

Keyword module

It facilitates the input of learning objective taxonomy (*keyword*) into IAS database. IAS uses the structure of Bloom's taxonomy (Bloom, Englehart et al. 1964) as reference. Bloom has classified learning objective taxonomies into three different domains: cognitive domain, affective domain and psychomotor skill domain. Under each domain, taxonomies are further classified into different levels forming a *class hierarchy.* In IAS, we have used this module to enter Bloom's taxonomy on cognitive domain. Users can use this module to enter other taxonomies or even create their own set of taxonomy and define the use for each keyword.

Strategy design module

It allows teachers to design their own teaching strategy. In IAS, a teaching strategy is composed of a set of activities with different activity type. Each activity type may consist of sub-activity type. For example, a lesson using concept attainment (Joyce and Weil 1986) as its teaching strategy will contain introduction, example(s), counter-example(s), analysis and conclusion. Example is composed of sub-activities such as description, question, answer and explanation. In designing a teaching strategy, the author will construct the teaching strategy structure by arranging activity types in order. The author will also indicate which domain and taxonomy class are likely/unlikely to be suitable for the teaching strategy. With this information available, IAS can use the keyword from learning objective to provide suggestion list of appropriate teaching strategies to a teacher at authoring.

Course design module

It helps a teacher on designing curriculum of a course, lesson and learning activities within a lesson by providing suggestions on reusable materials to a teacher at authoring.

In designing the curriculum, a teacher will construct a hierarchy of learning objectives for the course. On inputting a learning objective, IAS will check the keyword with previously entered learning objectives' keyword by using the class hierarchy. This is useful to detect any illogical sequence of learning objective. According to constructivism learning theory, any illogical order of learning objective hierarchy will increase student's difficulty in learning. Therefore, such a checking feature can help to improve quality of a course. At the same time a teacher is building learning objective hierarchy, an object hierarchy is also built using the objects from each learning objective. With this object hierarchy, we can identify the relation between each object. This relation will be useful in deciding which teaching materials may be appropriate for reuse and also in searching and retrieving closely related materials for the object.

In creating a lesson, a teacher will select a teaching strategy from the appropriate teaching strategy list. This list is suggested according to the class of domain keywords being used in the learning objective and the information from the strategy design module.

After teaching strategy of a lesson is selected, the author will follow the structure of the teaching strategy to design learning activities and sub-activities. URLs of multimedia files for each activity and sub-activity will be recorded into IAS database. In designing learning activities, IAS will suggest reusable activities and teaching materials for the author to select. The suggestion criteria available are based on activity type, learning objective, keyword and object. Suggestion criteria based on activity type will use activity type as filtering element. For example, if the activity at authoring is an example, then IAS will only list those activities that are examples only. Suggestion criteria based on keyword and object will list related activities/material according to the keyword class hierarchy and object hierarchy. This will reduce author's time in searching for reusable teaching materials, particularly when the database has hundreds of teaching materials available.

Conclusion

Using database repository method, normal authoring shell is able to provide simple reuse of teaching materials. Using learning objective with database repository method, a normal authoring shell will become more intelligent. It can provide some suggestions to teacher and thus reducing a teacher's effort in creating on-line course. Even though our IAS can provide some suggestions to teacher at authoring, we are looking forward to optimising the suggestion criteria to improve the effectiveness of suggestions.

References

Bloom, B. S., M. D. Englehart, et al. (1964). A Handbook of educational objectives: The cognitive domain, New York: David McKay, Inc.

Joyce, B. and M. Weil (1986). Models of Teaching, Prentice Hall, Inc.

Kam Wing, L. and J. Warren (1998). Reusing of teaching materials for an intelligent tutoring system with multiple teaching strategies. ICCE'98, Beijing, Springer-Verlag.

Sarti, L. and K. V. Marcke (1995). Reuse in Intelligent Courseware Authoring. 1999. http://www.pitt.edu/~al/aied/sarti_vm.html.

The Art of Technology The Technology of Art

Loy Lichtman
Victoria University
PO Box 14428 Melbourne City MC 8001
Victoria, Australia
Loy.Lichtman@vu.edu.au

Abstract: This paper explores what it means to be a visual artist in the age of information technology., and it explores how the degree in Computer Mediated Art at Victoria University attempts to answer this question. A number of Informing Principles are discussed which provide insight into the development and implementation of the program, a program which draws upon both traditional studio practice and digital studio practice. The paper concludes by examining how the technological shaping of (visual) culture produces an art of technology and a technology of art.

Art @ Technology.

Victoria University was initially configured as a university of technology intended to service the needs of its local industry based community in the economically disadvantaged western suburbs of Melbourne, Australia. In 1997 it was decided to change the low visual arts profile at the university into a high arts profile by introducing for the first time in the western suburbs, a fine arts degree. The degree however had two briefs: it could not be a conventional visual art degree as found in other universities around Australia; and it had to make digital technology central to it program.

Artists Adopting Technologies.

Artists have adopted technologies to their studio practice as soon as those technologies become available. These technologies have included the development of different types of paint such as oil, tempera, acrylics and gauche, the development and implementation of perspective and a variety of painting surfaces. In addition to these technologies, artists have also employed more mechanical innovations such as the camera obscura, photography and various printmaking methods such as off-set, silkscreen and etching. Electronic technologies such as video, photocopy and fax have been coopted into studio practice and more recently again, digital technologies through a variety of computer hardware and software applications.

Informing principle: If technology has always been a part of an artist's studio practice, then the inclusion of digital technologies would simply be a continuation of that process and in this way, technology would be defined as a range of ideas and tools which are available to the artist in order to realize a particular set of intentions.

Technology and Art History.

Computers in general, and art software packages in particular, do not represent a significant discontinuity from previous technologies used in the artist's studio. Software effects such as morphing were used by Escher in the early part of this century as were effects like interactivity found in Duchamp's Readymade series. Zooming and magnifying techniques were used by Lichtenstein in the sixties while Oldenburg played with changes in scale at the same time. As for hardware, the monitor, which physically resembles the landscape shape/format of a traditional canvas, is inherently perspectival.

*Informing principle:*Computer mediated art is primarily art made using the brain rather than the hand and it is this difference that turns the computer into more than an ordinary tool studio tool because it disturbs the 'taken for grantedness' of art praxis. Is the computer a tool like a paintbrush or pencil? Of course the answer will depend upon how 'tool' is defined, but what makes the computer interesting in the creative process is its potential to take on a role that traditional tools cannot by for example, generating automated creative processes through the use of scripts.

Used this way, the computer becomes a decision making tool which acts to amplify intelligence rather than replace it.

Atoms and Bits.

Central to this new artistic environment -the artist in the age of information technology- is an emphasis upon both atom based art and bit based art. Digital art consists of a series of electronic charges on a monitor rather than the physical presence of an analogue painting. Inherent in bit based art is computer memory and its ability to store, retrieve and manipulate image, sound and text in ways not previously possible in analogue art. In this way the distinction between master and copy typically found in the artmaking process is no longer viable. Each subsequent copy is now a perfect master.

Informing principle: Students will develop computer mediated art work which is either static two dimensional images in much the same way as atom based art work on the wall is static two dimensional as well as time based art which may or may not be interactive. As well, they may produce work which is three dimensional that can move fluidly without constraint, conveying us through various modes of discourse. Students will complete the degree with both a folio of analogue work and a folio of digital work on a CD-ROM/Web/DVD.

Aesthetics and Technology.

Computer mediated art provides no panacea for aesthetic problem solving nor for resolving the issue that while computers are being used to generate images, meaningful art still needs to be created irrespective of the technology. Artists need to consider what the end result might be and what part a computer might play in this being achieved. What can be done with traditional tools does not necessarily become more interesting because it has been generated on a computer: what is interesting is what was not conceivable before computers. The art software packages not only allow artists to work in substantially different ways to analogue art by allowing the combination of what would normally be considered mutually exclusive techniques -for example oil paint and watercolor- they also undermine one of the central goals of analogue art- the goal of fixed perfection. The Undo command allows artists to undo at will any mark or fill deemed inappropriate which may result in an art which lacks commitment or be too timid.

Informing principle: Alongside both analogue and digital art students will participate in a program which examines aesthetic issues in relation to technology as well as an art history which does not focus only on dead, European, white males. Aesthetic issues based on Asian art as well as issues of gender, particularly in relation to the art software packages being used, will be examined.

Virtual Studios.

A virtual studio will be established between students enrolled in the Bachelor of Arts-Computer Mediated Art and students enrolled in the visual arts stream of a Bachelor of Education at Deakin University in order to investigate the use of that virtual studio as a collaborative learning forum for creating computer mediated art. It will also examine the way artists are grappling with new digital technologies in their studio practice. The software which will be used for this virtual studio will be *Painter 5.5* because it has tools which are familiar and recognizable to artists. To achieve this, *Painter* relies on analogies with traditional artistic techniques such as virtual pens, virtual pencils and virtual canvas. *Painter* is also being used because it has a facility which allows it to be used via a TCP/IP connection. Essentially, there are two frames on the monitor- one for the artwork which is asynchronous and one for a chatline which is synchronous. Students at Deakin will be able to watch digital art being made at Victoria University and when that work in finished it can be sent down to the other student as a file, and vice versa. *Painter* also has the ability to record every stroke and combination of strokes in the creation of the visual image which can then be replayed at later stages to investigate issues of participation, patterns of use and the application of virtual technologies to the art making process.

Conclusion.

The Bachelor of Arts-Computer Mediated Art is not a multi media program, although possibilities exist for its use. Rather, it is a course aimed at fine artists who wish to use traditional paint brushes as well as paintbrushes which are plugged in to the computer in their studio practice, and to understand the implications and consequences of so doing.

The Status of Online Professional Development Available to Support Higher Education Staff.

Andrew Litchfield and Peta Spear
Centre for Professional Development
Macquarie University, Australia
andrew.litchfield@mq.edu.au

Abstract: The authors have conducted a survey to identify online learning resources specifically designed to support the professional development of higher education staff. This short paper outlines the survey and principle findings, and presents an overview of the *pdonline* website with links to the identified 'best-of' online resources. The authors offer the *pdonline* website for use with professional development activities to support higher education staff.

Introduction

The rhetoric, rationale and emerging practices of 'online learning', 'flexible delivery', 'just-in-time', 'anytime anywhere' education for learning and teaching programs is just as relevant for staff development. Online communication, activities and resources can enable more flexible ways of supporting diverse individual staff learning needs. Online media can be used to improve the support for mentored and facilitated 'just-in-time' professional development services.

When considering the design issues of online individualised staff development the authors considered a necessary first step was to survey and identify relevant online resources. This survey informed the content of a website of links to what we considered were the best of the identified online resources. We offer the *pdonline* website for use by higher education centres of staff development to assist their activities. The website is located at *<www.cpd.mq.edu.au/pdonline>*.

Survey Description

The survey aimed to identify the quality and scope of accessible, online resources specifically designed to support the development of English language university staff. The research was conducted from September 1998 to February 1999. All Australian, New Zealand, and United Kingdom universities, all Canadian and American universities with online teaching centres, and all known virtual campuses were investigated via the web. A total of 385 university websites were surveyed in detail.

The survey was designed to investigate and scan the web for accessible online university staff development programs and resources in learning and teaching, leadership and management, research, administrative and specialist support, and community service. The study's secondary focus incorporated other university centres such as flexible and distance learning centres, materials developed by faculty such as tips on teaching, web resource links recommended by staff development centres, and general web and database searching such as for corporate training websites.

The authors acknowledge that not all relevant websites were able to be examined within the funding and time constraints of this survey. Websites are constantly changing and without doubt there are now new useful resources online. Nevertheless we believe the study is extensive enough for useful observations to be made.

Survey Findings

The survey identified a vast amount of online activity generated by universities. Some had comprehensive online programs, resources and links in an impressive range of areas. However only a relatively small amount of activity was found to be specific to our staff development focus. Every university in this survey provided some form of in-house tuition for its staff and students in using the internet and substantial resources are dedicated to the development of software and web skills. Staff development was offered almost exclusively via in-house workshops in all universities. Where online modules were offered, content invariably focused upon opportunities offered by the web as a communication, authoring and publishing tool.

Although North American universities due to their number and size dominate the survey, Australian universities made a proportionately good showing in providing online staff development resources. Australian universities have approximately a 1:4 ratio of providing some useful online resources, with North American universities the ratio was approximately 1:6, while in the United Kingdom the ratio was 1:17. The ratio for North America is due to the high use of online resources which originate from Teaching Assistant handbooks.

The online resources found are predominantly in learning and teaching with a strong emphasis on teaching tools and the use of information technology. There are very limited online staff development resources in university leadership and management. Minimal activity was identified in research development, administration and specialist support, with no activity in the area of community service.

Apart from skill training in how to use the internet, the survey found nothing by way of a single, cohesive package of online staff development specifically designed for both faculty and general university staff. The closest to a comprehensive online program in university professional development was found in online courses of professional accreditation.

The *pdonline* Website at *<www.cpd.mq.edu.au/pdonline>*

Despite the overall bulk of material the quality of resources varied widely necessitating careful assessment of the materials chosen for inclusion on the *pdonline* website. Of the 385 universities surveyed in detail only 65 universities were assessed as having produced suitable online resources. All sources of chosen links were contacted for their approval before the website went online and are acknowledged on the website. When maintaining the website in late 1999 13 links were no longer active and were removed.

Selection criteria included a judgement of the quality of theoretical rigour and written expression, and the usefulness of the resource in staff development as a self-learning aid, an adjunct to workshops, and as a support for future online development activities.

Learning and teaching development was the best represented of all the areas investigated. Four main categories were devised; (1) *teaching advice* including *general teaching tips, planning, lecturing, teaching large classes, group learning, diversity, assessment,* (2) *theories of teaching practice,* (3) *teaching portfolios,* and (4) *teaching using the internet.* Resources originating from secondary sources were incorporated into each category as *useful resources.*

Online resources in *leadership and management development* were scarce. Only two links originated from within universities and other links are to private management training corporations and to websites of individuals.

The site includes links to three *accredited online professional development courses* in higher education.

Conclusion

Our survey clearly indicates universities everywhere are actively encouraging the use of online media in learning and teaching. Ample resources are available in how the technology works however staff are under-represented as learners and consumers in these new processes. There was no evidence of a comprehensive program of online professional development specifically designed for higher education staff.

We located and produced a unique bibliography of links to the 'best of' resources identified in the survey. The authors offer the *pdonline* website to support individualised learning plans and to provide supplementary resources for workshop-based programs. Hopefully this work can prevent at least some 'reinvention of the wheel' when staff development centers produce their own online resources.

Interesting opportunities exist in using online resources in the professional development of higher education staff. Online communication, activities and resources can enable and support 'just-in-time', flexibly delivered and individualised learning plans and this is the direction of the authors applied research. The *pdonline* website is a key resource to support this work.

Supporting the millennium teacher: faculty development in the use of information and communications technologies

Allison Littlejohn
University of Strathclyde
Graham Hills Bdg., 50 George St.
Glasgow, Scotland
allison.littlejohn@strath.ac.uk

Abstract: The UK government has established an Institute for Learning and Teaching (ILT) and will soon require that all professional teaching staff in Higher education (HE) achieve membership through either a portfolio or upon the successful completion of accredited courses. This development is driving a rapid expansion of coherent staff development programmes offering full recognition of the professional development staff undertake. The aim of this paper is to examine ongoing research which will inform future developments in faculty development in the use of Communications and Information Technologies (C&IT) in teaching and learning. An analysis of responses to an accredited staff development programme is presented within the context of the shifting role of the university teacher. This study will be of interest to staff developers who wish to offer this form of support to faculty within their own institution.

The shifting role of the university teacher

Traditionally staff development in HE has been through workshops offered on a need-to-know basis. However, there is no clear evidence to suggest that these have made a major impact in changing the nature of teaching and learning in universities within the UK. In 1997 the Scottish Higher Education Funding Council (SHEFC) commissioned a nationwide survey of staff development needs aiming "to investigate the training requirements for staff in HEIs to enable them to use the MANs (Metropolotan Area Networks) effectively and efficiently in teaching, learning and research" (Higginson & Tombs, 1998). The results of this analysis do not reflect an adherence to current educational theories advocating the development of students' adaptive and transformative attributes. For example most academics advocate using the WWW for delivery of information and teacher-initiated communication, corresponding to the conventional role of the teacher as the provider of knowledge and information. Likewise student-centred methods were allocated low priority by respondents.

These findings highlight the limited conception amongst HE teaching staff of how to use the World Wide Web (WWW) effectively for teaching and learning, echoed in other studies (for example Thomas et al, 1998). Littlejohn and Stefani (1999) reported that academics often view the WWW as another means by which they can 'deliver lecture notes', ignoring the importance of student dialogue. This was due mainly to the misconception that the use of new technologies involves transferring traditional teaching methods into an electronic format, with no regard for the underlying pedagogical implications. It seems clear that knowledge of web authoring skills without pedagogical design skills will not lead to effective online teaching. Despite this notion, a recent survey conducted by the Scottish Higher Education Funding Council examining the present state of ICT staff development in Scotland reported a significant gap between coherent courses which are pedagogically driven and a plethora of short, technology-driven workshops (Alexander, 1999). There is a need to bridge this gap by providing a faculty development programme which models current thinking in online teaching and places faculty in the role of an online learner.

In 1998 the University of Strathclyde piloted an innovative, accredited programme of this nature. Entitled 'Advanced Academic Studies', the Postgraduate Certificate/ Diploma course offers modules spanning various aspects of academic practice including Web Based Teaching and Internet Communication for Teaching and Research. The Web Based Teaching module takes place over a three month period with full day face-to-face sessions. In the first session *Getting Started* participants critically evaluate examples of web based teaching. The next stage is *Planning your Educational Website* in which participants storyboard an online learning activity. Following this *Incorporating Interactivity* focusses on introducing online discussion and assessments. Finally *Creating your Educational Website* is when participants create the necessary webpages and present their online learning activity as their final assessment. A major feature of this module is that it places faculty in the role of an online learner enabling experimentation and evaluation of new technologies at first hand.

This gives faculty the opportunity to foresee learning and technological problems which their students may experience (Ryan, 1998).

Analysis of faculty responses to this staff development programme

Group interviews followed by an online evaluation study took place upon completion of the Web Based Teaching module in May 1999. Nine of the ten course participants participated in the evaluation: four faculty members and five support staff including a librarian, a web developer, a learning support officer and audio visual staff. All the respondents thought the module increased their confidence in using the Web for teaching and learning. Perceived benefits included:

- The modeling of Web based teaching and learning placing faculty in the role of online learners.
- The use of learning activities building pedagogical and practical skills simultaneously.
- Online publication of assignments enabling participants to exchange and evolve ideas.
- Dialogue resulting from exchange of ideas online promoted the development of a community of scholars embracing the diversity of academic disciplines represented on the course.
- Publishing assignments on the Web made peer critiquing easy to facilitate compared with traditional methods.

Some drawbacks were also expressed including:

- Participants sometimes felt overwhelmed by the continuous learning activities. As a result some fell into the role of the 'convergent' student, for example by only completing activities which were to be assessed.
- Installing software on their own computers was occasionally problematic for participants
- 'Drop in' in web authoring sessions were requested

Most participants stated that the module enabled them to develop the required skills to improve an established class. However the final submissions of online courses indicated a continued adherence to teacher-centred teaching. Major barriers voiced against using the WWW for teaching focussed around three issues: negative attitudes of staff and students, lack of time to implement web based teaching and poor technical assistance. The most participants had access to an 'IT literate' person within their department who could offer immediate help with technical problems. The wide range of IT skills within the class may be alleviated in the future by linking with supplementary IT skills courses offered within the University. When the module was repeated in January - March 2000 there was stronger emphasis on the importance of strong educational design. A group interview with 15 participants offered evidence that participants' views had shifted slightly towards developing more student-centred courses. Participants requested that a further session could be offered in future enabling development and elaboration of their ideas in the form of storyboards.

The results of this study emphasise the requirement for full integration of current thinking in educational technology into teaching practice. The next step is to ensure that upon completion of the course faculty are encouraged to continually reflect upon and improve their teaching practice. Ongoing research aims to further improve this programme in an attempt to make a greater impact on changing teaching practice both within the University of Strathclyde and in the Scottish HE sector as a whole.

References

Alexander, W., (1999) TALiSMAN Review of Staff Development Courses and Materials for C&IT in Teaching, Learning and Assessment http://www.talisman.hw.ac.uk/CITreview/

Higginson, C. and Tombs, N, Exploring the Network for Teaching and Learning in Scottish Higher Education, TALiSMAN Training Needs Analysis, Feb 1998 http://www.talisman.hw.ac.uk/tna/

Littlejohn, A.H. & Stefani, L.J. (1999) Effective Use of Communication and Information Technology: Bridging the Skills Gap, ALT-J, 7.2, 66-76

Ryan, M. (1998) Using Computer Mediated Communication to Deliver Staff Development, Active Learning 9, 61 – 62 http://www.cti.ac.uk/publ/actlea/al9.html#contents

Thomas, P. J., Carswell, L., Petre, M., Price, B. A. (1998), 'A holistic approach to supporting distance learning using the internet: transformation, not translation', British Journal of Educational Technology, 29(2), 149–61

Intensive Ecommerce Business Training Course

Joe Luca, School of Communications and Multimedia, Edith Cowan University, Australia <j.luca@cowan.edu.au>
Larry Quick & Renee Ellis, Dow Digital, Australia <lq@dowdigital.com.au>

Abstract: The dramatic growth of the Internet and subsequent use of the Internet for Electronic Commerce is fundamentally changing the business paradigm, at both a local and global level. The emergence of the global on-line economy is not only providing immense opportunity and threat for small, medium and large businesses at a micro-economic level, but is posing similar opportunities and threats at a macro-economic level, all at 'break-neck' speed! This requires training students and business operators at a rapid rate, which raises some critical issues for educators, such as course structure, delivery methods, collaborative ventures with industry and keeping up with technology and business issues.

Rationale

"The uptake of electronic commerce has the potential to transform the global economy more rapidly than the industrial revolution" (Department of Industry and Tourism, 1998). Projections like this have serious training ramifications. How can large numbers of business operators be quickly trained in on-line technology and business strategies in order to take advantage of this new revolution? The Australian Federal Government considers on-line and Ecommerce as being a priority area for future growth in Australia. The Department of Communications, Information Technology and Arts (1999) has identified the following priorities:

- maximising the efficiency dividend from Ecommerce for the economy at large;
- reducing barriers for the development of Ecommerce; and
- demonstrating a business case for the integration of Ecommerce into business

In order to meet these priorities in a timely manner, training of both the existing work force, and of new students entering the business environment is required. University courses spanning three years duration will not provide the body of knowledge or skills needed by Australian business to compete in this rapidly changing on-line marketplace. Graduating university students need short, bridging courses to account for rapid changes in technology and the impact that such change will have on business practice and process. These courses need to provide ongoing collaboration and mentoring with industry to ensure the knowledge acquired is current and relevant.

Case Study - Ecommerce Intensive Training Program

In September 1999, ninety-second year multimedia degree students from Edith Cowan University completed a 10-day intensive Ecommerce business planning course. They had no previous instruction in business planning or any understanding of Ecommerce issues. They were required to develop an Ecommerce business plan, which could be sustained economically by a business to sell products in an on-line environment, and possibly be implemented anywhere in the world, including third world countries. For example, Amazon.com in Pakistan?

The course was subsidised by the Office of Information and Communications (a State Government Department), and developed by Dow Digital (an E-commerce and on-line services consultancy and development company). The program was designed to educate students and business representatives on how to prepare an Ecommerce strategy and business plan. The pilot course covered six modules dealing with all aspects of creating an Ecommerce plan for small to medium sized enterprises. Presentations were made from Ecommerce experts and local businesses that had already established Ecommerce as part of their business model. The course culminated in the students presenting their plans to a panel of Ecommerce experts, members of local industry and their peers after the 10 days of intensive instruction.

The program was focussed on constructivist learning theory which emphasised social interaction, communication, exchange of views, collaboration and support for learners to take more responsibility for the learning process through learner-centred tasks (McLoughlin & Oliver, 1998; Collis, 1998). Students had to work collaboratively to create the Ecommerce plan and share the expertise of the group. Students were faced not only with new information and material, but also with a collaborative learning method promoted by the tutors, course materials and student team leaders. The student team leaders were trained over two sessions to develop an emphasis on the required collaborative training process and to familiarise themselves with the materials. They were responsible for scheduling tasks, keeping the project on task, solving problems, encouraging collaboration, stimulating discussion, and ensuring that each student was contributing to the team effort. The students presented their Ecommerce plans on the final day of the program where they were assessed by a panel of industry experts.

The course ran for ten days and covered the following sessions: Ecommerce - paradigms and predictions; defining Ecommerce product; the Ecommerce transaction process; panel session of local businesses conducting Ecommerce; panel session of experts in Ecommerce technology; refining the Ecommerce plan; practising Ecommerce; feedback from tutors and experts on student plans; finalising the plan and presentation of Ecommerce plans. The overall objectives of the course were to:

- provide a, 'fast track' program which trained students from any discipline in Ecommerce business planning
- provide an training model that promoted collaboration between industry, government and tertiary providers
- assess whether the course model could be applied to developing countries

Conclusions

From the experience of running this course and from feedback gained from the student questionnaires, the following recommendations are made with a view of improving the course delivery:

- a ten-day intensive program for this type of course is too short and a greater "lead time" was needed
- more time is required from tutors and advisers in the tutorial sessions to help student teams
- each business planning team should be working on a "real" industry product
- each team should consist of approximately 4 student members and one industry representative
- the course is more suited final year students who are ready for employment

Feedback from both students and the industry representatives strongly supported a greater implementation of this type of Ecommerce training course. Opinion was strongly in favour of promoting an understanding of Ecommerce strategic thinking,, business planning, Ecommerce technology issues, on-line marketing and the generation of business ideas for the on-line environment. As indicated by the literature, business is rapidly moving to a global economy and judging from the student and industry attitudes gleaned from the evaluation sheets, there are still many new and fresh business ideas waiting to be exploited!

However, for a course such as this to be successful, it must be seen as valuable for all the "stakeholders". Government must see tangible benefits to business and the community in order to be convinced to sponsor such a course. The business sector will want to be involved if productivity and profit margins can be potentially improved, and students will want to be involved if these skills provide a means of securing employment, or as an opportunity to start their own on-line business.

Ecommerce is now offering "level playing fields" to new business entrants who understand how to take advantage of this new business paradigm. Existing and new business merchants cannot afford to ignore this trend, which is continually being highlighted by government and other strategic research bodies. Ecommerce training courses are needed for business operators and graduating students in a timely, efficient and cost effective manner. These courses must be well structured and correctly marketed to attract and promote this new form of trading. The course implemented at Edith Cowan University provides an example of how students and business operators can be quickly skilled in this rapidly changing area.

References

Collis, B. (1998). WWW-based environments for collaborative group work. Education and information technologies, 3, 231-245.

Department of Communications, Information Technology and the Arts (1999). Australia's Ecommerce Report Card. Commonwealth of Australia.

Department of Industry and Tourism (1998). Getting Business Online. Commonwealth of Australia. [on-line] http://www.dist.gov.au/infoind/busonline/gbo.pdf

McLoughlin, C., & Oliver, R. (1998). Maximising the language and learning link in computer learning environments. British Journal of Educational Technology, 29(2), 125-136.

Teaching Information Literacy to Undergraduates in the U.S.: Stand-alone Courses or Across the Curriculum?

Barbara G. Lyman
Southwest Texas State University
Department of Art and Design
San Marcos, Texas, U.S.
BL01@swt.edu

Abstract: This paper represents initial exploration of the relative merits of information literacy development for university undergraduates through stand-alone courses or an across-the-curriculum approach. Reasons for preferring stand-alone courses relate to the a) definition and scope of information literacy; b) rapidly evolving nature of the Web; and, c) various levels of prior exposure to Web-based learning represented among undergraduate students in the U.S.

A dilemma exists regarding the teaching and learning of information literacy among U.S. college and university students. With the increasing reliance on the Web as a source of information, both to augment and increasingly to supplant traditional course delivery, a pedagogical and policy issue is whether we need stand-alone courses, an across-the-curriculum approach, or some combination of both, in an effort to insure that students are armed with certain lowest common denominator skills and strategies for learning from the Web.

This paper represents an initial exploration of the relative merits of providing information literacy development for undergraduates through stand-alone courses or an across-the-curriculum approach. The stand-alone course approach provides assurance that the identified skills and strategies receive due and explicit attention. However, the stand-alone model begets the transfer of learning problem (Anderson, 1995), i.e., the frequent failure of learners to transfer skills and strategies to situational contexts which demand these abilities.

Nevertheless, there are three primary reasons for preferring stand-alone courses at the present time, relating to the a) definition and scope of information literacy; b) rapidly evolving nature of the Web; and, c) various levels of prior exposure to the Web among U.S. undergraduates.

Information Literacy

First, Marchionini (1999, p. 18) defines information literacy as "a continuum of skills, concepts, attitudes, and experiences related to information access, understanding, evaluation, communication, application, creation, and values." Similarly, Shapiro and Hughes (1996) say that information literacy consists of at least seven sub-literacies: 1) handling basic hardware/software (tool literacy), 2) mining/managing databases and archives (resource literacy), 3) recognizing social and institutional effects on information constructs (sociostructural literacy), 4) employing investigational tools/strategies (research literacy), 5) communicating findings (publishing literacy), 6) maintaining currency with advancements in information age tools (emerging technology literacy), and 7) evaluating the worth of information and information technologies (critical literacy). How do we know that due attention is being given to this intricate array of skills and strategies without offering dedicated stand-alone information literacy courses?

The Protean Web

Secondly, even a cursory look at the medium of the Web itself reveals a size and complexity which beg for a grasp of the whole as well as of its parts. By one estimate over 800 million Web pages have been created (Rabinovitch, 1999). The search engines designed to assist users with selection and access seem increasingly inefficient relative to this proliferation, although recent refinements promise improvements (Greenberg & Garber, 1999). The Web also changes constantly with sites appearing and evaporating in relatively short periods of time. Many sites remain in a limbo of partial construction. The validity of information on websites as well as the credibility of their creators often seem difficult to ascertain with any degree of confidence for one not already an expert in the domain of knowledge and opinion thereby represented. Once again, is it reasonable to expect that the multiple strategies and skills needed to tackle questions of authority, accuracy, and validity as students make their way through the Protean entity of the Web will be sufficiently taught without stand-alone courses devoted to this purpose?

Narrowing the Digital Divide

Finally, discussions of the digital divide (National Telecommunications and Information Administration [NTIA], 1999) and technological apartheid (Castells, as cited by Gerstner, 1999) strongly suggest and the data show (NTIA, 1999) that there are wide gaps in the information literacy of various groups of students entering higher education in the U.S. Should not courses therefore be provided which are designed to level the technological playing field? Stand-alone courses in information literacy have the potential to help insure that the digital divide is diminished rather than reinforced within institutions of higher education. Of course, stand-alone study and learning skills courses, to refer to one example from current practice, because they are often seen as remedial in nature may have a corresponding stigma associated with them. However, offering stand-alone courses does not necessitate buying into remedial models of intervention. Such implementation mistakes are to be avoided in providing information literacy courses.

A Dual Approach for the Foreseeable Future?

While an initial discussion of the relative merits of stand-alone and embedded or across-the-curriculum models for teaching undergraduate information literacy may raise more questions than it answers, the level of dialogue surrounding the issue should increase. More of us should be debating the question: Should teaching information literacy to undergraduates be accomplished via stand-alone courses or an approach of developing information literacy across the curriculum, or both? The already crowded curricula of undergraduate programs lessen the likelihood of offering dedicated stand-alone courses. However, unless existing courses throughout the curriculum are evaluated for the extent to which they incorporate information literacy, there are no assurances of systematic teaching of critical thinking for Web-based learning. A reasonable approach may be to advocate for both: stand-alone courses to narrow the digital divide and across-the-curriculum efforts to teach information literacy in context.

References

Anderson, J. R. (1995). Cognitive psychology and its implications (4th ed.). New York: Freeman.

Gerstner, J. (1999, March). The other side of cyberspace: An interview with Manuel Castells, cyber-scientist. Communication World, 16(4), 11-43.

Greenberg, I., & Garber, L. (1999, August). Searching for new search technologies. Computer, 32(8), 4-7.

Marchionini, G. (1999, March-April). Education responsible citizens in the information society. Educational Technology, 39(2), 17-26.

National Telecommunications and Information Administration. (1999, July). Falling through the net: Defining the digital divide. Available at http://www.ntia.doc.gov/ntiahome/digitaldivide.

Rabinovitch, E. (1999, September). Searching the Internet (will be) easier. IEEE Communications Magazine, 37(9), p. 14.

Shapiro, J., & Hughes, S. (1996). Information literacy as a liberal art: Enlightenment proposals for a new curriculum. Educom Review, 31(2).(http://www.educom.edu/Web/pubs/review/reviewArticles/31231.html)

USING VIRTUAL REALITY IN TEACHING SECONDARY SCHOOL PHYSICS

Bruce Ma, Division of Language Studies, City University of Hong Kong, Hong Kong, bruce.ma@cityu.edu.hk

Peter Mak, STFA Tam Pak Yu College, Hong Kong, petermak@hkstar.com

Abstract

The use of Virtual Reality (VR) in education has been depicted as an interesting and promising area where constructivist learning theory can be put into practice. This paper describes a work-in-progress project attempting to take advantage of the current VR technology for constructivist learning practices in the teaching of secondary school Physics.

The project involves the creation of 3D VR environments for use on the World Wide Web where learners are exposed to virtual physical environments. These environments incorporate rich and meaningful physical phenomena and relationships so that learners can navigate and explore freely, view from different perspectives and visualize the various physical concepts and relationships which otherwise can be difficult to visualize using traditional teaching material in the form of texts and graphics.

This paper also discusses the initial reactions from learners as well as colleagues teaching on the subject.

Introduction

The central tenet of Constructivism is that knowledge of the world is constructed by the learner (Boyle 1997). Constructivism proposes that courseware should be designed in such a way to provide an environment conducive to the construction of knowledge by the individual, rather than supplying knowledge directly. Constructivism also emphasizes collaborative learning and personal introspection into one's learning process (Brooks & Brooks 1993, 1996). It has been viewed by many (e.g., Moore 1995; Osberg 1997) that virtual reality (VR) offers promising grounds for creating and developing learning environments that promotes constructivist learning.

VR refers to computer-generated 3-D interactive environments in which the learner is an active participant (Bricken 1991; Bricken & Byrne 1992). The learners interact with and act directly upon the virtual environment and influences the variables in the environment (Moore 1995). Although some comment that the VR technology is still in a relatively rudimentary stage of development, it is our opinion that what is currently available can already be applied in teaching.

In secondary school Physics where many topics to be studied, for example, those in Mechanics, involve cognitive visualization of distance, direction, inclination and speed and intricate relationships between these elements, it is our belief that VR can play an effective role in creating 3-dimensional virtual environments that promotes learning.

Rationale

The traditional Physics class is predominantly filled with experiments with which students observe physical phenomena, record data, analyse data and the relationships they exhibit in order to verify established or current theories. While doing experiments promotes the principles of the Scientific Method, the drawback of conventional classroom experiments is that it is difficult to allow learners to design their own learning curve. In fact, under the constraints of the physical settings of a school laboratory and the apparent authority of teacher instructions, learners typically pursue in their experimental work outcomes that are expected of the experiment, either by the teacher or by the textbook. The individual differences in learners are rarely addressed and individuals rarely have the opportunity to develop unique ways of experimentation.

Moreover, the typical secondary school physics laboratory is simply not sophisticated enough to meet many learning needs. Observation and visualisation of complicated physical phenomena is a virtual impossibility. The collision of gas particles in the micro world, the circular motions of celestial bodies in the macro world, perfectly elastic collisions, frictionless environments are some typical examples.

To teach concepts and theories related to these physical phenomena, teachers often depend on 2-dimensional chalk and board or textbook-based descriptions and explanations. To learn them, students have to rely on their own creative imagination to construct in their mind a 3-dimensional space. Blackboard descriptions, and by the same token textbook descriptions, only allow the learner to view phenomena from a single rather than multiple perspectives. The use of static images to teach ideas involving motion is an understandably difficult task. What learners have constructed in their imaginary 3-dimensional world can differ tremendously from one another, and can deviate phenomenally from what the teacher is attempting to describe. This typical scenario presents great barriers in learning and makes in-depth classroom discussion and further exploration very difficult.

This project attempts to break through this barrier by constructing an interactive web-based VR environment in the secondary school Physics teaching classroom. This environment is created with a PC-based 3D virtual reality technology. In the initial stage of this project, the following areas targeted at Form 4 secondary school students have been selected:

1. Relative Motion: Ships in the Sea ; Sun Rise; Rotation of Planets
2. Pressure and Collision of Particles
3. Gas Pressure against Gravity
4. Periodic Motion: Simple Pendulum; Pendulum of 2; Pendulum of 5

Building and using the VR

To build the interactive environment, which we call *3D Physics World*, the following software has been used:

- Superscape 3D Webmaster (Evaluation version)
- Microsoft Frontpage

3D Webmaster allows users to create virtual reality environments called Worlds. In its *Drag and Drop Warehouse*, different 3D models including buildings, cars, plants and animals are available. Users can create their own models or modify from ones available. Most of the models used in this project were created by modifying the primitive objects in the *Drag and Drop Warehouse* using the *Shape Editor* provided. By assigning these objects in different initial positions and setting different initial velocities for them, a VR simulation was thus created.

Learners when working in this virtual world can observe the physical phenomena from any perspective and any frame of reference. The navigational controls provided by 3D Webmaster are intuitive enough for secondary school learners to grasp with ease in a couple of minutes. Once feeling comfortable with the navigational tools, the learner can view the physical phenomena from a perspective of his own choice. He can then initiate movements of objects by dragging and dropping and observe the motion created in different settings. He can also pause all motions to observe more closely for as long as he likes, or return to the initial settings at his discretion to start all over again. This kind of experience is not what traditional 2-dimentsional texts and graphics alone can produce.

Initial Observation and Feedback

The material developed in this project was used with a group of Form 4 students in the 1998-1999 academic year. Students seemed to be greatly impressed with the possibility of being able to control and explore with objects in a VR environment. There was an obvious surge in interest in the subject and in the motivation to learn. Many were excited by the hands-on experience and expressed the opinion that it was fun to learn compared with a situation where only the textbook and blackboard would be used. Peer discussion and share of experience among learners was also seen to increase as excitement about the different observations mounted.

Colleagues teaching on the subject also expressed positive comments after trying to use *3D Physics World* in class. They felt that the lesson was conducted with less teacher talk and resulted in better understanding of the subject being taught. Some commented on the need to design follow-up activities to go with the Web material in order to maximise learning.

Conclusion

It is believed that this project represents initial attempts by front-line secondary school teachers taking advantage of the available VR technology in teaching. It is hoped that the project could be further developed in the following lines:

- Extension to other topics
- Post-VR activities

More structured research can be carried out to study learner reaction, and learning outcomes as compared with the more traditional chalk and board approach. It is our hope that teachers teaching on the same topics will attempt to use *3D Physics World* posted on the World Wide Web (http://i.am/3dphysicsworld/) and give us their comments and suggestions for improvement.

References

Boyle, T. (1997). *Design for Multimedia Learning.* London: Prentice-Hall.

Bricken, M. (1991) Virtual reality learning environments: potential and challenges. *Computer Graphics,* (25)3, 178-84.

Bricken, M. and Byrne, C. (1992). *Summer Students in Virtual Reality: A Pilot Study on Educational Applications of Virtual Reality Technology.* Seattle, WA: Human Interface Technology Laboratory at the University of Washington, Technical Publications R-92-1.

Brooks, J.G., Brooks, M.G., (1993). *In Search of Understanding: The Case for the Constructivist Classroom,* Alexandria, VA: ASCD.

Brooks, M.G., Brooks, J.G. (1996). *Creating the Constructivist Classroom.* Course materials from an ASCD workshop by the same title, New Orleans, LA, March 14-15, 1996.

Moore, P. (1995). Learning and teaching in virtual worlds: Implications of virtual reality for education. *Australian Journal of Educational Technology*, 11(2), 91-102. http://cleo.murdoch.edu.au/gen/aset/ajet/ajet11/su95p91.html

Osberg, K. (1997). Constructivism in practice: The case for meaning-making in the virtual world. Doctoral dissertation, University of Washington. http://www.hitl.washington.edu/publications/r-97-47/index.html

A Game-play Intranet-based Multimedia Teaching Support System for Information Systems Training

Hing-Yin Mak
Hong Kong Baptist University, Hong Kong. jhymak@comp.hkbu.edu.hk

Andrew P. Mallard
Brunel University, United Kingdom

Introduction

The analysis and design of information systems is not only based upon the understanding of an organisation's objectives, structure, and processes, but also on the knowledge of how to exploit information for advantage.

Whilst traditional teaching techniques can prepare our students with the required methodologies and techniques that they need to design and develop information systems, it is extremely difficult within the confines of a lecture room, to convey any 'real' sense of the business environments in which they will have to apply these theories. Our challenge therefore is to find an effective method of conveying to our students, with little or no business experience, the analytical techniques and interpersonal skills required to quickly understand the relevant structure, processes and dynamics of a business - in order for them to practice their problem solving skills and conduct a thorough systems analysis.

This paper describes current work-in-progress on a project to design and develop a game-play Intranet-based Multimedia Teaching Support System (IMTSS) for our information systems students. We will first describe the background of the project. Then briefly discuss the methodology used, including game-play and the active learning approach. Finally we will give an overview of the system and highlight our conclusions to date.

Background

The aim of the proposed system is to assist and enhance the 'Systems Analysis and Design' and 'Group Project' course modules, which are both core subjects of the second year Computing Studies Information Systems (CSIS) Degree course in the Department of Computer Science at the Hong Kong Baptist University.

In the past the CSIS degree course was structured as a two-phase five year course, consisting of two years full time and three years part-time study, the latter including three years part-time industrial experience. However as a result of the re-structuring of our CSIS course in 1995 to a three year full-time study program, many of our students no longer have any direct IS related work experience. This problem has been further compounded by the scarcity of summer jobs resulting from the Asian financial crisis.

Over the last few years, our department has conducted a series of feedback exercises such as informal surveys, teaching evaluations and student-staff consultation meetings. These have revealed that whilst our students believe that the IS concepts and methodologies taught are very useful, they have found many of the ideas rather abstract. They have therefore requested more relevant examples to explain these concepts. However as most text books originate from North America or Europe, the case studies used are often not very relevant to Hong Kong. In addition our teaching staff have indicated that our final year project students not only need to improve their analytical interviewing techniques, but somehow also need to build their confidence at interacting with business users.

Therefore the objective of our IMTSS project has been to :

- provide a framework based on a game play approach, to help students develop analytical and problem solving skills through active learning
- make use of multimedia and internet technology to help provide students with a virtual organisational environment in which they can conduct their systems analysis
- incorporate the above into the design and development of an on-line bilingual multimedia teaching support system

Methodology

With these objectives in mind, we chose to adopt a combined active learning and game-play approach in the hope that students could develop analytical and problem solving skills through active learning, whilst stimulating and increasing their interests in the subject through the game-play approach.

This is based upon much historical research showing that playing games can be highly motivational and enhance learning through visualisation, experimentation, and creativity of play (Thomas and Macredie 1994, Betz 1995-96, Amory et al. 1998). Other research has shown that students learn more when they are actively engaged in their own learning, which leads to an increased ability to think critically and to solve problems. Furthermore this active learning approach helps students to learn content and process at the same time (Booth 1980, Page 1990, Marlowe and Page 1998).

Our justification for utilising multimedia technology in the form of streamed video, is that research has also demonstrated that users playing simulation games performed significantly better with highly graphical feedback, than when the simulation provided only textual feedback (Rieber 1996).

The IMTSS System

For this project, we have initially chosen a number of distinct case studies from various Hong Kong business sectors. For each of these cases our research team have conducted a series of interviews, in order to collate relevant material from the chosen end-users. This material has then been analysed, in order to create the business case structure and scripts for the multimedia teaching support system. These have then been translated into corresponding English and Cantonese scripts.

Each case study is comprised of a series of interactive multimedia elements, most of which are video clips. These video clips were either taken of business people on their own premises, or conducted by student actors at the University. These elements include explanations of the organisations background, current work environment, business processes, and interviews with relevant staff. Once the system content has been acquired and edited, it is stored into a client-server database. The overall system framework makes use of an intranet web server to control the interaction between the user and the multimedia elements held in the content database. We have conducted much research into the investigation of optimal video delivery methods, including clip duration, file size and effective delivery rates.

For each case study, the student is provided with an introductory video describing the relevant business environment, followed by an introductory interview from the case study sponsor. This introduces them to the various staff that are available for interviewing. They are then presented with a variety of options to navigate their way through the whole series of interviews. For each interview a series of questions may be asked, and each of these are tagged as good, neutral or bad. If the student chooses a good question then they are rewarded with a complimentary video clip and given some useful information. However should they choose a bad question then they may be confronted with a bored, sarcastic or annoyed response. In this way the students are able to navigate their way through the various interviews, collecting various pieces of useful information, and identifying the users requirements. If they run into problems they are able to return to the sponsor to get some additional hints, although this will decrease their overall score. The progress of each student is monitored throughout by the web server.

The proposed framework allows for the number of interviews per case study, and their relevant importance to be weighted individually. It is also designed to be both flexible and scalable, in order to allow additional business cases or alternative languages i.e. Mandarin Chinese, to be added over time. Furthermore this flexibility also allows for existing multimedia elements, that have been identified as causing confusion for students, to be easily updated or replaced.

Conclusions and Discussion

Although research is still ongoing, results so far from our prototype version of IMTSS have been extremely encouraging, and have clearly indicated that the system can provide our IS students with a stimulating and valuable means of bridging the gap between the theory learnt in the classroom, and practice in the business environment. Furthermore, the use of IMTSS also appears to help our students gain confidence to interact with end-users, which in turn should improve their final year honours projects, as well as better prepare them for their careers.

In addition we hope to demonstrate the potential benefits of this type of flexible framework to complement traditional teaching methods. Where students can study at their own pace, and in the language of their choice, free from the normal time and geographic constraints of lectures. Also we are currently investigating ways in which the system can be further improved to better monitor the students progress and absorption of study material, as well as highlight problem study areas.

Finally, we believe that the framework and methodology used in this system could also be adopted by other faculties such as Business, Management, Accounting etc. whose students also need to develop analytical skills for certain sections of their courses.

References

Amory, A., Naicker, K., Vincent, J. & Adams, C. (1998). Computer Games as a Learning Resource. *Proceeding ED-MEDIA'98*, Association for the Advancement of Computing in Education, Freiburg, Germany. 50-55.

Betz, J.A. (1995-96). Computer games: increase learning in an interactive multidisciplinary environment. *Journal of Educational Technology Systems*, 24 (2).

Booth, M. (1980). A modern world history course and the thinking of adolescent pupils. *Education Review*, 32, 245-257.

Marlowe, B.A. and Page, M.L. (1998). *Creating and sustaining the Constructivist Classroom*. Thousand Oaks, Calif. : Corwin Press.

Page, M. (1992). *Active learning: Historical and contemporary perspectives.* Unpublished manuscript, University of Massachusetts-Amherst. (ERIC Document Reproduction Service No. ED 338389).

[Rieber 1996] Rieber, L.P. (1996) *Animation as feedback in a computer-based simulation: representation matters*. Educational Technology Research and Development, Volume 44, Number 1.

Thomas, P. & Macredie, R. (1994). Games and the design of human-computer interfaces. *Educational Technology* 31, 134-142.

Multimedia Performance Based Language Assessment: The Computerized Oral Proficiency Instrument (COPI)

Valerie Malabonga
Foreign Language Education and Testing Division
Center for Applied Linguistics, Washington, DC, USA
valerie@cal.org

Dorry M. Kenyon
Foreign Language Education and Testing Division
Center for Applied Linguistics, Washington, DC, USA
dorry@cal.org

Introduction

The Computerized Oral Proficiency Instrument (COPI), is a multi-media, computer-administered oral proficiency test that is an adaptation of the tape-mediated Simulated Oral Proficiency Interview (SOPI) (Stansfield & Kenyon, 1992). The COPI uses simulated real life tasks to elicit speech samples and is rated according to the Speaking Proficiency Guidelines of the American Council on the Teaching of Foreign Languages (ACTFL) (ACTFL, 1999). The COPI has two parts: a self-administration program for examinees and a rating program for human raters.

Self-Administration Program

Steps in Taking the COPI

After being welcomed and introduced to the program, examinees perform the following: enter and check personal information, complete a self-assessment of their proficiency level, listen to an adequate response to a sample task, practice with the same sample task, respond to performance tasks (the actual test), and receive feedback about the levels of their tasks. While taking the test, examinees hear test directions with accompanying text and pictures in English and/or in the target language (depending on the proficiency level of the task) and record their responses. Depending on the choices that examinees make, they respond to 7-11 test items and take anywhere from 30-50 minutes to complete the test.

Examinee Control

The main goal of the COPI's self-administration program is to use the advantages of computer technology to provide examinees more control over the testing situation. Our assumption is that more test control will lead to anxiety reduction and ultimately improve test performance. Examinee control is achieved by giving them choices in the following: amount of preparation and response time, speaking function, topic, level of difficulty, and language of directions. The large pool of tasks (over 100 per language) is also very important in ensuring that examinees can make these choices.

Examinee Choice

The COPI provides more preparation and response time for higher- than lower- level tasks, but examinees still have the choice to use up all the time allotted or take less time. Also, after completing a task, they are given a choice of three new tasks, and an algorithm ensures that they get each speaking function and topic only once. Likewise, the examinees' self-assessment scores and the choices of levels during the practice task determine the level of difficulty for the first task. However, after the first task, the program alternates between giving examinees a choice of difficulty level or not. During the times that examinees are not given a choice, the algorithm pushes them to higher level tasks to ensure that they are given an opportunity to reach their performance ceilings. Lastly, lower-level speakers are provided with both English and target language directions whereas higher-level speakers are given a choice of getting the directions in English or just the target language.

Rating Program

The main goal of the rating program is to increase raters' efficiency, i.e., help them rate as quickly but as accurately as possible. The rating program does this by allowing raters to quickly access the examinees' audio, navigate quickly from one task to another, and listen to the tasks in any order. Also, as raters assess each task, elements of the task, such as its proficiency level, the picture accompanying the task, directions, and the native speaker prompt appear on the screen. These elements give raters background information about the task and facilitate the rating process. The program likewise allows raters to write notes to examinees so that, aside from providing a global rating, raters can give task-specific and overall feedback to the examinees. In addition, the raters can write notes to themselves about the examinees' responses and can go back to these notes when determining the task rating. Lastly, an algorithm calculates the global rating for each examinee.

Technical and Programming Requirements and Specifications

The COPI program works well with computers that have a Windows 95 operating system or higher, a Pentium processor and 64 MB of RAM and a soundcard. The examinees' responses can be recorded on internal or external zip drives, or the hard drive. We do not recommend the use of Windows NT or laptop computers because the small memory space in these computers makes recording difficult. The program was developed using Authorware 4.0. The directions in Arabic script were gif files inserted in the text box.

Future Directions

We just completed a study comparing student and rater performance and affect on the COPI versus the face-to-face interview or Oral Proficiency Interview (OPI), and the COPI versus the tape-mediated or Simulated Oral Proficiency Interview (SOPI). The results of this study will show us if the COPI is a viable option to the Oral Proficiency Interview (OPI), which can be too expensive or inconvenient; and if the COPI is a significant improvement over other technology-based oral proficiency tests such as the SOPI.

References

American Council on the Teaching of Foreign Languages. (1999). *ACTFL proficiency guidelines-speaking: Revised 1999.* Hastings-on -Hudson, NY: Author.

Stansfield, C.W. & Kenyon, D.M. (1992). Research on comparability of the oral proficiency interview and the simulated oral proficiency interview. *System,* 20, 347-364.

Acknowledgements

Support for the COPI was provided by a grant from the U.S. Department of Education.

DIVIDED ATTENTION IN MULTIMEDIA LEARNING

Bruce Mann
Memorial University Of Newfoundland, Canada
and
Paul Newhouse, Jeremy Pagram & Alistair Campbell
Edith Cowan University, Western Australia

The subjects in this research were Year Seven (12 year old) students (n= 42) from two primary schools in Western Australia. Our prediction was that temporal speech cueing would better enable school-age students to focus their attention than those in the temporal text cueing group. Small sample sizes are not uncommon in experimental multimedia research (Austin, 1994; Bridgman, 1990; Carroll & Mack, 1987; Shell, 1990). Year seven students were chosen for the study because this is the final year of primary school and thus the results from the study were more likely to be relevant for both primary and secondary students. In addition, primary school students were more suitable because the primary school curriculum is more thematic and flexible readily allowing the addition of content and a variety of teaching situations.

Materials

The "Engines" computer program was developed as a sequential hypermedia learning environment to provide learners with a linear path through a set of related nodes, as suggested in previous studies (Mann, 1993; 1995a; 1997a). Mann's (1996) procedure for adding sound prompts to hypermedia learning environments was used for the "Engines" program. "Temporal speech cueing" was operationalized as information about future or past events digitized in enthusiastic female speech prompts. Also, future or past event speech or text was implemented to elicit student writing in the Workbook. Further, the Engines program utilized Mayer's (1992) "description of phenomena" instructional approach, wherein a scientific explanation exists when a scientist observes events and describes them. In this study, the student-scientists read or listened to information, observed animated graphics and movies, and described their observations in a workbook. Both versions of the software, test, workbook and questionnaire were trialled with Year Seven students. The software, test, workbook and questionnaire were modified based on their comments. Two versions of a simple tutorial program introducing "Insects" was developed to be used as practice for the "Engines" treatment.

Design of the Study

This study employed a repeated measures quasi-experimental design with two treatment conditions, temporal speech cueing and temporal text cueing. Students were randomly assigned to one of the two treatment conditions based on their gender, reading ability as determined by their teachers' long-term observations, perceived modality preference on the auditory-visual-tactile/kinesthetic learning style inventory (Murphy-Judy, 1998), and students' attitudes toward using computers as determined by the Computer Attitudes Scale (Loyd and Gressard, 1994).

Procedure

The procedure in this study followed those suggested in previous studies of this kind (Knussen, Tanner, & Kibby, 1991; Mann, 1997a). A number of activities were done simultaneously and the final schedule was established at the mutual convenience of the participants and the investigator. First, the consent of teacher, principal, and parents were acquired. Next, over the course of a week of classtime, a reading test, computer attitude survey, modality inventory were administered. Later that week the computers were installed and checked (19/5/99). A week later the pre-test (26/5/99) was administered by teacher. The two treatment groups were created by the researchers based on students perceived modality preference, gender, reading ability, and attitude toward using computers.

Three weeks after the pretest was administered, the treatment and posttest were given. Each class was done separately as was each treatment group. The main intervention was conducted by two of the researchers using the 13 computers in the room set-up between the two classrooms. The entire process lasted just under 40 minutes and comprised the following steps. On the day of the treatment, subjects received information, training and practice on the "Insects" program. The main intervention involved the students in using the "Engines" program. Subjects were instructed to proceed through the program while following the instructions and writing their answers in their Workbooks. The post-test was then completed after they had quit the "Engines" program. Finally some free time to use the KidPix graphics package. No instruction or feedback was presented by the investigators at this time. Notes of the proceedings were maintained.

Results and Discussion

A repeated measures ANCOVA calculated on the data using the pretest as a covariate. Results of the analyses showed that statistical differences between auditory and visual groups were not significant. A correlation matrix showed low positive correlations throughout all the scales, with none significant. The dribble files showing efficiency with the program were also not significant. The consensus among the investigators however, was that the auditory group appeared to be more focused on the critical information presented in the computer program than the visual group. During temporal speech cueing, the room fell to silence with all eyes focused on their screens. We speculated that the students in this group were more involved, because they were listening to the instructions and directions coming through their headphones. During temporal text cueing however, the students were restless in their chairs, frequently looking around the room; the investigators having to remind them not to talk to their neighbour and to keep their eyes on their own computers and workbooks.

Conclusion

We think that the significance of this study resides in our discovery that temporal speech cueing in educational multimedia is only necessary, and therefore need only be employed on difficult, divided-attention tasks. Unlike previous research, our results appear to have been a consequence of tasks that were too easy or too familiar for these students. You'll recall that on easy tasks with familiar items, people use automatic processing which occurs in parallel; that is, we can process two or more different inputs simultaneously. Apparently, students in the present study implemented pre-attentive processing to work on easy tasks or highly familiar items presented in the "Engines" program. We think that our conclusion is a significant finding in itself, providing a new proviso into educational media research, which previously reported that the presence of speech could improve multimedia learning. A follow-up study has been planned at a different campus of the same school. Based on the findings of the present study, the Engines multimedia program will be revised to require serial processing from this same population of students.

References

Baddaley, A. (1992). Working memory. Science, 255, 556-559, January.

Mann, B. (1997a). Evaluation of three variations of a hypermedia system. Computers and Education: An International Journal. 28(2) 133-147.

Mann, B. (1995a). Focusing attention with temporal sound. Journal of Research on Computing in Education. 27(4), 402-424.

Mann, B. (1993). Effects of temporal sound on computer-based learning. Doctoral Dissertation. University of Toronto.

Mann, B. (1997b). Shifting attention in multimedia: Stochastic roles, design principles and the SSF Model. Innovations in Education and Training International. 34(3), 174-187.

Mann, B. (1996). Catching the .wav: Adding sound to hypermedia learning environments. HyperNexus: Journal of Hypermedia and Multimedia Studies. 6(3/4), 18-21.

Mann, B. (1995b). Enhancing educational software with audio: Assigning structural and functional attributes from the SSF Model. British Journal of Educational Technology 26(1), 16-29.

Mann, B. (1992). The SSF model: Structuring the functions of the sound attribute. Canadian Journal of Educational Communication, 21(1), 45-65.

Mayer, R. (1992). Knowledge and thought: Mental models that support scientific reasoning. In R. Duschl & R. Hamilton (Eds.)., Philosophy of science , cognitive psychology and educational theory and practice (pp. 226-243), Albany, NY: SUNY Press.

Mayer, R. (1997). Multimedia learning: Are we asking the right questions? Educational Psychologist, 32(1), 1-19.

Mayer, R., & Mareno, R. (1998). A split attention effect in multimedia learning: Evidence for dual processing systems in working memory. Journal of Educational Psychology 90(2), 312-320.

Mousavi, S., Low, R. & and Sweller, J. (1995). Reducing cognitive load by mixing auditory and visual presentations modes. Journal of Educational Psychology 87, 319-334.

Murphy-Judy, K. (1998). The Auditory-Visual-Tactile/Kinesthetic Learning Style Inventory. Foreign Language Department at VA: Virginia Commonwealth University.

Penney, C. (1989). Modality effects and the structure of short term verbal memory. Memory and Cognition, 17(4), 398-422.

PHASE THEORY: A TELEOLOGICAL TAXONOMY OF WEB COURSE MANAGEMENT FOR DISTANCE EDUCATION

Bruce Mann
Memorial University of Newfoundland, Canada

Theories are meant to explain something or to help us understand the way things are within a certain domain (Wilson, 1997). Phase theory is intended to help educators understand the way things are for using Web course management systems. A Web course management system is a set of software tools, customarily grouped together under a course name and protected by a password, and considered a system; a Web course management system (WCMS). Some examples of popular WCMS's include *LearningSpace* (Lotus Corporation, 1998), *Virtual-U* (Harasim & Calvert, 1997), *TopClass* (WBT Systems, 1997), and *WebCT* (Goldberg, 1997), to name a few. Central to phase theory is the view that that instructors learn to adapt their instruction to a Web course management system in phases, namely: Lesson Enhancement, followed by Resource-Based Teaching and Learning, then Online Learning Environments.

Lesson Enhancement

Lesson enhancement is the initial phase of Web course management and is often introduced to students as an extracurricular activity. Usually with help from the resident technologist, the educator will decide to introduce the Internet or Web-supported material as extra-curricular activities to enhance the curriculum. Three types of lesson enhancement are classified for this phase, as follows: 1) immersive collaborative environment; 2) online self-expression; 3) online lesson assessment.

Resource-Based Teaching

Resource-based teaching is the second phase of Web course management. "Resources" can be of any form, namely: text, pictures, video clips; and of any knowledge-type-declarative, procedural and/or strategic knowledge for subsequent retrieval by students. The mindset for resource-based teaching is similar to that of storing and retrieving materials in a media repository or school library. I have counted as many as fifteen types of RBTL using a Web course management system and operated directly by instructors themselves, namely: 1) to provide content (i.e., online notes, online reader, or an online resource pack); 2) to support a learning activity (i.e., online manual, online lab guide, a seminar guide, a fieldwork guide; online projects facts guide, or an online work placement guide); 3) to support a learning process (i.e., online skills guide, skills profile, or an online student log); or, 4) to build on other resources (i.e., online textbook study guide, online readings guide, or an online lesson outline). These types are reminiscent of the conventional resource-based learning categories described in Parsons and Gibbs' (1994) "Developing Teaching" series published by Oxford Brookes University Press. Resource-based teaching may require a re-definition of pedagogical goals, restructuring of curricular offerings, provision for educator training and support material, and sufficient online tools for the collection of student data. Terms like "stockpiling", "massing", "stacking", "accessing", "accumulating" might well" define the linguistic framework of the resource-based teaching phase.

Online Learning Environment

An "online learning environment" is the third phase of Web course management that demonstrates the application of cognitive psychology to education. A learning environment is a place where learners work together and support one another as they use a variety of tools and information resources in their pursuit of learning goals and problem solving activities (Wilson, 1997). The focus is on meaningful learning that is active and involves the students in learning by discovery. Five components comprise the learning environment, adapted from Perkins (1991), namely: 1) information banks; 2) symbols pads; 3) construction kits; 4) phenomenaria; 5) online microworlds, and; 6) virtual environments.

Conclusion

Phase theory can assist practitioners in the determination of their own inventions with Web tools based on the their intuition, personal preferences and prior educational experiences with Web course tools (Mann, 1998b). And as a descriptive taxonomy (Reigeluth, 1997), phase theory may be applied as a descriptive theory of professional development in Web course management. One future direction would be to implement phase theory as an instructional strategy to train a different sample from the same population of novice Web managers. See Mann (2000; 1999a; 1999b; 1999c; 1998b; 1998e) for further discussion on the first principles and underlying assumptions of phase theory.

References

ECT Inc (1997). *eWeb*. Salem, Oregon: Education Communication Technologies, Inc. http://www.ewebsite.com/default.html

Goldberg, M. (1997). Communication and Collaboration Tools in WebCT. Proceedings of the *Conference Enabling Network-Based Learning,* Espoo, Finland. May 28 - 30. [Online at http://homebrew.cs.ubc.ca/Webct/docs].

Harasim, L., & Calvert, T. (1997). *Virtual-U.* Vancouver, Canada: Simon Fraser University. [Available online at: http://virtual-u.cs.sfu.ca/vuweb/VUenglish/index.html].

Lotus Corporation. (1998). *Lotus Learning Space*. The Lotus Corporation. [Available online at http://www.lotus.com/home.nsf/tabs/learnspace].

Mann, B. (2000). Phase Theory: A Teleological Taxonomy of Web Course Management. In B. L. Mann (Ed.). Perspectives in Web Course Management. Toronto, ON: Canadian Scholar's Press.

Mann, B. (1999a). Web course Management in Higher Education. Bulletin of The Canadian Society for the Study of Higher Education.

Mann, B. (1999b). Web course management. Australian Educational Computing 14(1).

Mann, B. (1999c). Teaching online: The phases of a web-supported education. The Twenty-Seventh Conference of the Canadian Society for the Study of Education. St. Jean, Quebec: Universite de Sherbrooke. June 9-12, 1999.

Mann, B. (1998a). Instructional design for online learning: A case study of WebCT developers. Universities in a Digital Era: Transformation, Innovation and Tradition. Proceedings of the Seventh Annual EDEN Conference University of Bologna, Italy, June 26.

Mann, B. (1997). Shifting attention in multimedia: Stochastic roles, design principles and the SSF Model. Innovations in Education and Training International 34(3), 174-187.

Mann, B. (1998b). Motor learning, metacognition and teacher competencies: Critical competitors in educational technology. The Morning Watch: Educational and Social Analysis, 25, 3-4.

Mann, B. (1998e). Working through phases: Instructional design in WebCT. Paper presented to The School of Communications and Multimedia, Edith Cowan University, Perth, Australia. November 2.

Parsons, C., & Gibbs, G. (1994). *Lesson design for resource based learning.* Oxford, UK: Oxford Brookes University Press.

Perkins, D. (1991). What constructivism demands of the learner. *Educational Technology 9*, 19-21.

WBT Systems. (1997) *Top Class.* WBT systems. [Available online at http://www.wbtsystems.com/index.html].

Wilson, B. (1997). Thoughts on theory in Educational Technology. *Educational Technology.* Jan/Feb.

Reconfiguring the Academic Library for the New World of Learning

James W. Marcum, Library, College of Staten Island, CUNY
Marcum@postbox.csi.cuny.edu

Abstract: Knowledge modeling, knowledge-based systems, and other technology-based learning support systems utilized in business training can help the academic library meet the challenges of refocusing attention from instruction to learning.

While today's academic library is undergoing major changes in structure and purpose, it remains fixed within a model of education that steadily becomes less relevant, the model of instruction and information processing and transfer. As attention shifts to what the student actually learns (Katz, 1999), we must rethink and reconfigure the library in order to preserve and enhance its role in higher education.

The new learning is influenced by the ideas of multiple intelligences, learning styles, and the psychology of individual differences. A generation of work in the cognitive sciences has demonstrated that the mind actively engages in the creation of an individual's "reality" (Ackerman, 1999). Yet many in academe are not yet cognizant of how individual learning profiles, group versus individual learning preferences, personality and trait factors, self-monitored learning, better understanding of informal learning, and the conscious development of learning strategies require new behaviors and new policies. We must rethink and reconfigure the library to support the emerging culture of learning. One option is to create a new environment where learning-support teams (including subject specialists, information specialists, technical support, and instruction designers collaborating with expertise in personality and intelligence testing) maximize the possibilities of the new learning.

Useful models for emulation are available from business and management training, including knowledge modeling, knowledge-based systems, and other "learning strategies." For instance, "knowledge modeling" stresses the role of the "transactional mind," the central role (generally left to chance) of other influences upon the learner including peer interaction, self-directed inquiry, and the context the learner carries with them. Much more is going on in academia beyond the instructor-guided model that relies on lectures and defined readings (Greene, 1993, pp. 513-553). There are other approaches to the knowledge-modeling concept, running at very different levels of complexity, from the arcane world of artificial intelligence to a basic level, where knowledge modeling can be utilized to construct clear, manageable, and measurable knowledge structures detailing:

- the critical role of prior knowledge and context
- the differences between definitions, descriptions, and comparisons
- the nature of steady states
- cognition, classification, and categorization
- the role of time in the organizing of simple events
- steps, classes, and conditions of processes
- knowledge acquisition through accumulation, tuning, and restructuring
- using knowledge models as a basis for assessing student learning and knowledge (Mosenthal and Kirsch, 1991-1992).

Other approaches include knowledge-based systems. These systems can assist human operators, support decision-making, generate, critique, and evaluate knowledge structures, and monitor implementation. Such systems can address many of the problems we face today, including the need for individualized instructional methods to deliver material and dynamically model student comprehension (Hayes-Roth and Jacobstein, 1994). Indeed, we must ask whether the learning process-focused world of business training enjoys significant strategic advantage over the professor-centered world of academe.

All of these methodologies amount to the early development of "learning support systems," an approach that stresses the process of learning, not the mastery of traditional, discipline-bound information content. Utilized in business training, learning-support systems rely on mentors and facilitators to help learners understand their personal learning styles, consider performance standards, and test against competency measures (Davis and Davis, 1998). A case study drawn from a software learning project indicates that a variety of "lesson" formats, the provision for experimentation and encouragement of mentoring are means of bolstering and supporting the learning process (Harp, 1997). Clearly, comprehensive strategies for setting criteria, measuring prior knowledge, identifying learning traits, and tracking the accretion of knowledge and the impact of learning can be realistically pursued, particularly considering the software available today.

The potential of learning-support systems contains exhilarating implications for academic libraries. Learning is not something that is limited to the classroom; that's just where information and rules are transferred and learning challenges issued. Emergent learning occurs in groups, in study rooms, in laboratories, in individual study, and in dialogue (both face-to-face and electronic). To date, academic librarians have given little thought to the learning process. Traditional library evaluation focuses on materials, access, and the usage of materials and services. Only recently has concern about the impact of instruction and consultation become matters for measurement and evaluation. One prescription for this work calls for cultivation of "active learning," that is, crystallizing our goals, studying the impact of information technology on learning, and studying how students actually learn. The key is providing context, and problem solving is one good approach to that end. Academic librarians can and should adopt the goal of becoming the locus and advocate of technology-based learning and teaching on the campus. (Wilkinson, pp. 181-196).

What does all this demand of the library? First of all it requires thinking beyond the "digital library" to embrace a range of patron behaviors -- such a group learning and team development – as well as more comprehensive utilization of continuous media. New organizational structures are needed to utilize the more varied professional skills demanded by this complex learning environment. Other requirements include greater learner access to the Internet (via ubiquitous data outlets), more powerful networked servers for video storage and on-demand delivery, experimentation with thin-client and wireless configurations, and widespread use of "output" devices (such as CD-ROM/DVD printers), together with a variety of group study spaces, computer labs, and support for group inquiry by means of "collaborative portal" technologies. All this places enormous new expectations on an already overburdened institution. The challenge and the opportunity are there if we will but seize them.

References

Ackerman, P.L., et al. (1999). *Learning and Individual Differences: Process, Trait, and Content Determinants.* Washington: American Psychological Association.

Davis, J.R. & Davis, A.B. (1998). *Effective Training Strategies: A Comprehensive Guide to Maximizing Learning in Organizations.* San Francisco: Berrett-Koehler.

Greene, R.T. (1993). *Global Quality.* Milwaukee: ASQC Quality Press.

Harp, C , et al. (1997). Many Paths to Learning Software. *Training and Development,* 51 (5), 81-84.

Hayes-Roth, F. & Jacobstein, N. (1994). The State of Knowledge-Based Systems. *Communications of the ACM*, 37 (3), 27-42.

Katz, R.M. et al. (1999). *Dancing With the Devil: Information Technology and the New Competition in Higher Education.* Educause. San Francisco: Jossey-Bass.

Mosenthal, P.B., & Kirsch, I.S. (1991-1992). Knowledge Modeling. *Journal of Reading.* 35 (1), 58-61; (2), 156-160; (3), 250-155; (4), 332-338; (5), 408-415; (6), 490-497, (7); 588-596; (8), 668-678.

Wilkinson, J. (1997). Homesteading on the Electronic Frontier: Technology, Libraries, and Learning. In L. Dowler (Ed.), *Gateways to Knowledge: The Role of Academic Libraries in Teaching, Learning, and Research.* Cambridge, MA: MIT Press.

The Inadvertent Branding of a University Web-based Application

Kevin R. McClain
University of Virginia
ITC Applications and Data Services
P.O. Box 400198
Charlottesville, VA 22904-4198
krmcclain@virginia.edu

Abstract: In the Summer of 1999, a population of University of Virginia faculty completed a survey regarding a new interface for the Faculty Instructional Toolkit, a web-based application for the creation and management of course web sites. Results of the survey, and subsequent comments, produced interesting insights regarding the identity of the University of Virginia's Instructional Toolkit, the mindset of University of Virginia faculty, and inadvertent "branding" of web-based applications within the University context.

Background

In 1996 the University of Virginia developed a system called "The Faculty Instructional Toolkit." The Faculty Instructional Toolkit (Toolkit) is a Web-based (http://toolkit.virginia.edu) application that allows instructors at the University of Virginia to easily create and manage class home pages -- selectively use electronic features such as class e-mail lists, class rolls, anonymous course feedback, student homework submission, and final grade submission.

While the Instructional Toolkit system does enable University of Virginia faculty to quickly and easily create course web sites, faculty have an inability to modify the appearance of course web sites. Basic Toolkit navigation is included on all the class sites the system creates. The Toolkit's name and icon identify the system to students.

The interface of the University of Virginia's Instructional Toolkit had changed little since 1996. Toolkit support staff, through interaction with faculty and students over various issues regarding the increase in user options, had come to the conclusion that navigational issues could be addressed with an interface update. In the spring of 1999, Toolkit management expressed interest in developing a more "modern-looking" Instructional Toolkit, in addition to several usability enhancements.

The Study

The original Toolkit interface contained an image of the Rotunda, the flagship building of the University of Virginia. In an attempt to better utilize the "toolkit" metaphor, an interface highlighting a laborer's toolbox and a "folksy" color scheme was developed. In addition, the toolkit metaphor was extended to the navigational choices. The use of different tools, plans used in building, supporting documentation all easily map to functions of the Toolkit system.

A prototype showcasing the interface changes was developed. Several ITC staff were polled informally and their response was favorable. In July of 1999, a portion of University of Virginia faculty with previous Toolkit experience were polled concerning their reaction to the new interface design.

Later, a second interface was developed which maintained the same basic layout as the first redesign, yet replaced the toolbox and related icons with images of the Rotunda. The Rotunda images spanned the life of the building - its conception, construction and current state. The original survey participants were then again polled.

Findings

The response concerning the initial redesign's laborer's toolbox were mixed. Only a little more than the majority of the survey participants agreed with the statement, "The new colors and icons reinforce the 'Toolkit' metaphor." In response to the question, "Which best describes your feeling regarding the new Toolkit colors and icons?" just as many participants selected "Very satisfied," as selected "Not quite satisfied."

The census of open-ended responses was that the interface, specifically the colors and icons, "doesn't seem as professional." Distress concerning the replacement of the image of the Rotunda, "that old favorite," as it was referred to by one individual, was expressed. Even though "University of Virginia," was clearly stated it was evident that some users felt that the laborer's toolbox did not sufficiently tie itself to the University. The icons made the "toolkit [part] bigger than the UVA part," according to one survey participant. One survey participant was very clear that the system now "looks 'canned'" and asked it if the system could be changed so that course web sites do not appear as if they've been made with "cookie cutters."

Individuals contributing to the second survey were much more comfortable with the second design. The overwhelming majority expressed satisfaction with the colors and images of the Rotunda. The design "looks classier and more like UVa," according to one individual. The images representing the life of the Rotunda reinforced the toolkit metaphor, according to some individuals, while others concluded that "toolkit" is a poor metaphor for the application and would prefer the ability to drop the label.

Conclusions

Pinpointing the source of faculty dissatisfaction with the toolkit interface designs is difficult. One conclusion is that branding inadvertently occurred when the toolkit metaphor was extended into the application's interface and navigation. According to WebMonkey, a web development resource, the goal of a brand is "to encourage consumers to feel a certain way about [a] product." A brand encourages association, but has little to do with usability.

Prior to the redesign, the Toolkit system utilized an image of the Rotunda, an icon that gave context to the application. An attempt to give the Instructional Toolkit its own identity caused faculty members to focus on their association with the system. Paula Petrik, a professor in the Department of History at the University of Maine, expressed discontentment with "'courseware in a box' products," finding them "unacceptable in terms of aesthetic design." Teaching is a personal activity and she wants her class sites to "reflect my sense of myself as teacher and scholar." Uva faculty members using the Toolkit have are unable to disassociate themselves with the Toolkit's icon, as it appears on every course web sites the system creates. An association with an application that fails to emphasize the context of its use, the University of Virginia, or the personality of the course web site's owner was one that most survey participants were not eager to make.

Maintaining the University of Virginia iconography allows users of the Instructional Toolkit to associate their work with the institution. However, the ability to personalize course sites, by choosing a color palette or incorporating their own icons into their course, would allow faculty to leverage their own identity with the identity of the application. Faculty would then be able to associate with the Instructional Toolkit because the application associates individuals with their own course web site.

References

Petrik, Paula. (1999, Oct 14). Re: Online courseware. Retrieved Oct., 1999 from the listserv: H-MMEDIA@h-net.msu.edu

WebMonkey. (no date). Glossary - Branding. [WWW document]. Available: http://hotwired.lycos.com/webmonkey/glossary/branding.html [1999, Oct 12]

The distance educator's tool box: An overview of technologies for on-line learning

Thomas Fox McManus, Ph.D.
Saginaw Valley State University
7400 Bay Rd.
University Center, MI 48710
Mcmanus@svsu.edu

Abstract: Every day new tools become available to creators of distance education. Keeping up with them is almost impossible. This article gives a very short overview of several of the new technologies that have become available to distance educators in recent years, and touches on their instructional implications. Tools mentioned include DHTML, XML, Flash, Coursewrap, NetMeeting, ColdFusion, ASP, and Generator.

Introduction

Increasingly educational institutions and organizations are looking to the Internet as a primary means of delivering instruction to learners. Up until a few years ago, instructional designers and course creators have been limited to HTML and CGI or PERL scripts to create their online instructional environments. Then content creation and delivery tools like MacroMedia Director Shockwave and RealVideo came on the scene, and allowed designers to improve their instructional environments by adding a bit of rich media and interactivity. But the bandwidth demands of these tools still made it difficult to have environments which went far beyond the clickable book stage.

Today, distance educators need to harness the power of a new generation of tools to meet the growing demand of the learners who have become accustomed to business and entertainment sites that are interactive, personalized, and easy to navigate. Some of these tools have been in use in e-commerce and business for a few years, while others have been developed solely for the distance education field. These new tools affect all aspects of distance education, from course creation and communication to interaction and record keeping. Each tool, or class of tools, has instructional implications of which designers need to be aware.

Page Creation Tools

Cascading Style Sheets (CSS) are design templates that are used to provide augmented control over presentation and layout of HTML elements, thus separating the way you design information from the actual HTML content. **DHTML** is any combination of Style Sheets, JavaScript, Layering, Positioning, and Page Division used to create movement on-screen or user interactivity. This means that you are able to create complex interactive animations that do not require that learners have a particular plug-in installed. The disadvantages include that DHTML does require the user to have one of the newer versions of their browser, 4.0 or later, limiting the usefulness in some educational environments with legacy systems.

XML lets you create your own tags that describe the content of your document rather than its presentation. For example, whereas the <H1> tag in HTML specifies text to be presented in a certain typeface and weight, an XML tag would explicitly identify the kind of information: <TESTITEM> tags might identify evaluation questions, <CORRECTANSWER> tags could describe feedback for correct answers. One example of XML use with instructional implications is the Mathematical Markup Language (MathML) which is used to display mathematical and scientific notation effectively.

MacroMedia Flash is used to create highly interactive animations with file sizes equivalent to the current image maps used on many sites. This tool allows the designer to finally break out of the clickable book design metaphor and present instruction in the most contextually appropriate fashion. The disadvantage is that it requires the learner to install the appropriate plug-in before they can access the instruction. Flash can also be used to create small accent animations, like rollover buttons with audio feedback, for use in more traditional web pages.

Communication & Collaboration

Coursewrap has become the generic term for software packages that help the distance educator put their instruction online, foster communication and collaboration, and to track student progress through the environment. Examples of this include WebCT, Blackboard.com, and PathWare. Each package has different strengths and weaknesses, far too many to go into in a short article. But anyone heavily involved in delivering instruction online is likely to use one.

Network Conferencing software, like **Microsoft NetMeeting**, is another communication and collaboration tool that has great instructional potential. NetMeeting allows for multiple learners to work together in a shared virtual space. Tools include chat, whiteboard, file sharing, and voice/video communication. This allows for everything you can do in a classroom except touch. The disadvantage is that bandwidth constraints can negatively impact sound and picture quality and can cause lag in the shared resources

Dynamic Web Pages and Databases

To get truly interactive web pages, ones that will get information from your learner and return an appropriate page, custom created from information in your database, you need to use server side software. There are a few of which distance educators should be aware. **Allaire ColdFusion** is a database-to-Web software that has become a very popular tool for businesses that need to get lots of data onto the Web quickly. **Active Server Pages (ASP)** are server-generated pages which can call other programs to do things like access databases, serve different pages to different browsers, almost anything that can be coded. **MacroMedia Generator** accesses Internet optimized databases like **Oracle8Ii,** which can organize any type of media file, to dynamically generate Flash animations and seamlessly return them to the learner's browser. These are complex and expensive tools, but by allowing an instructor to tie into the power and organization of large databases, they have tremendous potential in distance education. Some examples include randomly generated tests, with questions taken from a database of items, or instruction that is dynamically generated to meet an individual learner's needs. These needs might be determined by a customer preference tracking software like **MacroMedia LikeMinds**.

Conclusion

The potential of tools like these to enhance distance education learning environment is great. It is essential that educators do not fall behind in the effective use of new technologies. Not every new toy that comes along should be adopted. But if a tool can make a learner's experience better or an educator's job easier, it should be used, whether or not it was originally aimed for use in education.

For More Information

CNET Web Building - http://www.builder.com
WebDeveloper.com - http://www.webdeveloper.com/
WebMonkey - http://hotwired.lycos.com/webmonkey/index.html
World Wide Web Consortium - http://www.w3.org

Developing New Roles for University Teachers: Grass-roots Local Staff Development Serviced by Top-down Investment and Policy

Carmel McNaught & Paul Kennedy
Learning Technology Services
RMIT University, Australia
carmel.mcnaught@rmit.edu.au
paul.kennedy@rmit.edu.au

Abstract: Effective staff development is the weaving together of many strands. We need to support staff in their current work, while providing them with ideas, incentives and resources to look for new ways to design learning environments which will enhance student learning. Staff development must be combined with specific projects where change is occurring. Ideas are not hard to find. Incentives and resources are another matter. The paper will outline some general principles for effective staff development. These principles will be applied in the description of the substantial investment RMIT has made in order to realise our Teaching and Learning Strategy. We have a model of 'grass-roots' faculty-based work funded by large-scale corporate 'investment'. 'Bottom-up' meets 'top-down'.

Introduction

Staff development can no longer be a pleasant 'cottage industry' on the fringes of academe or the enthusiastic enterprise of a few individuals supported by 'soft' money. Effective staff development is positioned at the centre of university functioning and yet needs to retain connections with the needs and perceptions of teaching staff. This is a demanding challenge. Staff development programs that are successful in meeting the needs of complex modern Australian universities need to be supported strategically (and financially) by their own universities.

McNaught et al. (1999) lists six key issues in staff development:

- The appropriate balance point between centrally provided and local staff development services needs to be determined in each university. Central services can be more clearly linked to university priorities; faculty or department services can be more in touch with local needs.
- As technology becomes more mainstream, support services need to be scaled up. This involves deciding on the level of support that can be afforded and the model of support which is most apposite. The educational design and evaluation, technical, and media production support services that universities currently have are under strain. It is unlikely that the existing examples of good practice at each university will be sufficient to ensure that new or revised subjects will be well designed and evaluated. By modelling good practice themselves, mentors can assist staff make optimal use of resources.
- A follow-on issue is determining the optimal relationship between staff development and production support services. Again, this needs to be decided in each university context.
- Even if an integrated model of professional development is adopted, there are still many professional development providers at most universities. Mapping the services of each provider and ensuring reasonable coordination is increasingly important as the need for support services scales up.
- Academic and general staff work load is a key issue. Careful work planning to ensure that staff have time to learn new skills and manage new processes is essential.

Learning Technology Mentors at RMIT University

RMIT University is an 'old' (in Australian terms; RMIT began in 1887) technological university. It is highly diverse - it is a cross-sectoral (includes vocational sector) university and has the largest number of international students of any Australian university. There are seven strong faculties which often resist central directions (what's new?). The Information Technology Alignment Project (ITAP) report (1998) forms the basis for a $A50 million investment by RMIT over the four years, 1999-2002. The report comprises several elements:

- IT infrastructure aligned with the needs of education to deliver the systems and hardware necessary to provide students with an electronically connected learning environment and access to computer-based learning resources;
- a Distributed Learning System (DLS) compliant with the emerging Educom/CAUSE Instructional Management System (IMS);
- an Academic Management System (AMS), fully integrated with the DLS to provide enrolment and subject and course progress records electronically accessible to academics and students;
- an extensive review of all academic processes within the university in a Business Process Re-engineering (BPR) project; and
- extensive staff development.

We have to deliver on our promise that we can provide a flexible set of tools that will enable staff who are not technological whizz kids to develop pedagogically sound, interesting, and relevant online courses in an efficient and well administered way. Quite an ask. How have we designed our Distributed Learning System (DLS)? Here are some of our principles:

- a suite of tools, not just one;
- integrating educational principles into the description of the toolset;
- IMS compliance of all tools;
- a team approach to all online projects; and
- involvement of all seven Faculties in a benchmarking exercise to evaluate the toolset and the effectiveness of the learning environments we are building.

Learning Technology Mentors have been appointed in each department of the University. There are currently approximately 150 Learning Technology Mentors (LTMs) - two in most departments of the university and some in central areas such as the Library. These are mostly academic and teaching staff who have funded one day a week time release to develop online materials and support their colleagues in their departments to engage with online teaching and learning. Each LTM is funded for 26 days time release, and some for longer periods.

These LTMs undertake an extensive staff development program about a week long which covers training in the use of the DLS toolset, key principles in online educational design, and organisational learning within the context of RMIT. Additional staff development sessions are run each week. Topics include hands-on training sessions on all the DLS tools, quality improvement and evaluation of DLS tools, student induction methods, assessment strategies for online learning, evaluation strategies for online learning, the role of the Library in supporting online learning, managing digital resources using metadata, project management, graduate attributes and other curriculum matters, and planning for online development using the DLS support documents.

All LTMs develop a work contract with the first author; if individual staff wish this can be formalised into accreditation for a subject in a Graduate Certificate of Flexible Learning. While one day a week is not a great deal of time, it has been enough to give many staff a space in which to learn new skills and enact them. We are seeing that staff development and support for developing online learning materials and strategies must become distributed across the organisation. Therefore the role of the faculty-based Faculty Education Services Groups (FESGs) is pivotal. Growth needs to occur in these units rather than at the centre. We have been delighted by the enthusiasm of many Learning Technology Mentors. Have we reached critical mass yet, where the appropriate use of technology will roll out across the University? Probably not, but we feel we are on the right track.

Reference

McNaught, C., Phillips, P., Rossiter, D., and Winn, J. (1999, in press). *Developing a framework for a usable and useful inventory of computer-facilitated learning and support materials in Australian universities.* Evaluations and Investigations Program report. Canberra: Higher Education Division Department of Employment, Education, Training and Youth Affairs.

Dynamic Databases as Knowledge Construction and Communication Tools in Online Courses

Sara G. McNeil
Department of Curriculum and Instruction, University of Houston, USA
smcneil@uh.edu

Bernard R. Robin
Department of Curriculum and Instruction, University of Houston, USA
brobin@uh.edu

Abstract: Database tools that dynamically generate Web pages have been in use by many commercial Internet sites for years. However, in the filed of education, the use of database applications has mostly been used to support traditional classroom learning activities. The use of dynamic Web-based databases as research and communication tools in higher education is currently gaining popularity as development of online courses continues to grow. This paper describes a theoretical framework for using Web-based databases to support constructivist learning and provides an introduction to how these tools are being used to facilitate the construction of knowledge and support student and faculty communication in an online environment.

Faculty and Student Concerns about Online Courses

With the rapid growth and acceptance of the Web as an educational medium, universities are feeling pressure to produce online training and instructional materials. Faculty members at colleges and universities are being told almost daily that they need to change the way they teach, as the value of traditional lecture-based instruction is being reevaluated and the promise of online course delivery is being glorified. Although faculty members at many institutions of higher learning have already begun to create and deliver online courses, there are few standard procedures for doing so. At some schools, early adopters are leading the way, but the acceptance of emerging technologies by large numbers of faculty seems far away. One of many reasons may be that faculty who create online courses are uncertain about how best to proceed. For many, the development of Web-based materials is time consuming and requires learning new skills, and support systems are not yet in place that can accommodate large numbers of new technology-using educators. In addition to the need for technical support, faculty are also concerned about pedagogical issues that arise when distance education modalities are discussed. Designing a Web-based course requires a different set of instructional strategies and philosophical orientations, and while some faculty members see the Web as an opportunity for implementing instructional innovations (Khan, 1997; Owston, 1997), many are largely uninformed about the advantages and disadvantages of online teaching. In addition, many are unclear about the effectiveness of online courses compared with traditional, face-to-face courses (Reeves, 1997). Interactions between students and faculty, a critical component in any course, change dramatically in an online environment where such tools as e-mail, listservs, and chat replace the more familiar student and faculty discourse. Ongoing discourse among participants is the driving force behind successful online courses, but unfortunately, many online courses fail to take advantage of these interactions that can add richness and depth to the construction of knowledge.

Using Dynamic Databases as Teaching and Learning Tools

Many, if not most Web pages simply duplicate print-based materials in electronic form. In education, converting existing course information to a Web-based format is not enough to effectively produce meaningful online courses. Attention must be given to the needs of the students, including facilitating social and instructional interactions, creating a sense of a learning community, and delivering the most timely and useful information. The use of dynamic databases allows users to dynamically generate Web pages that present the exact information that is being sought. This is important because it increases interaction between students and the course content and empowers students with control of the course environment. Additionally, the body of knowledge in the course does not remain static but continues to change and grow without requiring extra work on the part of the instructor.

Examples of Dynamic Databases

Students in our online classes use a variety of communication technologies, including a Web-based discussion list. To enhance the feeling of an electronic learning community, students' pictures are taken at orientation and uploaded to the database. Then, when a student posts a message to the listserv through a Web form, the message is displayed dynamically with their picture displayed. Students may also submit a variety of assignments through a Web form. The forms may contain text fields, pull-down menus, and radio buttons to submit different types of information. In addition, attachments may be uploaded and are entered in the database. Students may then use the query form to search the database by content area, audience, or author. After students submit their assignments, the instructor may use a faculty review form to provide feedback for the assignments that have been posted. Since all of the student postings are available in the database, this allows the instructor to review all of a particular student's assignments or all of the postings on a specific assignment, utilizing the common sorting functions of a database application. If desired, the database program may also be configured to automatically send the feedback to a student's e-mail address, a feature that helps students feel a greater connection to the course, the content, and the instructor.

Conclusion

Our use of dynamic database tools has helped us improve our online courses as they give students greater control over the information covered in the courses. However, some limitations to the use of this technology do exist. First, instructors who would like to incorporate dynamic database tools into their courses face a steeper learning curve than is required to create traditional web pages. A greater understanding of information design and information management is required and those educators who choose to learn these skills must commit more time and effort to this endeavor than originally anticipated. Additionally, students may require some instruction in the use of these database tools before they become completely comfortable submitting assignments and checking the progress of their coursework.

References

Khan, B. H. (Ed.).,1997. Web-Based Instruction. Educational Technology, Englewood Cliffs, NJ.

Owston, R., (1997). The World Wide Web: A technology to enhance teaching and learning? *Educational Researcher 26*(2), 27-33.

Reeves, T. C., (1997). A model of effective dimensions of interactive learning on the World Wide Web. [Online] http://www.unidata.ucar.edu/sum_wkshp/plan/reeves/WebPaper.pdf

Windschitl, M. (1999). The challenges of sustaining a constructivist classroom culture. *Phi Delta Kappan*, *80*(10), 751-755.

The Third Time is the Charm: the Evolving Nature of Web Design

Martha Meacham, Ph.D.
Instructional Technology
St.Edward's University, Austin, Texas US
martham@admin.stedwards.edu

Abstract: The iterative process of an instructional designer working with faculty members to develop a web-based module for an interdisciplinary freshman studies course is described in this paper. During the process, as it was necessary to change pedagogy to benefit from the use of the technology, teachers and students redefined their roles. The process has occurred over 3 years. The majority of planning, design and development occurred in the summer when faculty could collaborate with instructional technology staff and students who helped create the web pages.

What was Done

Since 1996, St. Edward's University has offered faculty members the opportunity to develop web-based, multimedia instructional materials for their classes during a 60 hour, 3-week Summer Technology Institute. Faculty members submit proposals and receive stipends to develop projects that range from the comprehensive redesign of courses to stand-alone tutorials to supplement instruction. The Instructional Technology department collaborates with the Center for Teaching Excellence to offer these intensive, individualized, hands-on classes. Faculty consult with the Instructional Computing Coordinator who acts as instructional designer and project manager.

In this particular case, a faculty member in the School of Humanities, who did not use his computer for much more than email, was recruited to attend the summer institute. The proposal addressed the need to develop instructional strategies to improve student mastery in a freshman course. The course was an interdisciplinary one (Humanities and Rhetoric and Composition) that had been revised many times to create consistency among the many writing teachers affiliated with the course. Traditionally, lectures were delivered twice a week and the other times students attended Rhetoric and Composition classes. The module this professor taught was a 3 hour lecture for a course that was a general curriculum requirement for freshmen. He would lecture in an auditorium of about 150 students twice a week.

During the first summer as course material was moved to the web for delivery of instruction, the professor learned the rudiments of designing web pages, including how to use an HTML editor, use graphics and how to manage online, asynchronous group discussions. With the support of student interns, a great deal of information about Japan was put on a web page that was created to support the class. Using streaming video and audio, freshmen students could hear Japanese spoken, they could see a slide show of images and listen to Japanese music with a narration introducing the culture.

The Process

Amidst the learning and practicing of the technical skills involved with web page production the *first* year, the faculty member and I consulted to focus the course content by specifying the learning objectives for students. We talked about changing the manner of assessment that had been in place for so many years, but we didn't get around to that. We consulted with the many faculty involved in teaching sections of the course to get their input. At the end of that first summer we had a dazzling web page that had lovely graphics, lots of links to supplemental information, audio and slide shows. That fall we implemented the site and requested student and faculty feedback in the form of surveys. Writing teachers and students used the web page as a resource to master the course content. The faculty member used his lecture time to introduce additional course information.

When all was said and done, the feedback was far from complimentary. Students and faculty alike complained that there was too much information and not enough clarity of learning outcomes. No one could figure out "what was going to be on the test". We had succeeded in demonstrating the lesson that we had added technology, but not "added value"! We had not changed pedagogy. We now had a glorified online lecture which had the Internet as it's boundary. Links led to links which led students to still other links around the globe.

The *second* year, in an effort to provide a structure or framework for learning the information, we designed a "WebQuest". This particular format, which is essentially the process of a systematic approach to instructional design, was developed at San Diego State University in early 1995 by Bernie Dodge with Tom March. The idea is that students take an active approach to their learning. Learning activities give students real world scenarios with which to work and experience collaboration.

The development of the WebQuest included faculty other than just the person who had delivered the lecture. The reading specialists contributed as well as other writing faculty. That fall the web-based module was implemented with much more success. Students and faculty felt that a framework had been provided. Surveys using the Flashlight Network toolkit were used to evaluate the use of the web this time. Additionally, the professor changed his assessment of student learning to reflect the change in pedagogy. Still a multiple choice exam, it now measured higher order thinking skills rather than simply literal or factual knowledge. Students need to reason and draw conclusions using the facts to answer test questions.

The plans are to still revise the web page yet again for a *third* time. We want to provide an interface that uses real-world metaphors and intuitive navigation. For example, the opening splash screen may be a student's room, desk, computer and maps on the wall. Students will interact by choosing objects to give them specific information. For example, by selecting the map of Japan, the student will get information on the geography of Japan.

The scenario will be changed again to reflect an activity with an even more meaningful context for the student. Students will seek information to answer questions related to living abroad for a semester. The framework for learning will focus on what the student needs to know to live in Japan for a semester such as what to expect socially and culturally. The authentic assessment will include a travel brochure on Japan compiled by teams of students.

Why it is Important

The process of creating instructional web pages is an iterative and collaborative process. The collaboration is among faculty and instructional designers and students. It stands to reason that many faculty are intimidated by learning new technology skills and then having to change their instructional strategies. Suggestions made by professional instructional technologists can not be forced on faculty. Faculty need multiple experiences and guidance to understand that it's not about the technology, it's about how you apply the technology to teaching. It takes surveying the students who use the web page to understand their perceptions of how the technology is being used to instruct. It takes analysis of the students' achievements and learning outcomes to see if objectives are being reached.

Not only should revisions be made in the instructional design using the formative feedback of the primary users of web pages, but designers should be constantly aware of ways to provide real- world applications for students through the use of technology. The web is changing the nature of learning, but we need to quickly move beyond "the syllabus and Powerpoint lecture online" use that is so prevalent. In a 3 year period we have been able to move toward a new paradigm of learning in a course that was traditionally lecture-bound. As this process occurred, both the roles of the students in the course and faculty member changed.

The lecturer realized how profoundly the students' roles changed by remarking how the students were active and engaged in their learning and took on responsibility. He no longer felt his role was to be the "sage on the stage". Although he did still use his lecture time to tell stories and provide bridges to the content that was on the web page, he enjoyed his new role as facilitator of knowledge and found that he could lead students to higher achievement with his new manner of teaching.

This process of collaboration and solicitation of student feedback ultimately seems to have evolved into a successful experience. It takes time for evolution. Change is slow. It takes team work. Hopefully this paper can encourage faculty, who may feel unsuccessful in their first attempts to *add value* and technology to their course, to "try again".

UNLOCKING THE GATES OF THE KINGDOM: DESIGNING WEB SITES FOR ACCESSIBILITY

Steven C. Mills, Ph.D.
University of Kansas
2601 Gabriel
Parsons, KS 67357
Stevem@ukans.edu

Abstract: Most web page authors are completely unaware of accessibility issues and have little or no experience in making their web pages usable by persons who coannot see the screen or use a mouse the same way they do. The World Wide Web Consortium (W3C) has recognized a disparity in web accessibility and has developed a set of web page design standards to address the issue of web accessibility.

Introduction

Overall use and availability of information resources through the Internet have continued to skyrocket; however, cyberspace predominantly has been the domain of persons without physical or mental disabilities. While sighted people hold the keys to the virtual kingdom, for all practical purposes the kingdom gates have been closed and locked for persons who are visually impaired or have other disabilities. According to Tim Berners-Lee, World Wide Web Consortium Director and inventor of the World Wide Web, "The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect." Most web authors develop web pages to convey content visually and do not allow for the eventuality that some web surfers may not see, hear, move, or process some types of information, may have difficulty reading or comprehending text, or may not have, or be able to use, a mouse or keyboard. The World Wide Web Consortium (W3C) has recognized a disparity in accessibility to the Web between persons with and without disabilities and has responded by developing a set of web design standards and strategies that specifically address the issue of web accessibility.

Problem Statement

Web accessibility is an issue that must be confronted by site developers and page authors. In a recent opinion from the U.S. Department of Justice (see http://www.internetlawyer. com/ada.htm), the Americans with Disabilities Act also applies to cyberspace. According to this opinion, entities covered by the ADA that use the Internet for communications regarding programs, goods, or services, must be prepared to provide these communications through accessible means as well. Additionally, Section 508 of the U.S. Rehabilitation Act requires federal departments and agencies to evaluate the extent to which their electronic and information technology is accessible to and usable by individuals with disabilities (see http://www.508.org).

In April, 1997, the W3C created the Web Accessibility Initiative (WAI) as an official activity under the Technology and Society domain of the W3C. The WAI is funded separately from other W3C member activities and is sponsored by representatives of web development industries, disability organizations, research organizations, and government. Some of the WAI sponsors include the National Science Foundation (NSF), National Institute on Disability and Rehabilitation Research (NIDRR), Microsoft, IBM, Lotus Development, and NCR.

To facilitate the efforts for promoting Web accessibility, the WAI joined forces with the W3C HTML Working Group in the design of HTML 4.0 and in December, 1997, HTML 4.0 became a W3C recommendation (see http://www.w3.org/TR/REC-html40/). Additionally, in May, 1998, an official W3C recommendation for Cascading Style Sheets, Level 2, (CSS2) was issued (see http://www.w3.org/TR/REC-CSS2/). In May, 1999, the WAI issued the Web Content Accessibility Guidelines 1.0 (see http://www.w3.org/TR/WAI-WEBCONTENT/). These guidelines incorporated the recommendations of HTML 4.0 and CSS2 and were intended for use by all web content developers including page authors, site designers, and developers of authoring tools.

Developing Accessible Web Pages

Web accessibility is based on design principles that provide for the development of web pages that accommodate the needs of a broad range of users, computers, and telecommunications systems without regard to age or disability. When a web site is accessible, anyone browsing the site should be able to gain a complete understanding of the information presented on the site as well as have an undiminished ability to interact with the site. Since many educators are commonly authoring on-line courses or publishing research findings in web pages, they need to implement and apply the design strategies of the Web Content Accessibility Guidelines to the development of web pages that facilitate accessibility for web surfers with disabilities. The Web Content Accessibility Guidelines (WCAG) consist of 14 guidelines that are formulated around two general web page design strategies: (1) ensuring graceful transformation, and (2) making content understandable and navigable.

Ensuring Graceful Transformation

Web surfers may operate in contexts very different from the one in which a web page is developed. The WCAG support and promote the development of pages that transform gracefully. A page transforms gracefully when it remains accessible despite any constraints that may include (though not be limited to) physical, sensory, and cognitive disabilities, work constraints, and technological barriers. For example, a web surfer may not be able to see, hear, move, or use a keyboard or mouse, or may have difficulty reading or comprehending text. The surfer may have a small screen, a slow Internet connection, an early version of a browser, a different browser, a voice browser, or a different operating system. Web pages transform gracefully when text or text equivalents are provided because text can be rendered in ways that are available to almost all browsing devices and accessible to almost all users. Web pages should not rely on one type of hardware and should be usable by people without a mouse, with small screens, low resolution screens, black and white screens, no screens, or with only voice or text output. The theme of graceful transformation is addressed primarily by Guidelines 1 to 11.

Making Content Understandable and Navigable

Web page authors should make page content understandable and navigable. The language of a web page should be clear and simple, but also provide understandable mechanisms for navigating within and between pages. Providing navigation tools and orientation information in web pages maximizes accessibility and usability. Not all surfers can make use of visual clues such as image maps, proportional scroll bars, side-by-side frames, or graphics that guide sighted users with graphical desktop browsers. Web surfers may also lose contextual information when they can only view a portion of a page, either because they are accessing the page one word at a time as with a speech synthesizer or a Braille display, or one section at a time as with a small or magnified display. Without orientation information, users may not be able to understand very large tables, lists, or menus. The theme of making content understandable and navigable is addressed primarily in Guidelines 12 to 14.

Principles of Accessible Web Design

The WAI has produced an extensive set of guidelines for authoring accessible web pages. The HTML Writers Guild (see http://www.hwg.org) has proposed six principles of accessible web design upon which the WCAG were written:

1. Create pages that conform to accepted standards. Use the W3C recommendations for WCAG, HTML 4.0, and CSS2 for designing web pages.
2. Know the difference between structural and presentation elements. Use HTML structural elements to convey page content and style sheets to convey page presentation and formatting.
3. Use HTML 4.0 features to provide information about the purpose and function of elements.
4. Ensure that pages can be navigated by keyboard.
5. Provide alternative or text-based methods to access non-textual content that includes images, scripts, multimedia, tables, forms, and frames for user agents that do not display them.
6. Be careful of common programming techniques that can reduce the accessibility of your site such as ASCII art, blinking text, or adjacent links that are separated by non-printable characters.

Conclusion

As the use of the Web is perceived to be an effective tool for dissemination of research findings or for the provision of asynchronous instruction, the issue of accessibility of web page information will become more relevant. The World Wide Web Consortium has embraced the issue of accessibility through its Web Accessibility Initiative and essentially thrown open the gates to the virtual kingdom for persons with disabilities. The implications of accessibility features for sound web page design are a benefit that offsets the additional time and labor required to author accessible web pages. Because of the commitment of the W3C to web accessibility, the statutory requirements that ensure equal opportunity and access for persons with disabilities, and the preponderance of resources available for web authors to use in the development of accessible web pages, new and experienced web authors have a compelling mandate for including accessibility features in web pages.

USING SCENARIOS TO CREATE A CAL DESIGN METHOD

Michelle Montgomery Masters
Dept. of Computing Science
University of Glasgow, Glasgow G12 8QQ
+44 141 339 8855 ext. 8330
michelle@dcs.gla.ac.uk

Abstract :There have been recent advances in educational theory at Higher Education level, reflected in Laurillard's conversational framework [3]. Current Instructional Design methods and their underlying educational model, are not compatible with current views of the Higher Education teaching and learning process. Therefore there is a need for a practical instructional design method which is inspired by the Laurillardian view of the teaching and learning process. The rest of this paper discusses the way in which design methods developed for highly interactive computer systems have been employed to solve this CAL design problem.

CAL DESIGN

In the United Kingdom a government white paper in 1991 detailed the government's plan for a cost effective expansion of the Higher Education system, this included the use of CAL to combat increasing student numbers. Following the white paper's publication the government set up a number of initiatives to develop CAL for Higher Education, Computing in Teaching Initiative (CTI) and the Teaching and Learning Technology Programme (TLTP.) These initiatives resulted in large quantities of CAL being produced across disciplines. Investigations conducted on a samplc of these resulting CAL packages, indicated that very little formal design was carried out on Higher Education CAL [5]. The only formal design method in evidence, followed an Instructional Systems Design (ISD) approach to design

THE CONVERSATIONAL FRAMEWORK

ISD's underlying model of the teaching and learning process is very teacher centred - however a student centred approach is currently a much more popular idea in the education community. Laurillard's "conversational framework" [3] falls somewhere in the middle ground. The framework promotes equal roles and dialogue between the teacher and learner in the complete teaching and learning process. The framework identifies twelve activities that Laurillard believes must happen [3]— by traditional methods or by computer — in a given learning situation for learning to take place.

CREATING A DESIGN METHOD WITH AID OF SCENARIOS

At a British HCI group workshop in 1997 on "Usability and Educational Software Design," it was stated that educational design is a craft not an engineering process.
Schneiderman [7] says that "Design is inherently creative and unpredictable." CAL design can be made less dependent on the particular skills and talents of a few artisans by applying some science to the design process, embodied in an explicit design process. As Schneiderman goes on to say "in every creative domain, there can also be discipline, refined techniques, wrong and right methods, and measures of success." In order to impose such a discipline, it was necessary to find some

way to use Laurillard's conversational framework in an instructional design setting. The discipline comes from the imposition of the conversational framework on to a CAL design by the instructional designer. To make this a reality, it was necessary to work out when and how to use the conversational framework.

Traditional methods for solving this type of task have relied on the use of observational techniques such as video recording or interviewing, to capture knowledge on the way activities are performed [6]. Scenarios have in the past been used in place of observational studies. A Scenario is "a narrative," "it is a description of context, which contains information about users, tasks and environments." [2]

Jack Carroll [1] says that scenarios can help to ensure that computer systems are "easy to learn/easy to use," that they McKerlie [4] identified two distinct roles for scenarios.

1) Supporting the generation of design ideas.

2) Evaluating a proposed design.

This work adds a new use for scenarios, an enhanced version of role 1) -

3) Supporting development of new design methods.

Maclean & McKerlie call type 1) scenarios *enivisioner scenarios*. The fundamental idea behind the use of envisioner scenarios being that they "drive...and contribute to the evolving design." [4]. Although scenarios have been used in the past to envision interactions with an implemented system, these statements seem also to apply to the creation of a design method.

THE DESIGN METHOD

From observation of existing design methods and the way people generally approach CAL design, identifying aims and objectives of the package was the place to start. Although this is the same starting place as the traditional instructional design methods that were earlier criticized, the follow on is radically different. The scenarios acted as a prompter - what way now? By constantly returning to the scenario, requirements for the design method were elicited.

e.g. Having identified the aims and objectives, what do I do now? How can the framework help me to proceed? It was clear there was a gap. It identified the need for explicit instruction to take each objective and work round the conversational framework. But before this it was clear decisions had to be made with respect to how each activity in the conversational framework would be implemented - was it a human to human activity or human/computer or by some other means. These decisions resulted in formulation of a table indicating the possible implementations.

Use of an enhanced envisioner scenario allowed the design problem to be made more realistic and concrete. The scenario provided a setting to explore requirements for a new design method and to discover what instructional designers would require from such a design method. It does however remain true the method was generated through a creative process, not the mechanical application of a systematic method. The use of a scenario contrasted with actual immersion in a real design problem saved considerable time and effort. In principle, the technique could also be used to test the method with problems and in contexts, which would be difficult or impossible to use for real.

References

Carroll, J. M., (ed). (1995). *Scenario-Based Design - Envisioning Work and Technology in System Development*. John Wiley & Sons.

Karat, J., (1995). *In Scenario-Based Design - Envisioning Work and Technology in System Development*. John Wiley & Sons,

Laurillard, D., (1993). *Rethinking University Teaching, a framework for the effective use of educational technology*. Routledge.

MacLean, A. & McKerlie, D., (1995*). In Scenario-Based Design - Envisioning Work and Technology in System Development*. John Wiley & Sons.

Montgomery, M., (1996). *Learning design by intention not by accident*, Proceedings of ALT-C '96, Integrating technology into the curriculum, Oxford.

Newman, W. M., & Lamming, M. G., (1995). *Interactive System Design*. Addison Wesley Publishing Company.

Schneiderman, B., (1992). Designing the User Interface - Strategies for Effective Human-Computer Interaction. Addison Wesley Publishing Company.

Representing Oral Traditions through Interactive Multimedia - an example from Hindustani Classical Music

John Myers
Simons Rock College of Bard
84 Alford Road
Great Barrington, MA, 01230 USA
johnm@simons-rock.edu

Abstract: This project utilized object-oriented programming in Lingo and the Director authoring environment to bring together video, audio, text, and graphics in an instructional CD-ROM program presenting the classical tabla traditions of South Asia. Working in a highly collaborative framework in which the subjects were partners as well as informants, the developers were able to use interactive media to reflect the pedagogic structure, mnemonic techniques, historical development, and performance practices of the oral traditions being represented.

One of the greatest challenges faced in the fields of ethnomusicology, anthropology, folklore and related disciplines is the issue of using the written word as a mode of communication when describing traditions that utilize non-verbal modes of expression. Even in cultures with their own written languages and elaborate taxonomies, we find that the simultaneous presence of gesture, pitch inflections, iconography, color symbolism, and other forms of communication serves to intensify and expand an experience that is not just verbal, but truly multi-sensory in nature.

Interactive multimedia, particularly when delivered in high-bandwidth contexts such as CD-ROM presentations, offers the possibility of transcending the limitations of writing, but without sacrificing writing's potential for conveying and promoting analysis and reflection. In particular, the branching structures of interactive presentations allow the designer to present a body of material in an organized, analytic fashion, just as one can find in printed works, while the media elements themselves offer a more profound experience of the actual subject matter.

In the world of music, the experience of learning an instrument is almost always associated with oral transmission. Even in cultures that make extensive use of music notation, there are many subtleties of interpretation, many nuances of pitch, rhythm, and tone color that are learned only through careful listening, observation, and imitation. Often this body of knowledge is passed on through generations of musicians, and represents a kind of living cultural treasure. While nothing can replace the human relationships on which this transmission is based, the three-fold process of listening, observation, and imitation mentioned above can also take place when the traditions are conveyed though computer-based media. If the material being presented has the required quality and integrity, the sonic aspects of a music genre can be accompanied with the appropriate amounts of visual and textual information, and the level of learning can more closely approximate the presence of a teacher, a qualified "carrier" of that tradition. This project attempts to utilize an interactive presentation, delivered on CD-ROM, to represent and introduce the major oral traditions of tabla, the premier percussion instrument of Hindustani classical music. The single word tabla is used to refer to a paired set of drums that are generally played by finger strokes rather than by hand strokes or sticks.

The intended audience for the program is quite broad, and includes learners with a background in music and/or Asian studies as well as those with a more general or casual interest. Because we have chosen to focus on one instrument, a comprehensive view of its diverse musical genres can be gained, and a practical sense of how to play the instrument can also be acquired, without exceeding the stringent storage limitations of the CD-ROM format. In the classical music of North India, oral transmission of musical knowledge was originally achieved through the system of gharanas, families of elite musicians. These families served in the courts of the emperors, nawabs, and rajahs of the Hindustani cultural region, which extended from Pakistan in West, Afghanistan in the North, throughout North India, and Bangladesh in the East. This entire region was once dominated by the Mughal Empire, which dominated South Asia from the 15th century until the rise of British colonial power in the 18th century. Because the musical families often continued to serve the same courts for several generations, a certain amount of regional variation developed in terms of instrumental technique and musical structurc. During the 20th century, with the acceleration of communication and travel, the geographic isolation of the gharanas began to break down, and the context of the music changed. It was no longer heard exclusively by the elite, and became more accessible through emerging media such as records, tapes, audio CDs, and broadcast media. Among professional Hindustani classical musicians, it has become more common to learn repertoire from outside one's own gharana, and the collective body of musical material, in spite of its massive size, is now being viewed as a group of bundled, closely-related traditions.

Therefore it is important for the program to include representative selections from each of the major gharanas, even though the basic strokes are held in common. Working with tabla virtuoso Enayet Hossain and his colleagues, we used a DV camera to videotape several selections from each tradition, and edited the clips in Quicktime format for inclusion within the interactive presentation. Along with solo repertoire, we recorded tabla duets, tabla trios, and tabla in its more common role as an instrument that provides accompaniment for melodic soloists. Through Mr. Hossain, we also acquired additional material from sources in India, and brought it into the program. These performances, however, include many rapid passages that would be far too challenging for most beginning learners.

In order to accommodate beginners, we have been able to draw upon the traditional South Asian system of teaching and transmitting musical patterns. This system evolved in India over hundreds of years, and is learned by dancers, vocalists, and melodic instrumentalists as well as percussionists. In a lesson with a live teacher, these rudiments constitute the first material to be learned. The system is a kind of drum "language" in that every possible sound made on the tabla has a corresponding verbal syllable. Although it is quite sophisticated, it is not a language such as the drum languages of West Africa, because the system is completely non-lexical, and is used only for musical or artistic purposes, even though many of its syllables are shared as phonemes in Hindi and other South Asian languages.

We found that the media capabilities of CD-ROM make it an ideal vehicle to convey the actual sound and display the required technique. Therefore a section was included which focuses on the basic drum syllables, or "bols." Each spoken syllable corresponds to a discrete sound made on the drums. Working with professional tabla players to make sure that the lexicon was complete, we represented each stroke with a high-resolution audio clip of each spoken drum syllable, a small video clip showing how each stroke is produced, and phonetic transcription in text. This section serves both as a reference for advanced musicians and as a primer for beginners.

To communicate with the widest possible audience, we chose to create a cross-platform CD-ROM that can be played on both Macintosh and Windows systems. As an authoring tool, Macromedia Director enabled us to create the application rapidly, so that we could build a logical navigation structure and present the layers of textual information without losing the multi-sensory dimension that is so crucial to the learning process. The video clips were presented in Quicktime format, because Quicktime is also cross-platform and can be easily controlled with Lingo, Director's scripting language. Most of the programming involved navigation control. Aside from simple branching commands and navigation cues, I using Lingo's object-oriented features to create a "watcher object" that would keep track of the places visited by the user in any given section. The places are stored as a two-dimensional array in RAM, and the object increments the array with each program location visited, allowing the user to backtrack through the program. Other programming allows the user to play the Quicktime videos in single frame slow-motion, so that the music students can observe details of the strokes.

Although the main function of this CD-ROM is pedagogical, there are also documentary and historical aspects that would be of interest to more general students, and to scholars in ethnomusicology and Asian studies. Maps are provided to show the original geographic locations of the various gharanas, full artists' profiles are included, and a historical section is provides background on each of the various gharanas, as well as on the general development of tabla as an instrument. The CD-ROM will also serve as a kind of digital archive, preserving the work of several representative artists from living oral traditions at the turn of the millennium.

As a means of conveying oral traditions, well-designed interactive multimedia programs are able to combine the most useful aspects of both print media and linear media to provide learners with a more comprehensive experience. But in order to reflect the subject matter accurately, the designers must themselves be knowledgeable of the material being represented, and must try as much as possible to incorporate traditional pedagogy as part of that experience.

Scaffolding Student Learning in Information-Dense Technology-Enhanced Teaching and Learning Environments

Som Naidu
Multimedia Education Unit, The University of Melbourne, Australia,
email: s.naidu@meu.unimelb.edu.au

Mike Keppell and Gregor Kennedy
Biomedical Multimedia Unit, The University of Melbourne, Australia
email: m.keppell@medicine.unimelb.edu.au; g.kennedy@medicine.unimelb.edu.au

Abstract: This paper is fundamentally about supporting learning in technology-enhanced educational settings where students are often confronted with very large amounts of information, and where they are also required to exercise a great deal of independence as part of their learning activity. First, it outlines very briefly, the critical attributes of such educational settings, the challenges to learning that they pose, and some ways of supporting students in their learning as they are confronted with these challenges. The paper also discusses the pedagogical foundations for building these types of cognitive supports and discusses some preliminary work that is being carried out on these lines at The University of Melbourne in Australia.

Technology-Enhanced Learning Environments

For the purposes of this paper, technology-enhanced learning environments refer to those educational settings where some element of instructional technology (such as CD-ROMS or the Web) is used to support the interaction between the teacher, the learner and the educational content. Students in these educational settings are often confronted with very large amounts of information by way of databases and other resources (making them information-dense) which they are required to use to pursue self-directed and open-ended inquiries. Interest in building these educational environments, where students are immersed in learning by doing and where the meaning of knowledge and skills are realistically embedded in authentic problem situations, has been growing in the last decade (see Brown, Collins, & Duguid, 1989). These environments are designed not so much to "instruct" as to provide contexts wherein understanding and insight can be uniquely cultivated. Papert's concept of "microworlds as incubators for knowledge" reflects the philosophical bias of these technology-enhanced, student-centered learning environments (Papert, 1993, p. 120). They are called student-centered because the focus in these learning environments is more on learning, and less on the delivery of the content. Examples of these student-centered learning designs are goal-based scenarios (Schank, 1997), and problem-based learning (Koschmann, Kelson, Feltovich & Barrows, 1996).

Challenges and Problems of these Learning Environments

Technology-enhanced student-centered learning environments do not, in themselves, lead to learning efficiency or effectiveness. Indeed for some learners, the use of technology and the student-centered nature of these learning environments can be quite daunting, and pose a real threat to their success and motivation to learn. While creating opportunities for student-centered learning, these environments also create demands for new skills in managing complex information and higher order cognitive processes. Being successful in such learning environments requires the ability to organize, evaluate, and monitor the progress of one's learning. Not all learners have the skills to function efficiently and effectively in such educational settings. Students need help with acquiring learning strategies to enable them to organize and reflect on information they have encountered. They have to be taught the learning skills and self-monitoring (i.e, metacognitve) strategies which would in turn enable them to take advantage of rich databases, and open-ended inquiries (see Weinstein & Mayer, 1986; Jonassen, 1988). While a considerable amount of work has been done in supporting students' learning with various types of learning strategies in such educational settings (see for example, Bernard & Naidu, 1992; Edelson, Gordin, & Pea, 1999), work on supporting student learning with software-based cognitive tools is still lagging.

What does this Work Involve?

Weinstein and Mayer (1986) suggest that the development of learning strategies (i.e., in *learning how to learn*) can influence learner characteristics. They argue that employing these strategies and methods can help with the encoding process, which in turn affects learning outcomes. These authors have identified several categories of learning strategies, namely *rehearsal, elaboration, organizational, self-monitoring and motivational* strategies. These strategies provide a pedagogically sound framework for supporting *"learning how to learn"*, and they can also be used to guide work on scaffolding and supporting student learning in information dense, technology enhanced learning environments. They have guided the research and development work that is reported in this paper.

As part of our work on the design and development of technology-enhanced learning environments, we have been exploring both, the pedagogical designs and the technical architecture of a variety of these types of learning supports. Some examples of these are *comparison frames* to view content elements in relation to each other, *clusters* for organizing data by themes, *modeling and simulations* for exploring dynamic processes, and *chronological traces* for providing students with representations of their own actions.

Comparison frames (an instance of an *elaboration* strategy) are particularly useful in areas such as medical and the biological sciences where students are often observing cells and images of anatomical parts to determine unique characteristics and/or abnormalities. *Clustering* (an instance of an *organizational* strategy) is useful for organizing data or information to draw out and represent meaningful relationships among them. *Interactive modeling and simulation* (instances of *elaboration* and *self-monitoring* strategies) are useful approaches to support tutorials in applied domains such as in mathematics as well as in the natural sciences. As part of this, concrete dynamic models with which the student can interact and experiment are used to represent abstract concepts. *Chronological traces* (an instance of *organizational and self-monitoring* strategies) allow students to observe their own actions and problem-solving behavior after they have reached a solution, and compare it with other solutions.

The presentation of this paper will focus on *"The Skin Atlas"* which is an instance of an *elaboration* strategy. The *"Skin Atlas"* is a multimedia module that contains images of the histology and pathology of human skin and associated disorders, which allows students to study specific images in detail and to select and compare images.

Conclusion

We believe that the kind of work that is described in this paper has the potential to significantly expand our knowledge about scaffolding student learning in information dense, technology enhanced learning environments. By improving the scaffolding of student learning in these environments, we hope to assist the efficiency of student learning. Furthermore, a record of students' actions at a number of levels (e.g., *gathering*, *comparing*, *clustering*, and *organizing data*, as well as *self-monitoring*), has the potential to provide a richer picture of their learning activities. These can be reflected upon by students themselves for revision and group discussions, by the teachers for assessment purposes, and by researchers to understand and improve student's learning experience in terms of content gathered, and the types of reflective learning activity in which they have been engaging.

References

Bernard, R.M., & Naidu, S. (1992). Post-questioning, concept mapping and feedback: A distance education field experiment. *British Journal of Educational Technology, 23*(1), 48-60.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, *18*(1), 32-42.

Edelson, D. C., Gordin, D. N., & Pea, R. D. (1999). Addressing the challenges of inquiry-based learning through technology and curriculum design. *The Journal of the Learning Sciences*, *8*(3&4), 391-450. Lawrence Erlbaum Associates, Mahwah, NJ.

Jonassen, D. H. (1988). *Integrating Learning Strategies into Courseware to Facilitate Deeper Processing.* In D. H. Jonassen (Ed.), Instructional Designs for Microcomputer Courseware, (pp 151-181), Lawrence Earlbaum Associates, Hillsdale, NJ.

Koschmann, T., Kelson, A. C., Feltovich, P. J., & Barrows, H. S. (1996). Computer-supported problem-based learning: A principled approach to the use of computers in collaborative learning (pp.83-124). In T. Koschmann (Ed.), *CSCL: Theory & Practice in an Emerging Paradigm.* Mahwah, Lawrence Erlbaum, NJ.

Papert, S. (1993). *Mindstorms.* (2nd ed.), New York, Basic Books, Inc.

Schank, R. (1997). *Virtual Learning: A Revolutionary Approach to Building a Highly Skilled Workforce.* McGraw-Hill, NY.

Weinstein, C. E., & Mayer, R. E. (1986). The teaching of learning strategies. In M. Wittrock (Ed.), *Handbook of Research on Teaching.* (pp 315-327), New York: Macmillan.

Increasing Interaction through Computer-Mediated Communication in Distance Education

Kwok-chi NG
School of Education and Languages
The Open University of Hong Kong
Hong Kong, SAR, China
kcng@ouhk.edu.hk

Abstract: This paper reports on the first phase of a research project which aims to support student learning through computer-mediated communication among a group of about 20 students enrolled in an educational management course in the Open University of Hong Kong. It describes the results of a questionnaire designed to collect information on how ready the students are to access a Web-based course. Their interaction patterns in the Discussion Board during the first few months of the implementation are analysed. Some challenges for managing the online communication activities in the institutional context are discussed and the next action steps are then suggested.

Introduction

The Open University of Hong Kong (OUHK) is the only distance learning institution in Hong Kong. For the April 1999 presentation, the OUHK launched a pilot project to promote an online course delivery system: the Online Learning Environment (OLE). A Web course development tool – WebCT – was selected as a unified platform for delivery. It is intended that the Interactive Tools in the WebCT – Email, Discussion Board and Chat Room – will create an interactive learning environment for communication among students, tutors and the Course Coordinator.

Course E805 *Effective Leadership and Management in Education* was chosen for the pilot. E805 is a post-graduate level course in the Master of Education, which aims to improve participants' professional capability in educational management through developing knowledge of theory and critical reflection on practice. An invitation letter describing the nature of the online mode of learning was sent to all E805 students before the commencement of the course. There were 70 students on the course in total, and eventually 20 students chose the online mode. A videotape on setting up the OLE system and a User's Guide to the OLE were provided to these students.

In the literature, computer-mediated communication (CMC) has been discussed largely in terms of providing an additional medium to assist students' learning (Burgstahler and Swift 1996). Claims have been made that it can provide an environment through which learners can interact and engage themselves in social activities such as discussion and debate. As the Course Coordinator (CC) of the course, the researcher is concerned about how the CMC tools in the OLE system can support student learning by providing more opportunities for them to share their understanding of theories and their reflections on management practice with their tutor and other students.

The Study

This study is the first phase of the project, which aims to gain insight into how students had adjusted to the E805 OLE during the first five months of implementation. Students' views of CMC in learning and how ready they are to use the CMC tools in studying the course were collected through a questionnaire survey. The electronic communication messages over this period were reviewed as a source of information for understanding whether any interaction exists and how it relates to learning.

Questionnaire Data

The questionnaire was sent to all 20 online group students. Seven students responded, a response rate of 35%. The questionnaire comprised 26 questions which probed the following 3 issues:

Internet access. All of the respondents had their own PCs, and were able to access the Internet at home or at the workplace. When asked how many hours per week they used the Internet, students most often responded 1-5 hours, and two students indicated usage of more than 10 hours. Web browsing and Email were the most common functions used, and the activities included communication (33%), online study (33%) and entertainment (20%).

Skills in using the Internet. Responses were given on a 4-point Likert Scale (1 = strongly disagree and 4 = strongly agree) to indicate their skills in using the Internet. In general, the participants showed competence in using Email and Web-browsing (mean □3.0), but were less competent in using the Chat and electronic conferencing system (mean = 2.5) in the Internet.

Use of the E805 OLE. At the time the survey was conducted, all the respondents had accessed the OLE for E805. Most of the respondents (86%) spent less than one hour per week on the OLE, and accessed the OLE system at home (71%) most of the time. This survey paid special attention to students' use of the Interactive Tools in the OLE. Respondents were asked about the usefulness of each of these features up to that point in their studies. Email was rated as at least 'somewhat useful' by more than 50%, but the Discussion Board and Chat features were not rated as highly. Some students had not used the latter features at the time the survey was conducted. Of those who had, more than half the respondents thought they were not very helpful.

Online Discussion Content

There were 41 messages in the Discussion Board over the above period. The items are arranged according to chronological order. In the column on student postings, the alphabetic letters indicate individual students.

Item no.	Item Title	Themes	No. of postings			
			Student	Tutor	CC	Total
1	Welcome from Course Coordinator	Hello message	a+b+c	0	1	4
2	Welcome from tutor	Hello message	c+d	1	0	3
3	Web-links	Course content related	e	0	1	2
4	Statistical figures	Course content related	3e+f	1	1	6
5	What is management?	Assignment related	2a+e+f	2	0	6
6	What are taken-for granted assumptions?	Course content related	e	1	1	3
7	Online survey	Course administration	0	0	1	1
8	Course material	Course content related	a	0	3	4
9	Tutorial visit	Course administration	0	0	1	1
10	Question in Section 6	Course content related	e	0	1	2
11	The reform of Education Department in Hong Kong	Assignment related	0	0	1	1
12	Forward Email	Course administration	2a	0	2	4
13	Examples of leadership in secondary school	Course content related	2a	1	1	4
			21	6	14	**41**

Table 1: Summary of the electronic messages in the Discussion Board

Reflections and further actions

Based on the survey outcomes, students' training needs were further identified. Despite the fact that this was a self-selected group with a reasonable level of computer competence, they needed more guidance on using the Discussion Board and Chat features. To help students become more familiar with these features, the researcher will summarize the procedures and highlight some of their useful functions. Briefing sessions will also be arranged.

The electronic messages showed the interaction patterns of the online group. Among the 13 items, only four of them showed student-student interaction and, in general, students were not involved as active partners. Only six students posted messages, but only three of them were more active members. To motivate students to become more involvement in online discussion activities, Chat room sessions will be organized. This is to allow students to have a real-time interaction to discuss their assignments or the suggested topics. The tutor will be invited to join the Chat room sessions, and the transcript of the Chat discussion will be posted on the Discussion Board for further examination with students' permission. Hopefully, in such ways, students will be encouraged to play a more active role in utilizing the interactive features in the OLE.

It should be noted that most of the discussion topics were related to course content or assignments. Based on the item titles, it is difficult to tell whether online communication can promote improved learning. These messages need to be further reviewed through content analysis (Mason 1992) to understand whether any interaction exists and how it relates to learning. Last, statistics on users' login records and the time spent on each component in the Interactive Tools will be collected. This will help identify individuals who read the messages posted but do not participate in discussion (so-called 'lurkers').

References

Burgstahler, S. and Swift, C. (1996) Enhanced learning through electronic communications: a research review. Eric Document 410 734.

Mason, R. (1992) 'Evaluation methodologies for computer conferencing applications' in Kaye, A. R. (ed.) *Collaborative learning through computer conferencing*, Berlin Heidelberg: Springer-Verlag.

Acknowledgements

This research is being supported by grants from the School of Education and Languages of the OUHK.

A Framework for Generating Non-trivial Interactive Mathematical Exercises in the Web: Dynamic Exercises

Ossi Nykänen
Digital Media Institute / Hypermedia Laboratory
Tampere University of Technology
Finland
ossi.nykanen@cc.tut.fi

Introduction

Successful tutoring is largely a matter of well-timed and focused feedback. A computer program can hardly replace a good, motivated teacher, but it can certainly do better than a non-existing one. Computer-verified interactive mathematical exercises are useful cognitive tools supporting the development of personal mathematical skills and knowledge in the absence of human tutoring. Our goal is to find out and propose specific means supporting computer-aided solving of computer-generated mathematical exercises. We aim to achieve this goal by introducing a concrete system called *Dynamic Exercises* (DE) for doing non-trivial exercises interactively in the Web.

Exercises created with DE are said to be *in the Web*, since they are accessed via Internet and processed by using basic WWW services. Exercises are said to be *interactive*, because the process of solving exercises is carried out in incremental steps, in an interaction with a computer program being capable of interpreting and manipulating user input and providing feedback. Finally and most importantly, exercises are claimed to be *non-trivial* since exercises are designed and interpreted as multiple code modules using DE extended Maple programming language. Solving exercises does not require understanding Maple language since input can be elaborately processed using arbitrary text filters.

This study continues our previous line of work of designing and implementing Internet-based learning environments, especially from the viewpoint of teaching and learning university-level mathematics (see, e.g., (Pohjolainen *et al*, 1999) and (Nykänen & Ala-Rantala, 1998)). Motivation of constructing computer-generated interactive exercises originates largely from a recent survey conducted with our *A&O* learning environment (see (Pohjolainen *et al*, 2000)). DE aims to develop things further.

Design Framework

The design and implementation process of creating interactive exercises consists of three phases: designing a *dynamic exercise*, implementing it as a set of *form template files*, and publishing it under a *DE server*, which finally runs the exercises when requested. Each dynamic exercise consists of one or more forms. *Forms* are logical sub-tasks of the exercise, compiled from form template files on demand. Forms introduce mathematical tasks, formulae, textual descriptions, variables, and graphics for the user, and accept input from the user.

User input is interpreted automatically by form's input evaluation programs. Feedback is presented by means of textual or graphical output including comments, variable values, and formulae. In addition, input evaluators may branch the execution flow to other forms, thereby providing entire forms as an output. This kind of branching of the form execution makes it possible to effectively implement exercises with non-linear structure. For instance, branching enables recognising and accepting various kinds of different solution strategies instead of a single one.

Programs generating exercises and providing input-sensitive feedback are written using the DE extended Maple programming language and are embedded in the form template files. Program blocks essentially set up task variables, produce graphical plots, and evaluate user input when present. Publishing an exercise means putting the exercise form template files in some appropriate DE author directory. In addition, classes of exercises can be compiled into libraries, the use of which can be optionally controlled and monitored using some additional WWW mechanisms.

Syntax for form template files is kept as straightforward as possible. Each form template file is a text file consisting of a logical combination of the following *DE elements*: INITIALCODEBLOCK, TEXTFIELD, OUTPUTFIELD, INPUTFIELD, IMAGELINK, LOADFORMBUTTON, and RESETBUTTON. These elements (with proper attribute values) initialise form's mathematical task, provide static text descriptions (optionally including other media elements), and print dynamic DE variable values for the user. In addition, elements accept, parse, and evaluate user input, insert hypertext links pointing to generated images, add buttons for manually launching other forms, and finally, provide a button for resetting the exercise and generating a new one. DE also enables generating demonstration-orientated exercises instead of problem-based ones. Figure 1 presents an example of a simple exercise in action.

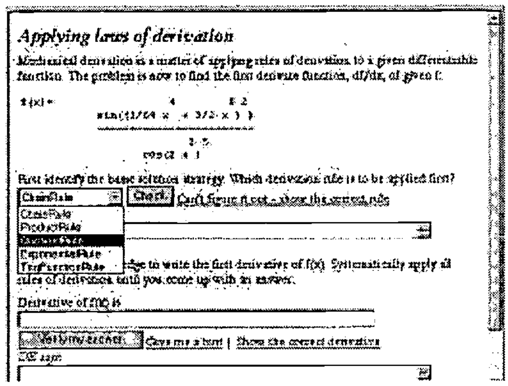


Figure 1: Solving a simple exercise: interacting with a form via Web browser.

DE elements INITIALCODEBLOCK and INPUTFIELD introduce Maple programs needed for initialising the form's mathematical problem and evaluating user input. From non-technical point of view, the interaction scheme is quite straightforward: first a set of problem variables is generated, which are presented to the user along with some static descriptive text fields. When user types in an answer it is parsed and processed by the program defined in the selected INPUTFIELD. Answer evaluator produces elaborate feedback to the user or jumps to another form that is compiled and presented to the user. After one interaction step is complete, DE server is ready to receive the next input from the user and the process continues. DE monitors the interaction process and maintains a simple symbol table of DE variables recording essential state information. To get a better idea how forms are designed and written in practice, please see the DE home page at <http://matriisi.ee.tut.fi/ ~onykane/deserver/>.

Implementation

DE is based on a well-known CGI-based client-server architecture. Server software effectively exploits Mathedge development library providing full Maple V Release 3 Kernel functionality (Waterloo, 1995). Performance requirements for clients are minimal since DE server carries out all computations. Technical implementation of *Dynamic Exercises* follows guidelines found in (Nykänen & Pohjolainen, 1998). MathEdge is a relatively expensive product, available for HP9000 and Sun platforms, and the large-scale use of the software is limited inside our university with effective licensing policy. Maple is a well-known (commercial) general-purpose computer algebra system by the Waterloo Maple Software and the University of Waterloo. Maple includes a nice mathematical programming language and a rich set of mathematical packages and plotting facilities (see, e.g., (Heck, 1993)).

References

Heck, A. (1993). *Introduction to Maple*. Springer-Verlag, New York.

Nykänen, O & Ala-Rantala, M. (1998). A Design for a Hypermedia-Based Learning Environment. *Education and Information Technologies* 3 (pp.277-290).

Nykänen, O & Pohjolainen, S. (1998). Using General Purpose Computer Algebra System Maple in WWW-Based Open Learning Environments. In *Proceedings of the LeTTet'98 and MaTILDA'98 Joint Conference.* Pori, Finland, May 1998 (pp.73-80).

Pohjolainen, S., Ruokamo, H., Pesonen, K., Hartikainen, V-M & Nykänen, O. (2000). A Learning Experiment using A&O Open Learning Environment. In *Proceedings of ED-MEDIA 2000.*

Pohjolainen, S., Ruokamo, H & Nykänen, O. (1999). A&O Open Learning Environment. In *Proceedings of PEG 99*, Exeter, UK, July 10-12, 1999 (pp.23-34)

Waterloo (1995). *The MathEdge Developer's Guide for Unix.* Waterloo Maple Software, Ontario.

Added Value Services on the Greek Web for Schools

Giorgos Papadopoulos, Michalis Karamanis, Petros Roussos
Hellenic Pedagogical Institute
400 Mesogeion Av. & 1-3 Aig. Pelagous Str.
153 42 Ag. Paraskevi - Athens - Greece
[gpap, mkaram, peroussos]@pi-schools.gr

Abstract: During the last four years, the Hellenic Pedagogical Institute (HPI) has had a consistent presence in the WWW virtual space, providing various educational services to the Greek schools' community (http://www.pi-schools.gr). With the implementation of the project "Added Value Services on the Greek Web for Schools", the HPI aims to create an integrated learning environment over the WWW, which is going to complement and extend the already existing infrastructure. This paper addresses the objectives, the design principles and the functions of the project.

Project's philosophy and design

During the last three years, the Greek Ministry of Education has been attempting to introduce and utilize Internet technology in the educational process. Through various projects, secondary schools around the country are supplied with advanced computer and networking equipment as well as Internet access. None the less, the use of sophisticated equipment and Internet connection does not necessarily mean utilization of Internet technology to the educational process. Having access to the information does not necessarily mean an advance of knowledge (Laurilland, 1993, p. 123). The critical point for the effective incorporation of Internet services in the educational process is related firstly with a convenient access to high-quality content and secondly with teachers' capability to use the provided information and services as structural materials and components for the design of educational activities.

The HPI with the design and implementation of the project "Added-Value Services on the Greek Web for Schools" is aiming to create an integrated environment for the distribution of educational material and services through the Internet, for Greek secondary schools. The HPI's objective is not to enforce a centralized educational model on the Web, but to establish a number of services and design principles for the creation, expansion and maintenance of the Greek Educational Web. These services are classified along two main axes:

- Implementing a distance learning center (in a pilot mode) over the Internet for the increasing training needs of Greek secondary school teachers.
- Providing the schools with the ability to promote their projects and activities through the WWW.

The project creates an integrated learning environment, which is going to cover the functionality and activities for both axes. The users of the environment will have different access levels to the information and services provided according to their roles and needs. The services and activities are described as virtual "spaces" following the standard Internet terminology.

The first axis aims to create a flexible Internet based educational platform for the design, implementation and delivery of teacher training services at a distance. The adopted training model is based mainly on the principles of Supported Self-Learning model. In this model, the trainee has the ability both to use educational material and manipulate its flow and structure according to his/her learning goals. In addition, in order to avoid feelings of isolation and inactivity which are common during tele-training programs, dynamic communication channels (one to one, one to many, many to many) will be established (Nipper, 1989). In the framework of the adopted model, the distance-training center includes the following virtual spaces:

"Space" of training material, which is structured over two levels (level of resource-based training and level of structured training). The resource-based training level will function as a reference "place" for the teachers as well as a rich source of educational material for the enhancement of their work. The level of structured training aims to support the implementation and delivery of structured training programs for specific topics, making use of flexible tools appropriate for the demands and features of the Web-based learning environment (Dabbagh, 1999).

Promotion "Space" for the teachers' work. The structure and the function of this space will follow that provided by online journals, which are very common over the Web.

Teachers' "Meeting point", providing the community of teachers with both synchronous and asynchronous communication channels.

The design and implementation of the second axis aims to offer to the members of the educational community the opportunity to contribute their own work and activities on the Greek Web for Schools. Additionally, already existing digital educational material can be gathered and structured under thematic categories in order to facilitate the search process (Luebke *et al.*, 1999; Collis, 1995, p. 6-9). The second axis includes the following virtual spaces:

Space of educational material. The material will be annotated according to the developing international standards for educational metadata. The users will be able to submit remarks and comments on the provided material along with their own work.

Kiosk for school projects. In this virtual place, school projects and activities will be accommodated under specific thematic structures.

Exhibition of educational software. In this virtual space, informative material will appear concerning evaluated titles of educational software.

Schools' "meeting point", providing the members of the educational community (students, parents, teachers, managers) with both synchronous and asynchronous communication channels.

Operating specifications of the project

Online database of training and learning material. The database will cover the needs of the educational material and software along with those related to the level of resource - based training. Also, through the database application, both the needs of the Promotion "Space" for the teachers' work and the Kiosk for school projects will be facilitated.

Applications for the access to the Learning/Training material over the Internet. Through this application, the members of the educational community are going to dynamically interact with the material through their favorite browser over the Internet.

Online courses' authoring and delivery tools. These tools will facilitate instructors to create dynamic web-based courses and make them accessible over the Web.

Applications for text-based synchronous and asynchronous communication. These applications are going to serve the needs for the "meeting" points of both axes.

On-line help desk and search engine. The application will serve all spaces described.

Future plans for the project involve the creation of intelligent help agents and searching machines which will be included in the learning environment. Furthermore, the potential and the abilities of the collaborative virtual spaces (MOO) for educational purposes will be investigated. In addition, peripheral content servers will be created in order to accommodate issues of local interest. Finally, a lot of effort will be put on the enrichment of the environment with educational content. Towards this direction, all related authorities and organizations have been invited to participate.

References

Collis, B. (1995). *Tele-learning in a Digital World.* London: International Thomson Computer Press.

Dabbagh, N. (1999). Web-Based Course Authoring Tools: Pedagogical Implications. In B. Collis and R. Oliver (Eds), *Proceedings of ED-MEDIA 99.* Charlottesville: AACE

Laurilland, D. (1994). *Rethinking University Teaching. A framework for the effective use of educational technology.* London and New York: Routledge.

Luebke, S., Mason, H., & Rebelsky, A. (1999). Annotating the World Wide Web. In B. Collis and R. Oliver (Eds), *Proceedings of ED-MEDIA 99.* Charlottesville: AACE

Nipper, S. (1989). Third generation distance learning and computer conferencing. In R. Mason and A. Kaye (Eds.), *Mindwave, Communication, Computers and Distance Education.* Oxford: Pergamon Press.

A Multi-Method Strategy for The Assessment of Adult Literacy Software

Graham J. Passmore, Wayne Lewchuk, Geoffrey Rockwell, and Sandy Shaw
McMaster University
Canada

Abstract: This paper investigates the introduction of software into an adult literacy program. Pre and posttests, questionnaires, focus group interviews and iterative observation are combined to form a multi-method assessment strategy. The method is used to assess the satisfaction that users derive from computerised instruction. It is also used to assess the culture of learning that develops in the classroom. Six components of user satisfaction are identified: learning, teacher role, tedium, real-world applications, software and gender differences. An approachable, friendly and interactive teacher is found to be the key component of a successful learning environment.

Introduction

This project sought to identify best practices for introducing technology into the classroom. It was determined that this matter would best be investigated by answering the following questions: what is the nature of the satisfaction that users derive from a computerised adult literacy course, and what is the nature of the culture of learning that develops in such a course. Current thinking has it that multiple methods are needed to capture the variety of outcomes that students derive from an educational experience. A multi-method assessment strategy is described below as are the results obtained from its application

The study

Five software modules were developed. They were designed to teach the following literacy skills.
Module 1: Reading words and phrases
Module 2: Filling out forms
Module 3: Writing for various purposes
Module 4: Following instructions
Module 5: Reading to find information

Savenye (1992) considers suitable methods for answering common research questions. Her suggestions lead to the selection of the following methods for this study: participant observation and focus group interviews to assess user satisfaction and the culture of learning. Paper and pencil tests to assess learning outcomes (the quantity of learning) and questionnaires to assess attitude and socio-demographic background. Arrangements were made to access two basic computer literacy classes that were run in the Toronto Offices of the United Food and Commercial Workers Union. Each class contained 13 students. The methods were applied in each class over five consecutive weeks in the following manner. Prior to the first class the attitude and socio-demographic questionnaires were administered. Pre and posttests were administered before and after the students studied each module. Students were observed as they worked with each module and a focus group interview was run at the end of each class. Data from the first set of observations was collated into groups. The name of each group was said to represent a component of user satisfaction. Confirmation of the accuracy of the first set of observations was sought during the first focus group interview. Data from the interview was used to update the components of satisfaction as necessary. The observe/interview process was repeated for each module and the descriptions of user satisfaction and learning culture were refined at each iteration. The attitude questionnaire was rerun at the end of the study.

Results.

The attitude questionnaire consisted of six questions that were measured on a Likert scale of strongly agree to strongly disagree. At pre-test, the participants answers to the questions were that they: enjoy using computers to learn, think that it is important to learn how to use computers, look forward to using computers to learn, think it is easier to learn using computers, think that computer use makes for faster learning and that computers provide a better way to learn. Cochrane's test was used to detect attitude shifts from pre to posttest . Significant changes were detected for questions 1 ($p = 0.044$), 4 ($p = 0.025$), and 5 ($p = 0.001$). The change for question 1 was positive; the changes for questions 4 and 5 were negative. Despite these changes alone the Likert scale the participants' overall attitude (as described by the above responses) did not change over the course of the study.

Three sets of t-tests were run on the remaining data. Set one compared the mean responses of the socio-demographic groupings at pre-test. It indicated that females thought that learning to use the computer was more important than males ($X_1 = 1.26$, $X_2 = 1.11$, $p = 0.02$). No significant differences were detected between the remaining socio-demographic indices. In set two, pre-test scores were subtracted from post-test scores to determine which modules successfully taught what they were designed to teach. Modules 1, 3 and 4 produced significantly different pre- and post-test scores. (module 1 ($X_1 = 20.02$, $X_2 = 65.14$, $p = 0.00$), module 3 ($X_1 = 20.02$, $X_2 = 27.31$, $p = 0.00$), and module 4 ($X_1 = 32.00$, $X_2 = 39.56$, $p = 0.01$)). It is not known if modules 2 and 5 were inappropriately designed or whether the material they covered is unsuitable to computerised instruction. The third set of t-tests examined the influence that socio-demographics have on learning outcomes. No significant differences were detected for the socio-demographic groups.

The iterative observation process identified six components of user satisfaction: learning, teacher role, tedium, real world applications, software, and gender differences. In regard to learning, the students reported that the computerised instruction simulated one-on-one student-teacher interactions. That is they felt that the feedback provided by the software enabled (to some extent) self paced learning. Teacher role was seen as a pivotal component of a successful computer course. A teacher who is interactive and approachable is needed to alleviate the students' initial anxiety toward computerised instruction and to provide continuing support when problems arise. The above qualities develop a spirit of collaboration in the classroom. Although the students reported that they enjoyed using the software they also felt that it would be tedious to take an entire course on a computer. The fourth component, "real-world application" is an inherent plus for computerised instruction. Computer skills were seen as a ticket to a better job and a better life. The software component indicated that the skills of the learner have to be accounted for during the design of the software. At the start of the study students with very little computer experience required help from the teacher. Had the disparities between their skills and the software's operational demands been much greater they might have proved a barrier to learning. More experience computer users reported that they would have liked a more interactive multimedia format. Designers can avoid these problems by matching software to the skills of the learner. In regard to gender differences, a few of the male participants expressed an interest in a home-based computer course. Females indicated that there were too many distractions at home for them to learn effectively there.

A friendly, interactive teacher who encourages camaraderie and a fast pace of learning was deemed essential to the development of a positive culture of learning. Such a teacher promotes a sense of "we are all in this together." The small class size (13 computers) with students sitting close together was also thought to influence the creation of a collaborative atmosphere. The observer postulated that a positive class culture engenders faster learning as strong participants can provide timely assistance to the weak. When students interacted, they interacted in small groups of two or three. Operational problems of the software and the computer were discussed. By week three participants had become familiar with the software and their interactions dropped off considerably. From this time on data was primarily obtained from the focus group interviews

Conclusions

Iterative observation affords repeated runs at a question so that it can be explored in considerable detail. Multiple assessments mean that inaccurate conclusions drawn from initial observations may be removed. Iterative observation also affords the reallocation of resources to accommodate factors that are only discovered part-way through a series of observations. Evaluators wishing to use this technique should expect that changes will have to be made to their initial evaluation strategy. The ability to embrace these changes will determine the success of the investigation. The participants change in attitude toward computer learning may be a result of the hyperbole associated with the computer industry. If participants entered the study thinking that computers make for effortless, extremely rapid learning they would have been disappointed. Computerised instruction is not without problems, it works best when used in conjunction with a friendly interactive teacher who instills a spirit of collaboration in the classroom.

References

Savenye, W. C. (1992). Alternate methods for conducting formative evaluations of interactive instructional technologies (Report No. IRO15758). Arizona: Convention of the Association for Educational Communications and Technology. (ERIC Document Reproduction Service No. ED 348 021)

Choosing the tools wisely: Learning the lessons the hard way!

Denise M. Peterson
College of Education and Counseling
South Dakota State University
United States
Denise_Peterson@sdstate.edu

Loye Romereim-Holmes
College of Education and Counseling
South Dakota State University
United States
Loye_Romereim-Holmes@sdstate.edu

Abstract: This paper provides the experiences of two faculty members learning technology and how to integrate it. Both members have received grants to revise curriculum to integrate technology. Based on their experiences and the awarding of a technology challenge grant, faculty members are learning to choose their tools wisely.

Introduction

Given the current climate of technology integration in education, our institution has begun to encourage faculty to use technology within their classrooms. The mandate is clear from the governor on down to the college levels that technology will be used. Thus, there has been an increase in the number of faculty trying to use technology in their teaching. The real issue, however, is not using technology, but rather using it wisely.

The experience of a lifetime

Both authors have been recipients of summer grants awarded within the state's higher education system. Because of these awards both authors revised existing courses with the goal of increasing the technological aspects of the courses. These courses were requirements in the undergraduate teacher education program. The purpose of the awards was to increase technology skills and knowledge by both education faculty and students. The grant covered salary and provided each instructor with $5,000 to spend for equipment and training during the summer.

In each case the authors begin the process by investigating equipment they could purchase. This was welcomed because the existing technology had not been recently updated and therefore many of the project goals were not possible. One of the barriers encountered was the system for ordering equipment and software. The process was a complex process in which faculty took weeks of their project time to obtain bids and order the equipment they need to accomplish their goals.

Another issue that arose was support in terms of training on equipment use and programs. Faculty receiving the grants had to actively seek campus resources to order equipment, gain training in computer skills including WebPage design, course software and presentation media. Some training was offered through the Instructional Technology Center on campus, however, not all participants attended. Once discovered, the support persons were available to the awardees and provided guidance.

During this process the authors found that the grant was wonderful for receiving new equipment and learning skills. However, the actual course design and integration was an evolving process. In fact, the authors have found the longer they worked on their grant projects, the more they realized that technology integration is an ongoing process. Even though the spirit of the grant proposal was accomplished, some of the faculty found that more time, resources, and thought were needed to go into their projects. Thus the authors are making significant revisions to their courses as they realize that using technology to facilitate instruction is a complex process. The time it takes to implement technology that is truly useful to our students' learning is, at the outset, tremendous.

Both authors decided to use web-based materials to support instruction for their grant projects. Besides the grant projects, the authors have infused technology into other courses they teach. The goal in using web-based materials was not to provide the lecture notes for their classes but rather to extend learning opportunities within their classroom. This meant increasing access and interactivity between instructor and student as well as to student to student collaboration.

In one project the author used WebPage templates designed by the university's instructional designer. The templates allowed the faculty member to put materials such as an online syllabus, course schedule, assignments and discussion on the web. As courseware became available during the following year the information was migrated to the new courseware application which provided password protection for the course materials and interactions. Another goal in this project was to increase the student's use of technology and was accomplished by specific training and required projects such as use of the digital camera, scanners, and PowerPoint.

In the other project, the author took existing materials developed for web publication and updated the materials as well as adding components such as discussion, online surveying and project development. Courseware provided by the campus was used at first to revise the existing course. This courseware was not sufficient for the project's purpose so the author used grant time to find other courseware options.

As the awardees learned skills and extended their ideas, they became aware of the barriers in integrating technology such as problems with infrastructure, the selection of the web-based courseware and the ability to locate resources to facilitate web-supported instruction. The other concern was that while increasing skills in technology, faculty members were not being trained as to how courses including technology should be redesigned. Technology integration requires that faculty rethink how the education process really happens.

As this realization hit, the college began participating in a technology grant. Through the five-year statewide technology challenge grant entitled Learning Organizations for Technology Integration (LOFTI), faculty members in the college have begun to receive both technical instruction and instructional design instruction. The authors feel that the focus should be on teaching our content using technology to enhance the learning process. Technology is a media decision, which should be dependent on the faculty's need to communicate with students, the content, and the educational environment.

In the first year of the LOFTI grant, planning was done by a group of higher education faculty, students and practicing K-12 teachers. This group's first activity was an intensive week of skills-building workshop for faculty members. This workshop was planned to concentrate on skills identified through a needs assessment and included e-mail, building internet activities, basic word processing, spreadsheets, databases, ethics and standards, and WebPages development. Faculty members chose the sessions they wanted to attend and were paid a stipend based on the number of workshops they participated in. Also in the first year, a request for proposals went out among faculty calling for summer projects that revised curriculum to include technology integration for undergraduate teacher education students. These projects were intense in nature and, while not providing the monetary value of the previous statewide grant program, allowed faculty members to concentrate on a specific course revision.

Currently in the second year of LOFTI, the planning group has determined that the focus of the grant should be staff development in technology integration, recognizing that skills training still need to be offered. One of the projects is conducting college seminars on using instructional design principles to integrate technology within existing courses. The seminars allow faculty an opportunity to discuss, brainstorm and educate themselves about the concept of using technology as a tool.

Conclusion

Through our experiences with the statewide grant and the opportunities presented by the LOFTI grant, we hope to encourage appropriate use of technology to facilitate learning. We have discovered that time and resources are vital to the success of technology integration, however, these are not the only variables at play. Good instructional design principles and support and encouragement by fellow faculty members are necessary factors in developing curriculum, which uses technology that enhances the learning process. Ultimately, learning to integrate technology that strengthens our undergraduate teacher education students experience will provide a model for them to take into their classrooms of the future.

PUBLISHING IN THE FIELD OF INSTRUCTIONAL TECHNOLOGY: GETTING STARTED

Robert V. Price, Ph.D.

Nancy J. Maushak, Ph.D.,

Instructional Technology Program, College of Education, Texas Tech University
Box 41071, Texas Tech University, Lubbock, TX 79409 USA
Bob.Price@ttu.edu

Abstract: In this session, we provide a brief guide for aspiring authors in the field of educational technology. We concentrate on journal articles rather than on books or electronic publishing. After looking briefly at some of the reasons for publishing, we discuss some of the most popular types of articles currently appearing in the literature and review educational technology journals. Hints for creating publishable articles are also provided.

Many young professionals in the field of Educational Technology view the process of getting published as one involving mystical wisdom. Some find the prospect of rejection intimidating and others just don't know how to get started. While successful scholars in the field are sometimes characterized by an extraordinary intellect, most are primarily distinguished by a willingness to be systematic and persistent.

Why Publish?

Although the expression "publish or perish" has now become a cliché in academic circles, the importance of its message to faculty who desire to advance in higher education remains as strong as ever. For graduate students and recent graduates of educational technology programs desiring to obtain an academic position, publications can provide that extra edge that sets their credentials apart from those of other candidates. But even for those whose career success does not depend on publishing, there are considerable personal rewards of seeing one's work appear in print.

Publication Outlets

There are many journals that publish articles on educational technology. In addition to the many journals that deal directly with the field, there are dozens of others that publish articles in which an application of educational technology in a particular content area is the major theme. Because we can't review every educational journal, we have chosen to concentrate here on those journals that deal specifically with educational technology.

A review of *Cabell's Directory of Publishing Opportunities in Education, 5th edition, 1998* identified 37 journals that deal primarily with educational computing, Educational design, distance education, or other aspects of educational technology. Seventeen of these are listed in Table 1 showing circulation rate, acceptance rate, the time required for review of manuscripts, acceptable manuscript length, and the email address of the publisher. Information was not reported for the other 20 journals, so they have not been included. Readers should note that the information included here is self-reported and subject to change. This list is not meant as a comprehensive list but merely suggests the broad scope of possibilities for publication in educational technology.

Table 1: Educational Technology Journals

Title of Journal	Circulation	Acceptance Rate	Months to Review	Length	Email or URL

Behavior Research Methods, Instruments, and Computers	2001-3000	46%	2-3	any	proctor@psych.purdue.edu
British Journal of Educational Technology	1,300			4,000 words	www.blackwell.com
Education Technology Research and Development	4001-5000	11-20%	1-2	26-30	ross.steve@coe.memphis.edu
Educational Technology	3001-4000	21-30%	<=1	any	edtechpubs@aol.com
Educational Technology Systems	1001-2000	5%	4-6	16-20	TLIAO@ccmail.sunysb.edu
Information Technology & Libraries	5001-10,000	65%	2-3	>30	dan.marmion@wmich.edu
International Journal of Educational Telecommunications	<1000	NA	4-6	35	pubs@aace.org
International Journal of Instructional Media	2001-3000	11-20%	2-3	11-25	NA
Journal of Educational Computing Research	<1000	11-20%	2-3	26-30	rseidman@minerva.nhc.edu
Journal of Educational Multimedia and Hypermedia	1001-2000	21-30%	4-6	11-30	pubs@aace.org
Journal of Research on Computing in Education	2001-3000	50%	4-6	10-20	Dmcgrath@ksu.edu
Journal of Technology and Teacher Education	<1000	21-30%	4-6	11-30	www.aace.org
Journal of Technology Studies	5001-10,000	70%	2-3	15-25	jstreich@bgnet.bgsu.edu
Learning and Leading with Technology(Formerly: The Computing Teacher)	10,001-25,000	50%	4-6	3-8	anita_best@ccmail.uoregon.edu
Multimedia Schools	10,001-25,000	NA	4-6	2400 words	veccia@well.com
T. H. E. Journal: Technological Horizons in Education	>25000	11-20%	1-2	6-10	www.thejournal.com
TechTrends	5,001-10,000	40%	2-3	6-16	NA

It is worth noting that the same manuscript must not be submitted to more than 1 journal at the same time (American Psychological Association, 1994). However, it is generally accepted as ethical practice to present a paper at a conference and then submit the paper or a revision of the paper for journal publication.

Final Thoughts

In conclusion, learning to write for publication can be an exciting experience, help enhance your career, and earn you the respect of colleagues. Although at times publishing may be humbling, most aspiring authors become increasing successful with experience.

References

American Psychological Association. (1994). Publication Manual of the American Psychological Association (4th edition). Washington, D.C.: Author.

Cabell's Directory of Publishing Opportunities, 5th ed. (1998), Cabell Publishing Company.

Narrative and Visual Design of Web-based Learning Materials

Andy Reilly and Alison George
Media Development Department
The Open University
United Kingdom
a.a.rcilly@open.ac.uk/a.r.george@open.ac.uk

Introduction

Web-based publishing presents editors and graphic designers with novel problems. Can a hypertext presentation deliver a coherent narrative? What written style suits screen presentation? How can professional standards of graphic and typographical design be rendered successfully in HTML? This paper suggests some answers to these questions using experience drawn from the presentation of a large-scale web course in the U.K.

The Course

In 1999 a web-based course entitled, T171: *You, Your Computer and the Net* was presented to 900 U.K. and European students (Weller, 1999). This was a pilot presentation, and now in 2000 the course is being studied by 12,000+ students in its first full-scale presentation.

Editorial Issues

Publishing via the web poses problems of narrative design and written style that arise from the disjointed nature of hypertext (Plowman, 1998) and the well-documented difficulties of reading from screen (Jones et al., 1998).

The problems of constructing coherent narrative in disjointed media are often described in terms of the search for nonlinear narrative, as if nonlinear narratives are a new phenomenon of the digital age. Umberto Eco has pointed out (Eco, 1993) that in almost all literary fiction nonlinear narratives are the norm.

Students of film studies are similarly familiar with the scope for nonlinear narrative in an otherwise linear medium (Chatman, 1989).

Eco makes an important distinction between narrative and exposition. In a book or film the exposition is linear, but the narrative need not be.

The issue with interactive digital media is not so much 'how can we develop nonlinear narratives?', but rather 'how can we present coherent narratives in a medium in which the exposition is both nonlinear and under the reader's and not the author's control?'

The answer lies in the scope web constructors have for shaping the exposition. In our course we exploited the advantages of the web for both guided and free exploration, while tying our students to a core linear flow of information.

This structure can be summarised as the 'bottlebrush' narrative model.

Reading from screen is neither as comfortable or as efficient as reading from paper (Jones et al., 1998). There is thus an advantage to writing in a concise style (Morkes and Neilsen, 1997,1998). In our course the web site provides 'wrap-around' materials to support two set books (Cringely, 1996; Hafner and Lyon, 1998). The books in themselves carried strong narratives, and provided detailed, discursive texts. So the web site could be presented in a more condensed style, without risking it being either too obscure or too light-weight.

Brevity leads to the second style question: where does one strike the balance between asking your reader to scroll through a long page, and asking them to jump to a new one? We suggest a rough rule-of-thumb: don't require your readers to scroll for more than about five screen depths, and design your pages to download in a reasonable time.

Visual Design

The graphic designers were given the brief to produce a stylish, restrained and simple design that would be stable when viewed with any one of the commonly available browsers.

The site was rendered and managed using UserLand's Frontier. The graphic designers produced design templates in HTML using DreamWeaver, and the software support team wrote scripted macros that Frontier used to render tagged HTML files into finished designed pages. The generation of final pages was thus automated.

The first major design decision was whether to use frames or not. The arguments against frames included: the perceived difficulty of bookmarking framed pages, the relatively low browser specification that we had to accommodate, and the size and complexity of the site. The arguments for frames included: that the site would look more sophisticated (for example, menu lists would not scroll off the screen), and that navigation would be simpler in a frames environment. The final decision, however, was not to use frames.

We used tables to implement the design. Tables allow for quite sophisticated layouts, and it was not easy to decide how far to go in exploiting the potential of tables to deliver fine-tuned design. Compared to many commercial sites the T171 pages show a relatively simple design, but it should have been simpler. A balance had to be struck between the achievement of particular design effects, and the time expended to make them happen. For this balance to be struck both graphic and software specialists had to understand each other's different perspectives.

Seigel (1997) recommends that an average web page should be around 30k in size. Sometimes this can rise to 70k, but should never exceed 100k. As modem speeds improve these figures may need to be revised upwards, but the T171 design took them as benchmarks. This led to difficult decisions about how far to reduce the visual quality of illustrations in order to meet the benchmark file sizes. A lot of the images that provided the basic design were used many times, and so we could rely on them being cached by the students' browsers.

Conclusion

The web is a publishing medium, and web-based learning materials can benefit from support from publishing and design professionals. In supporting web-based educational publishing both editors and designers have to apply skills developed in the world of print publishing to a dynamic and potentially nonlinear medium.

In developing coherent narrative structures it is useful to recognise the distinction between narrative and exposition, and to employ narrative models that allow for exploration and discovery while maintaining an underlying narrative drive. The well-documented problems associated with reading from screen also demand conciseness.

Good visual design is important in enabling ease of use. Close teamworking between graphic designers and software support staff is essential, and both categories of staff need a good understanding of the nature of each other's task, and the constraints under which each operates.

Design decisions should be informed by considerations of orientation, navigation, complexity versus practicality, and download times.

References

Chatman, S. (1989) *Narrative Structure in Fiction and Film*, Cornell University Press.
Cringely, R. X. (1996) *Accidental Empires*, Penguin, Revised Edition 1996.
Eco, U. (1993) *Six Walks in the Fictional Woods*, Harvard University Press.
Hafner, K. and Lyon, M. (1998) *Where Wizards Stay Up Late: The Origins of the Internet*, Simon & Schuster.
Jones, M. H. , Kear, K. and Reilly, A. A. (1998). The design, development and use of a CD-ROM resource library for an Open University course. *British Journal of Educational Technology*, 29 (3), 241-254.
Morkes, J. and Nielsen, J. (1997) 'Concise, SCANNABLE, and Objective: How to Write for the Web', useit.com. Available on the web at: http://www.useit.com/papers/webwriting/writing.html
Morkes, J. and Nielsen, J. (1998) 'Applying writing guidelines to web pages', useit.com. Available on the web at: http://www.useit.com/papers/webwriting/rewriting.html.
Plowman, L. (1998) 'Getting sidetracked: cognitive overload, narrative, and interactive learning environments', The MENO project team, The Open University. Available on the web at: http://meno.open.ac.uk/meno/lydiacog.html
Seigel, D. (1997) *Creating Killer Web Sites*, 2nd edn., Verso Editions.

Weller, M.J. (1999) 'A large scale Internet based course for computer beginners', ED-MEDIA 99, AACE, pp. 1474-1475.

Evaluating Software for the New Millenium: An Example from *Project Links*

Jennifer C. Richardson, Karen Swan, and Dianna Newman
University at Albany
ED B-8, ED 114A
Albany, NY 12222
Jennrich1@hotmail.com , swan@cnsvax.albany.edu

Abstract: This paper reviews the design, implementation, and testing of *Project Links'* WWW- based modules developed at Rensselaer Polytechnic Institute (RPI) to support the integration of mathematics, science and engineering concepts in undergraduate teaching and teaming. Using the *Project Links* experience as an example, the authors argue for particular foci, as opposed to generic approaches, and formative, as opposed to summative, testing in the evaluation of technology-based programs and the usability of particular software.

Perspectives

Project Links is part of the *Mathematics and Its Application Across the Curriculum* initiative funded by the NSF and aimed at reforming undergraduate mathematics, science, and engineering education by making clear the connections between mathematics and its applications in science and engineering. *Project Links* centers on the development of a library of WWW-based hypermedia modules that link important topics in mathematics with useful applications in engineering and science. Modules in the library cover the mathematical areas traditionally studied by undergraduate engineering and science majors, including calculus, differential equations, mechanics and linear systems, advanced mathematical methods, and probability and statistics.

In the *Project Links* modules, these ideas are both explored as mathematical concepts and contextualized within applied science and/or engineering situations. Each module consists of several sections that are designed to be completed in a single class session or in part of a single class session. An important feature of most modules is interactive simulations designed to help learners visualize the mathematical, engineering, and/or scientific concepts being illustrated. Although they are made so that they can be used in a variety of instructional settings, *Project Links* modules are designed to support an innovative model of undergraduate education pioneered at RPI known as *studio* teaching and learning (Wilson, 1994). In studio style teaching and learning, large lecture classes are replaced by many smaller, technology-supported studio classes that integrate lecture, discussion, and laboratory-type explorations, many of which are computer-based or computer-supported (Boyce & Ecker, 1994).

Methodology

The authors reviewed *Project Links* documents and worked with the *Links* Project Directors to isolate a set of defining factors that the latter believed best encapsulated what was most important in the project. These were: the explicit linking of concepts, support for studio-type teaching and learning, flexibility (the potential to be used in other sorts of teaching and learning situations), support for collaborative learning, discovery orientation, and multi- modality (the use of multiple kinds of representations for single concepts). These factors then became the basis for the formative evaluation of *Project Links* modules. This evaluation is ongoing and has taken multiple approaches.

Firstly, a software evaluation protocol was designed to explore whether or not the six factors deemed most important *to Project Links* were explicitly instantiated in individual modules. Evaluators were asked to answer a series of questions in a narrative format for each of these factors, as well as to rank the modules using a scale of one to seven. Two evaluators independently completed the software evaluations for each module, then came together to resolve any differences through consensus.

Secondly, we devcloped a version of think aloud protocols (Erickson & Simon, 1993; Pressley & Afferbach, 1995) to explore the ways in which students make sense of the modules. Representative students were asked to work on particular modules, "thinking aloud" as they worked. As they did so, both their faces and the computer screen in which they were working were captured on a single videotape using a video mixer and picture-in-picture technique. Users were also asked to tell what they remembered from the modules (retrospective report) and to answer specific questions concerning their behaviors while viewing sections of the tapes (stimulated recall). Tapes of all three were reviewed for evidence of sense making, reflection, and usability issues.

Finally, studio classes in which modules were used were observed to explore their actual use in such setting, and students within those classes were interviewed to gain more detailed information concerning the software.

Results:

The software evaluation review protocol proved to be invaluable in the revision process during the ongoing development of *Project Links* modules, especially regarding the formatting of information, the design of multimedia simulations, and the overall design of the modules. In fact, a template was created to ensure consistency of navigation and design as a result of the review process.

In addition, the think aloud protocols demonstrated that the *Project Links* modules could be used by four categories of students - content area novices and experts, and technology novices and experts. Usability testing is ongoing to try and determine students' cognitive processes while interacting with the modules. Classroom observations have indicated that there is still a need for professional development concerning classroom use of the *Project Links* software. In particular, cooperative use of the modules is rare. An initial professional development day was completed in the spring and more are planned for the 1999/2000 school year.

Educational Significance:

Project Links is an innovative program that is exploring new ways of teaching and learning math, science, and engineering through technology at the undergraduate level that integrate concepts across these disciplines and help learners visualize difficult underlying concepts. This study helps highlight the software features and teaching practices that make it successful.

Additionally, this study demonstrates the efficacy of contextualizing software evaluation according to the particular purposes for which software is created. Such an approach, we believe, is beneficial for two reasons, First, it only makes sense to evaluate educational software relative to pedagogical purposes because differing purposes are best served in vastly different ways. Programmed instruction, or objectives based programs, for example, is well suited to behaviorist and perhaps information processing pedagogical approaches, but ill-suited indeed for constructivist ones. Secondly, assessment always guides practice. Teachers teach to the tests just as students study for them. Similarly, software designers will write and revise based on assessment procedures. Evaluation protocols that focus on the issues important to a particular project or pedagogical need will help insure that those issues are held central.

References

Boyce, W. E. & Ecker, J. G. (1995) The computer-oriented calculus course at Rensselaer Polytechnic Institute. *College Mathematics Journal, **26, 45-50.***

Erickson, K. A. & Simon, H. A. (I *993) Protocol Analysis: Verbal Reports as Data.* Cambridge, NM: MIT Press,

Pressley, M. & Afferbach, P. (1 *995) Verbal Protocols of reading.* Hillsdale, NJ: Lawrence Erlbaum Associates

Wilson, J. M. (I 994) The CUPLE physics studio. *The Physics Teacher, 32,* (9), 518-523

How to Make the Most of Online Interaction

Introduction

The educational community is finding itself on the edge of a new era, online learning. Online learning has been shown to be more cost-effective and convenient than traditional educational environments as well as providing opportunity for more learners to continue their education. However, some critics claim that web-based or online learning is not as effective as traditional classroom learning experiences (see Freeman and Capper, 1999; Noble, 1996; Perelman, 1992; Cuban, 1986). When queried as to the difference in the learning experiences across environmental format, many cite the lack of face-to-face interactions as being the foremost deficiency. However, when considering this challenge, researchers have to ask themselves if it is really the act of viewing, the instructor/students, that is an essential element of learning, and if not, then what element are these critics referring to? Perhaps it is the interactions that take place between the student and instructor, but interactions can take place in an online environment as well as in a traditional classroom. This being the case, we argue that the element that critics are referring to is that of "social presence."

Social presence theory, a sub-area of communication theory, postulates that the critical factor in a communication medium is its "social presence," which is defined as the "degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships" (Short, Williams, and Christie; 1976, p. 65). This is interpreted as the degree to which a person is perceived as a "real person" in mediated communication. Short, et al. further define social presence as a quality of the medium itself and hypothesized that communication media vary in their degree of social presence. Social presence is described as a construct that comprises a number of dimensions relating to the degree of interpersonal contact including the concepts of "intimacy" and "immediacy." Thus, it can be argued that social presence is both a factor of the medium as well as of the communicators and their presence in a sequence of interactions (Gunawardena and Zittle; 1997).

Review of the Literature

In the era of online and web-based learning and course offerings, there is an increasing need to understand social and political contexts of learning that are created by this type of learning environment. The significance can be demonstrated by the growth of available online courses. For example, The SUNY Learning Network (SLN), the most comprehensive online course network in the country, has increased the number of courses they offer from 4 in the 1995-1996 academic year to over 1,000 courses in the 1999-2000 academic year, a growth of more than 250% in less than five years (Swan, Shea, Fredericksen, Pickett, Pelz, and Maher, in press). Recent studies conducted by Jones (1998), Baym (1998), Agre (1998), Gunawardena (1997), Haraism (1993), Warschauer (1999), and Rheingold (1993) have emphasized the need for further research into the social context of web-based environments as it impacts learning and communication. To date there has not been much research done on Social Presence Theory and computer-mediated communications. A review of the literature produced only four articles pertaining to this area.

Although Hackman and Zane's (1990) work examines a televised classroom environment, it examines issues in common with online learning and social presence. Their study investigated the effects of conveyance systems design and social presence, in the form of teacher immediacy behavior, on perceived student learning and satisfaction. The results indicate that system design and teacher immediacy behavior strongly impact student learning and satisfaction. In addition, system variables such as interactivity (e.g. students are able to comment during lectures) and clear audio and video transmission positively influenced perceived learning and satisfaction. Moreover, it was found that instructors that engaged in immediate behaviors such as encouraging involvement, offering individual feedback, and promoting a relationship with off-campus students were viewed more favorably (p. 203).

Demonstrating the shift in social presence theory, Gunawardena (1995) conducted a two-part study examining whether social presence was an attribute of the communication medium or users' perception of the medium. The studies were conducted in the Spring of 1992 and Fall of 1993 with students who participated in a GlobalEd computer conference course. GlobalEd "linked graduate students in several universities to discuss issues related to distance education, engage in collaborative learning and research related to distance education, and experience distance education" by using technological medium conducive to the deliverance of distance education (p. 149). The studies focused on students' perceptions of seventeen five-point bipolar scales related to the computer-mediated conference system. The GlobalEd conferences were conducted using a listserv, or an electronic distribution list. The findings from both of her studies indicated that "although computer-mediated conferencing (CMC) is considered to be low in its ability to convey social presence, participants tin this conference rated CMC highly as an interactive, active, and social medium" (p. 158). It is the researcher's belief that these findings were due in past to the social cohesion of the conference and the individual input from each student that allowed them to create an online community. In other words, social presence wasn't a quality of the medium, as Short, Christie and Williams (1972) initially proposed, but rather a quality of how the participants chose to interact with the medium. If the participants had not been committed to creating a cohesive online community then they could have fallen victim to the medium. As Gunawardena explains, "the participants create social presence by projecting their identities and building online communities. In order to encourage interaction and collaborative learning, it is important that moderators of computer conferencing promote the creation of conducive learning environments. CMC participants can be trained to create social presence in a text-based medium and build a sense of community" (p. 163).

It is also Gunawardena's belief that "in reviewing social presence research, it is important to examine whether the actual characteristics of the media are the causal determinants of communication differences or whether users' perceptions of media alter their behavior. It was noted that social presence can 'be cultured' among teleconference participants, a position different from the view that social presence is largely an attribute of the communication medium" (p. 164). This study is especially significant because it demonstrates that Short, Williams and Christie work has become somewhat outdated in terms of defining social presence. Although to be fair, they could not have guessed the capabilities of today's technological innovations.

In a later study by Gunawardena (1997), she examined the possibility of using social presence as a predictor of satisfaction within a computer-mediated conferencing environment. The participants were 50 graduate students from five universities enrolled in a "GlobalEd" conference course that provided a forum for graduate students in distance education to share and discuss research and experience distance education by using computer-mediated communication. The instrumentation consisted of a questionnaire developed to assess participants responses to CMC, the GlobalEd experience, and areas of theoretical interest identified in the literature as potential influences on CMC satisfaction; fifty-two five-point Likert-scale items were used as the measure (Gunawardena, 1997, p. 13). The results demonstrated that approximately 58% of the variance was contributed by social presence, suggesting that social presence is a strong predictor of satisfaction in a text-based computer conference. Moreover, it also "supports the view that the relational or social aspect of CMC is an important element that contributes to the overall satisfaction of task-oriented or academic computer conferences" (p. 19). In addition, students' perceived enhanced socio-emotional experience by using emoticons (symbols to express emotions) to express missing nonverbal cues in written form. Overall, the findings imply the need for designing academic computer conferences where equal attention must be paid to designing techniques that enhance social presence and instructors will need to learn to adapt to the CMC medium by developing skills that create a sense of social presence (p. 19).

Finally, Boverie, Nagel, McGee, and Garcia (1996) conducted a study to examine elements of learning styles, emotional intelligence, and social presence as predictors of distance education student satisfaction needs. The participants were enrolled in two different class formats: a 16 week traditional format teleconference class and a weekend format teleconference class; e-mail was also used for group discussions and learner support. The results showed that of the three constructs, only Social Presence was found to be a significant predictor of satisfaction. In other words, regardless of student location on-site or off-site, or status as a graduate or undergraduate student, participants who perceived higher social presence also perceived a higher level of satisfaction overall with the course. A secondary finding also indicated that those students who perceived a higher level of social presence also tended to anticipate a higher outcome in terms of grades (e.g. A versus B). The researchers hypothesize that the higher confidence levels may also affect the students' perceived closeness with the instructor.

There is a need for further research in the area of socio-psychological perspective in computer-mediated communication as the measures and research methods to date have been few and they have not been validated. In addition, the fact that studies conducted in traditional classrooms point toward teacher immediacy and/or social presence as a highly significant factor in improving instructional effectiveness, it is necessary for research to be continued in these areas in relation to online learning in order to build a better model of online education.

By beginning the examination of available research studies conducted on the construct of teacher immediacy, it is evident that this construct is essential to learning in terms of affective, cognitive, and student attitudinal effects. By reviewing the research, teacher immediacy has demonstrated that it not only affects outcomes but also student, and possibly instructor, satisfaction with a course (Moore, Masterson, Christophel, and Shea, 1996).

In addition, the construct of social presence appears to have subsumed that of teacher immediacy while also taking into consideration the fact that some medium (e.g. computer, satellite television, audio-tapes) is in some way altering the learning environment. Moreover, the research on social presence has demonstrated a shift in thinking for this construct. While social presence theory was initially considered a quality of the medium (Short, Williams, and Christie, 1976), it has been demonstrated by research studies that this may not in fact be the case. Instead, recent researchers in the area of online education and computer-mediated conferencing claim that social presence should be considered to be a quality of the users of a medium. Gunawardena claims that social presence can be created or "cultured" in computer-conferencing environments, just as it can be created in a traditional classroom. Although nonverbal immediacy behaviors, such as facial expressions and dress may not be transmitted via computers or other mediums, the possibility exists that users of a particular medium may not only compensate for their loss but also create a parallel set of behaviors (e.g. emoticons).

Moreover, these findings have serious implications for the development of online courses. As other areas of research have demonstrated, it is essential that courses are created in a way that demands interactivity among participants not only with the material, but also with each other and instructors (see Irani, 1998; Hiltz, 1994; Romiszowski and Cheng, 1992; Haraism, 1987). This area of research substantiates those claims by demonstrating that the amount of social presence and/or teacher immediacy behaviors play a strong role in the motivation and levels of satisfaction students derive from a course, as well as their learning outcomes in terms of cognitive and affective behaviors.

Finally, there is a significant need for further research into both teacher immediacy and social presence constructs. Not only because they have thus far proven to be essential to learning outcomes and student satisfaction, but also because there is a lack of research in these areas in both traditional learning environments and especially the online learning environment.

Purpose

XXX. More specifically, the purpose of this paper is to examine the course activities and the nature and frequency of instructor participation/interaction as they relate to students' perceptions of overall course satisfaction.

Methodology

Participants

In the fall of 1999, surveys were posted in a common "bulletin board" area and students enrolled in the online courses were asked to complete the surveys.XX of the XX students, only XX responded to the survey. The low student response rate is one limitation of this study.

Instrumentation

One focus of the posted survey was to gather students' perceptions regarding the social presence of the instructor, medium of delivery, and satisfaction with online course. Students were asked to give background information regarding their education (e.g. number of college creditsgender, age, etc.). Next, they were given 13 Likert-type questions with responses ranging from 1 to 5 (strongly agree to strongly disagree). Finally, they were asked to answer 6 open-ended questions to gather further detail regarding the Likert-type questions. All of the questions, both Likert and open-ended were then coded so that analyses could be run.

Results

Due to the low number of respondents, a nonparametric test of bivariate correlations (Spearman's rho) was run and analyzed. By looking at the bivariate correlations between overall course satisfaction and the Social Presence Scale (modified from Gunawarden and Zittle, 1997) we found the following significant correlations:

• Online or web-based education is an excellent medium for social interaction		.333*	
• I felt comfortable conversing through this medium	.343*		
• I felt comfortable introducing myself in this course	.336*		
• The introductions enabled me to form a sense of online community.		.515**	
• I felt comfortable participating in course discussions.	.519**		
• I felt comfortable interacting with other participants in the course.			.415**
• I was able to form distinct individual impressions of some course participants		.377*	
• The instructor created a feeling of an online community.	.405*		
• The instructor facilitated discussions in the course	.405*		

(significant at the .05 level, significant at the .01 level)

Discussion

Thus, the significant correlations indicate that there is indeed a strong relationship between the social presence students' perceive in an online course and overall course satisfaction.

Subsequent studies are looking at these areas as they relate to students' perceived learning and to instructor reports of student learning. These studies are informing our instructor training process to emphasize effective use of "airtime" in designing course activities and in participation during course delivery.

Implications for future research

Future research implications include the need for further study into the area of social presence and online courses to determine the best possible course design as well as indicators for successful courses.

The Affordances and Constraints of Asynchronous Learning Networks: Looking at Interaction in an Online Environment

Jennifer C. Richardson, Craig Tunwall, and Carol Carnevale
Center for Learning and Technology
SUNY Empire State College
Saratoga Springs, NY, USA
JennRich1@hotmail.com

Introduction

As researchers in the relatively new dimension of online learning, we need to gain a better understanding of the different interactions that can and do occur in these developing learning environments, as well as their effect on students' levels of satisfaction. The positive relationship between students' satisfaction with instruction and their subsequent success in a course (Pascarella, et al., 1996) is further linked with the integral role that interaction plays in the level of learning attained by students (Vygotsky, 1986; Maxwell, Richter and McCain, 1995; Reeves and Reeves, 1996). More importantly, "few chances to interact with the instructor limits students' ability to clarify and negotiate instructional goals, explore alternative methods, or construct meaning within in a social context based on personal knowledge (Garrison, 1993)."

The importance of teacher-student interactions in successful teaching episodes is supported by a large body of research, much of which illustrates the belief that without interaction, knowledge, whether it be in the form of concepts, skills, or strategies, tends to be inert, and learner's lack the ability to apply the new knowledge effectively (see Laurillard, 1994; Bennett and Dunne, 1991; Webb, 1991; Clements and Nastassi, 1988; Vygotsky, 1978). To quote Oliver and McLoughlin (1997), "few dispute the advantages offered by interactive elements that support dialogue in teaching and learning. Communicative interactions can be used to engage learners, to cause them to reflect on and to articulate ideas. Interactions encourage and facilitate cognition and play an important part in promoting learners' intellectual operations and thinking processes (p. 37)." In addition, when high levels of interaction are present, students report that they experience more than in situations that involve low levels of instructor-student interactions (Richard, Gorham, and McCroskey, 1987:, Gorham, 1988).

When dealing specifically with web courses or online courses, interaction and feedback have significant impact on the learning process since they add value that results in improving quality and success in those courses (Hazari and Schnorr, 1999). In addition, Comeaux (1995) has also found that interaction and involvement lessened the psychological distance for students at remote learning sites. Moreover, the findings of Moore and Kearsley (1996) and Cornell and Martin (1997) show that interaction and feedback from the instructor are factors that not only play a role in course satisfaction but also in course completion. Similarly, Barker, Frisbie, and Patrick (1989) argue that the effectiveness of distance learning is increased through enhanced instructor-student interaction. This line of research is further validated by studies on feedback within the distance education model and its relation to the attitudes of students (McCleary and Egan, 1989).

Purpose

The purpose of this paper is to determine if interaction in online courses has an effect on students' perceptions of that course. More specifically we would like to establish a better understanding of the possible relationships that exist between students' perceptions of interaction in online courses and overall course satisfaction.

Methodology

Participants

In the summer of 1999, surveys were sent out to students enrolled in online courses through the Center for Distance Learning at Empire State College for the Spring 1999 semester. Of the 127 possible participants, 37 responded, giving us a return rate of 29%.

Instrumentation

The focus of the distributed survey was to gain a better understanding of student's perceptions of learning, learning styles, instructor interaction, and student-to-student interaction. Students were asked to give background information regarding their education as well as the number of courses taken in online format. They were given 13 Likert-type questions with responses ranging from 1 to 5 (strongly agree to strongly disagree) that dealt with interaction and course satisfaction variables. Finally, they were asked to answer 6 open-ended questions to gather further detail regarding the Likert-type questions. All of the questions, both Likert and open-ended were then coded so that analyses could be run.

Results

Correlations between three of the four interaction indicators examined were statistically significant at the $p<.01$ level. An examination of the analysis revealed the following: students' perception of instructor interaction (in general) and overall course satisfaction had a strong positive correlation (.615); students' perceptions of instructor feedback and overall course satisfaction had a strong positive correlation (.732); and students' perceptions of interaction with other students for the purpose of offering support and/or differing perspectives and overall course satisfaction registered a moderate positive correlation (.474). However, students' perceptions of interaction with other students (in general) and overall course satisfaction did not indicate a statistically significant correlation (.07).

Discussion and Implications for Future Research

The aforementioned findings indicate that there is indeed a strong positive relationship between students' perceptions of interactions in online courses and their satisfaction level with those courses. Moreover, these findings indicate instructor feedback and course satisfaction are the strongest relationship, which tells us that students perceive the importance of scaffolding their knowledge with that if the instructor. Similarly, while students' perceive interaction with other students to also be important, it is not perceived to be more important than interaction with the instructor.

Subsequent studies are in progress examining which course activities effect these relationships as well as how these areas relate to students' perceived learning and to instructor reports of student learning. Finally, these studies are informing the instructor training process to emphasize effective use of "airtime" in designing course activities and in participation during course delivery. These studies will also examine the demographic variables of the student population to look for potential effects.

References

Barker, B., Frisbie, A., and Patrick, K. (1989). Broadening the definition of distance education in light of the new telecommunications technologies. The American Journal of Distance Education, 3 (1), 20-29.

Comeaux, P. (1995). The impact of an interactive distance learning network on classroom communication. Communication Education, 44, 355-361.

Garrison, D.R. (1993). A cognitive constructivist view of distance education: An analysis of teaching-learning assumptions. Distance Education, 14 (2), 199-211.

Hazari, S. and Schnorr, D. (1999). Leveraging student feedback to improve teaching in Web-based courses. T H E Journal, 26 (11), 30-37.

McCleary, I.V. and Egan, M.W. (1989). Program design and evaluation: Two-way interactive television. The American Journal of Distance Education, 3 (1), 50-60.

Moore, M. and Kearsley, G. (1996). Distance education: A systems view. Belmont, CA: Wadsworth Publishing.

Oliver, R. and McLoughlin, C. (1997). Interactions in audiographics teaching and learning environments. The American Journal of Distance Education, 11 (1), 34-54.

Pascarella, E.T., Whitt, E.J., Nora, A., Edison, M., Hagedorn, L.S., and Terenzini, P.T. (1996). What have we learned from the first year of The National Study of Student Learning? Journal of College Student Development, 37 (2), 182-192.

Reeves, T.C. and Reeves, P.M. (1996). Higher Education and the WWW. [online] Available at http://itech1.coe.uga.edu/higherEd/index.html.

Richmond, V., Gorham, J., and McCroskey, J. (1987). The relationship between selected immediacy behaviors and cognitive learning. In L. Barker Communication Yearbook, 10 (pp. 574-590). New Brunswick, NJ: Transaction Books.

Automating Online Course Evaluations Over the WWW

Guido Rößling, Bernd Freisleben
Department of Electrical Engineering and Computer Science
University of Siegen
Hölderlinstr. 3, D-57068 Siegen, Germany
{roessling,freisleb}@informatik.uni-siegen.de

Abstract: Evalutions are regularly used in many universities. Manual evaluation is very time-consuming, and therefore a natural candidate for delegation to computers. To avoid duplicating code or evaluation forms, we have developed a collection of tools that can address all evaluation needs. Statistics can also be gathered on the fly by accessing the tools online.

Introduction

During the last year, we have implemented *WebWorks*, a tool suite for Web administration in teaching. In this paper, we describe the subcomponent for online evaluations of the *WebWorks* project. Several other components of the *WebWorks* tool suite have previously been described elsewhere (see references), and include support for *administering online knowledge tests*, *text* and *animation generation*, an *animation tool*, and *automatic indexing*.

Evaluations are regularly used in many universities for a variety of different courses. The basic evaluation process usually remains the same; sometimes, the only difference between two evaluations lies in some questions, date and title. Thus, it would be helpful to have a single tool that can handle an arbitrary number of evaluations and is easily customizable. For this purpose, we have developed a collection of Perl tools that support the whole evaluation process over the WWW. One tool is responsible for generating the evaluation forms and storing the entries, while another tool handles the generation of evaluation reports in a variety of formats.
In the following, we will briefly outline the tools and their functionality.

Generating Online Forms Using the **feedback** Tool

The tool feedback is responsible for generating a HTML form according to the settings for the current evaluation context and parsing user input. The basic structure of the feedback tool is shown on the left side of figure 1.

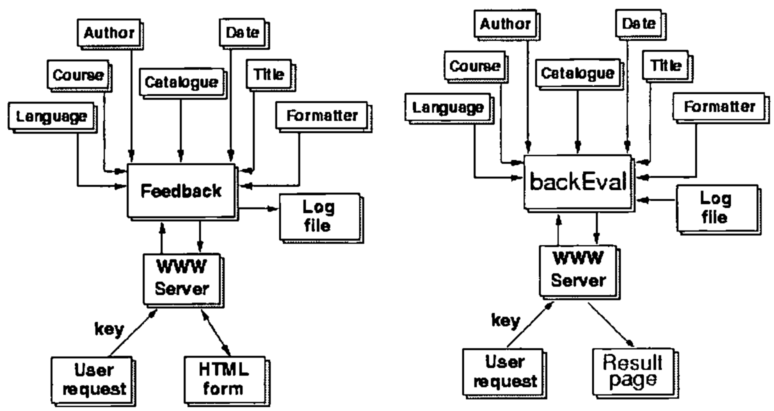


Figure 1. Components and Interaction of feedback and backEval

BEST COPY AVAILABLE

All entries apart from *date* and *title* are components allowing for easy reuse and dynamic exchange. Thus, it is very easy to reuse a given set of questions and possible answers (called "*catalogue*") in a different context by simply replacing the *author* and *course* components. feedback currently supports standard text messages in both English and German, but can easily be extended to other languages. The *formatter* component can currently provide output in either ASCII, HTML and LATEX; we are also working on providing RTF output.

When a user accesses feedback with a given access key, the required components are determined and used to build a HTML form. The HTML elements *radio button, selection menu, checkbox, text field* and *text area* are supported. Upon submission of the form, feedback checks if all entries marked as *mandatory* are given, and if so, generates a new entry into the log file.

Each catalogue consists of a set of question entries. Each question entry contains a *question text*, *type* and a list of *answers*. Furthermore, the author can mark any question as *mandatory*, and select whether the evaluation of the entry should be available to all users, only the author, or remain completely hidden. Registering a new catalogue requires specifying the entries shown in figure 1 and entering a single line in the ASCII-based registry.

Automatic Evaluation Report Generation Using **backEval**

The backEval tool has the same basic architecture as feedback, as shown in figure 1. Any user may access the tool via the WWW to get up-to-date statistics on any given evaluation; however, as mentioned before, authors may restrict the availability of entries.

The generated page contains all questions visible to the current user including their evaluation. The evaluation lists the question, all possible answers and how often they were chosen by users. Text inputs resulting from text fields cannot be displayed in this way, as it is rather unlikely that two users have entered precisely the same text. Thus, text entries are shown in formatted lists.

Statistics are generated in either ASCII, HTML or LATEX format, with a RTF implementation under development. Except for ASCII format, colored bars are used to highlight the percentage of any given answer. It is thus easily possibly for any user to print the current evaluation directly from their preferred browser.

backEval has a number of options for modifying the display of the statistics. It can also show the submitted entries separately in the order they were given, making it applicable for tasks such as online registration. Due to privacy concerns, this evaluation can only be selected by the authenticated author of the given catalogue.

References

Rößling, G. & Freisleben, B. (2000). Approaches for Generating Animations for Lectures. *11th Society for Technology and Teacher Education Conference (SITE 2000)*, 2000, Association for the Advancement of Computers in Education, Charlottesville, VA. 804-809.

Rößling, G. & Freisleben, B. (2000). Experiences of Using Animations in Introductory Computer Science Lectures. *31st SIGCSE Technical Symposium on Computer Science Education (SIGCSE 2000)*, 2000, Association for Computing Machinery, New York, NY. 134-139.

Rößling, G., Schüler, M. & Freisleben, B. (2000). The Animal Algorithm Animation Tool. *5th Annual Conference on Information Technology in Computer Science Education (ITiCSE 2000)*, 2000, Association for Computing Machinery, New York, NY (to appear).

You CAN Get There From Here - Developing Assessments from Skill Standards

Peter Saflund, Bellevue Community College, USA
Lauren Hebert, The Chauncey Group International, Inc, USA

This paper describes effective ways that the nationally validated Information Technology Skill Standards developed by the NorthWest Center for Emerging Technologies have been used by the Chauncey Group, Divison of Educational Testing Service to develop vendor - neutral certification exams in eight IT skill cluster areas. The paper will also describe preparation workshops and educator versions of the exams that allow faculty to demonstrate or certify their expertise in Information Technology, and how educators benefit from the program.

Collaborative Hybrid CD-ROM / Internet in a "Learning by Doing and Creating" environment

Nicoletta Sala
Academy of Architecture of Mendrisio
University of Italian Switzerland
Largo Bernasconi
CH 6850 Mendrisio - Switzerland
nsala @ arch.unisi.ch

Abstract: Constructivism is learning which takes place when learners actively construct their own reality and/or knowledge or least interpret it based upon their perceptions of experience. Constructivism, as theory of learning, is a subject which educators are beginning to discuss in connection with Distance Education and Computer - Mediated Communication. The use of multimedia technologies can help the constructivist theory because it is possible to build a "Learning by Doing" environment that combines multimedia technologies and the constructivist approach. In educational process the students generally build hypertexts and hypermedia on subjects which they know. Their teachers control and give them all information to include in hypertext. Using this approach the role of the students is passive, because they transfer, on digital documents, information furnished by the teachers. For this reason I have thought to control two different samples of students that have researched, selected information, and produced a hybrid CD-ROM/Internet on a subject which they didn't know before (Neural Networks). This paper describes this project which I have named "Learning by Doing and Creating" (LDC).

Scenario

Two different samples of students (aged 17- 20) of a High School (specialization course in Information Technologies), during the school years 1997-98 (15 students) and 1998-99 (14 students), have researched, studied and built a hypermedia (on Neural Networks) using the new educational technologies and they will propose this CD-ROM to other students. This hypermedia has been developed in the Laboratory of System and Techniques of Transmission (3 hours in the week throughout the school year) in a technical institute in Italy. I have organized my educational project in three stages.

First stage of the project

In the first stage, school year 1997 - 98, I have worked with 15 students (aged 17 - 19). I have proposed them a simple multiple choices test (8 questions) to control the students' knowledge on the Neural Networks. The percentage of correct answers has been the 27,5% (33 on 120) , deducing that my students didn't know the subject "Neural Networks" and they were a good sample to try my "Learning by Doing and Creating" (LDC) approach. After the test, the students have researched in the Internet: information on hypertexts and on hypermedia; (their history and their organisation), how to build a hypertext (using HTML) and hypermedia (with an introduction to Java Language and Java-Script). I have also explained them how to use some software and hardware tools to digitized the images, the movies, the sounds, and the correct calibration of the communication codes in educational hypermedia [Sala, 1999a; Sala, 1999b]. Inside this approach I have introduced some novelties. For example: a periodical "time out" which is a stop of all activities in the classroom. It is necessary to discuss the students' problem during the project (e.g., the coordination with the components of the group, the interaction between the groups, the organization of the hypertext, and so forth), and a journal of the classroom where the students resume all project' activities done in a day (like a "logbook"). The sample of the students has:

- researched in the Internet some information on Neural Networks,
- researched the main bibliography (using the public libraries),
- selected the information,
- built the storyboard of the hypertext (they have chosen a hierarchical hypertext),
- chosen other information to insert in the hypermedia (e.g., animations, movies, and so forth);
- realized and controlled the hyperlinks.

The hypermedia has been carried out using the Hypertext Mark Up Language (HTML) because it is easy to learn, it can be integrated with Java Applet and Java Script to introduce the multimedia codes (e.g., the animations, the movies), and

we can used a common browser without runtime module (e.g., Netscape Navigator™ or Internet Explorer™).
First version of this hypermedia, finished in month of June 1998, comprises: 20 pages of hypertext, 20 animations using Java language and Java Script, 2 movies (one is an interview to an expert on Neural Networks, the other is on the authors). After the hypermedia production my students have studied, for six hours, the subject "Neural Networks" (NN) using their CD-ROM. During the learning phase the students have noted that it is difficult to study using only the monitor without a textbook. For this reason they have selected the text frames and, using "Copy and Paste", they have made notes. An other problem is the cognitive overhead, which is avoided only by the best students. I have also controlled their knowledge using multiple - choice tests (15 questions, the first 8 questions were the same of the first test). The worst case of this multiple-choices test corresponds to the question 15 ("To draw some model of Neural Networks") because this subject is difficult to understand for Secondary School students and it has been proposed in a long hypertextual page (using the scrolling). The results of these analysis have been encouraging, because the 65.3% (which corresponds to the 147 correct answers on 225) of my students have achieved the educational goals that I have established. The comparisons between the first test and eight same questions of the second have demonstrated that the students have learnt the subject Neural Networks (first test 27.5%, second test 72.5%). My contribution to the project has been well evaluated. I have used the negative data to modify my interaction with the classroom; this feedback it has been important because all educational process was under control.

Second stage of the project

In the second stage, school year 1998 - 99, I have worked with another sample of 14 students (aged 18 - 20) of the same technical school . have answered to the entry test on NN (the same of the last sample) and after they have analysed the hypermedia produced. They have evaluated, answering to the multiple choices test, the icons (e.g., the shape and the image should recall the linking function); the hot words, the text- frames, the visual interface, the navigation in the hypermedia. The results of this analysis have been used to modified the first version of the hypermedia. The second sample of the students have modified the contents of the hypermedia difficult to understand (e.g., some pages dedicated to the Hopfield's model), and they have added other pages (e.g., three pages dedicated to the Kohonen's model). New version of this hypermedia comprises a map which performs the "here we are function", 90 pages of hypertext, 25 animations using Java language and Java script, 10 digitized videotaped segments (quick-time movies), 30 links to other Internet sites on Neural Networks. In the last part of this second stage, I have controlled the students' knowledge on Neural Networks using the same multiple - choices test that I have proposed in the school year 1997/98. The correct answers have been 157 on 210 (74.8%) I have also made a comparison with the two samples of students using the histograms.

Conclusions

This educational project is a "work in progress". In the school year 1999/2000 I shall control a third sample of students that will study the Neural Networks using the traditional educational methods, and I shall compare the educational results with the other two samples. This LDC approach is an example of "Learning by Doing" environment where some students build an educational hypermedia and they learn while build it. I have added the term "Creating" because there was also the creativity during this hypermedia development (e.g., the creation of the animations, the choose of the graphics interface, and so forth). Some researchers, such as Spiro and Jehng (1990), have emphasized the active role learners must play in order to learn in hypertext-based learning environments. Therefore, the multimedia technologies can help the teachers to complete this evolution. I think that the "Learning by Doing and Creating" approach is in agreement with this old Chinese proverb: *" If I listen, I forget; if I see, I remember; if I do, I understand".*

Reference

Sala N. How to Use Some Multimedia Technologies in a New Course of Mathematics: the Case of Architecture of the Academy of Architecture of Mendrisio . *Proceedings M-SET 99,* Editor David A. Thomas, (1999a) pp. 310 - 315.

Sala N. Multimedia Training and Remote Operating Laboratory: New Solutions for Electronic Measurements Courses. *Proceedings ED-MEDIA '99* Edited by Betty Collins & Ron Oliver (1999b) pp. 792 - 797.

Spiro R. J. and Jehng J. Cognitive flexibility and hypertext theory and technology for the nonlinear and multidimensional travel of complex subject matter. In D. Nix and R. Spiro (Eds.) *Cognition, education, and multimedia: Exploring ideas in higher technology.* Hillsdale, NJ: Lawrence Erlbaum (1990) pp. 163 - 205.

A Study of Usability Evaluation for Interactive Computer Mediated Teletraining Systems

Françoise Sandoz-Guermond
sandoz@gprhp.insa-lyon.fr

Gérard Beuchot
beuchot@if.insa-lyon.fr

ICTT - INSA de Lyon
Bat 401 -20 Av. Albert Einstein 69621 Villeurbanne - France

Abstract : The objective of this study was to evaluate teletraining in an interactive computer mediated system through the communicative behavior, the specificity of each situation in order to better understand and to optimize the communication in group. In a first part, we propose a contextual evaluation method in order to evaluate performance reached by the trainees, actors and socio-technical system behavior, and satisfaction of actors. We have applied our methodology in the evaluation of CETTE (Communication Environment for teletraining in Engineering) (Gradinariu 1999). We present, then, some original results of this evaluation and their interpretation in lecture, practical works and cooperative project context.

Introduction

In a complex and new situation it is desirable to use several methods and different sources of information to evaluate the same objective on populations, which carry out the same task in the same environment and to increase gradually the complexity of the task by diversifying pedagogical strategies.
An other point which is seldom precise in studies about the experimental evaluation is how to analyze series of date and observations to which we attach different significance and which have not the same nature when the evaluation methodology is based on a multiplicity of methods.

Methodology of Evaluation

We propose a contextual evaluation method based on (see Sandoz-Guermond & Beuchot 2000):
- quantification of the training outcomes about cognitive activities : memorization, understanding and mastery
- analysis of communication types used during each activity to resolve the task. We suggest to conduct objectives observations made by human evaluators and measures on the level and the content of the communication, during each session of apprenticeship. The measures are collected by software sensors in order to evaluate the behavior of actors and the behavior of the socio-technical system during each training session.
- questionnaires on the perception and the usage of the different items of the environment (Rao 1994) that make easy the communication during the training session (interface quality, effectiveness of new technology, concentration, interaction, motivation) in order to evaluate the satisfaction of actors in the mediated environment.

Data Analysis and Results Interpretation

Experimental procedure

Experiments were conducted on two student populations with a lecture, practical works and cooperative project on numerical command language for mechanical tools: 19 students with the bachelor in manufacturing engineering which have a good background in the training subject and 6 undergraduate students with low knowledge in this subject. The same kind of session with the same contents of the training subject material was carried in a traditional environment with 8 students preparing their master in mechanical engineering.

Training outcomes

The question is to compare the training effectiveness in mediated environment with traditional situation.
In an interpretative and comparative cognitive perspective both on the nature of the population (knowledge, capacities) and the technology (traditional, multimedia supported by the computer), we determine, for each of the three cognitive activities (memorization understanding and mastery) similarities, small differences, great differences, surprised on an ordinal scale and report.
Statistical results indicates that trainees in the remote site achieved quite identical results than in the traditional environment. Training outcomes' standard deviation of the student in the mediated environment is very small compared to the student in the traditional environment, indicating that their grades were very homogeneous.

Satisfaction of the actors

In order to analyze the data from our study (Rao 1994), we firstly ran descriptive statistics on each of the items and their variables. The results (means and standard deviation) indicate that the different groups have appreciated the training progress, they are quite motivated to part in it. The students in the mediated teletraining system interacted more among themselves and with the professor than did those of the traditional environment. We observed a significant difference concerning the concentration : the remote students were also more concentrated than were those of the on-site location.
The second step in the analysis of replies to the questionnaire is to understand which items indicate a difference of satisfaction in the population. The analysis of the variance of replies to questions allows thus to define the constructs of the usage quality with their variables (components) as below :
- Acceptability of the communication technology: perception of the teletraining environment, use of computer tools, remoteness
- Difficulty to achieve their task : quality of the interface, interaction, accessibility of the information
- Personal investment : motivation, participation, need to solicit the trainer, concentration
- Quality of feedback of the system : effectiveness of new technology.

Actors and system behavior

In a situation of physical isolation with possibilities limited of telepresence, the verbal behavior is the real reciprocal orientation tool in the cooperative work. In the cooperative project, generally two students (out of four) are speaking simultaneously.
Three criteria allow to characterize the non-verbal behavior : the mutual orientation in the shared work, the behavior in critical situation and the research of the assistance. According to the trainer, due to the lack of feedback, it is very difficult to appreciate the level of comprehension of the trainees in a lecture context.

Conclusion

Our study, we retain a feasibility of the interactive teletraining with computer mediated systems. The usage of the new technologies seems as efficient as in traditional situation. There is no significant difference during their use. However, we note a greater students' concentration and tiredness during the teletraining session: the duration of the session must be reduced, the lecture re-designed and news pedagogical strategies introduced.

References

Gradinariu; L. (1999). Evaluation de la communication dans le travail coopératif sur des situations de téléformation en téléprésence, *PhD*, March 24' 1999 – France.
Rao; V.S. (1994). Dimensions of Satisfaction in Teleconferencing : An Explanatory Analysis, In *Proceeding of the Twenty-Seventh Annual Hawaii International Conference of System Science*, 1994, pp 124-133.
Sandoz-Guermond, F. & Beuchot, G (2000). An Evaluation Methodology for Computer Mediated Teletraining Systems, In *SITE 2000 – Society for Information and Teacher Education* , San Diego, California. February. 8-12, 2000, Vol. 1, pp 30-36.

METHODOLOGICAL RESOURCES ASSISTANT (MRA): HOW TO APPLY INSTRUCTIONAL DESIGN TO OUR WEB-BASED-MATERIALS

Albert Sangrà
e-Education Laboratory
Universitat Oberta de Catalunya, Spain
asangra@campus.uoc.es

Andreu Bellot
Instructional Designer
Universitat Oberta de Catalunya, Spain
abellot@campus.uoc.es

Josep Mª Duart
e-Education Laboratory
Universitat Oberta de Catalunya, Spain
jduart@campus.uoc.es

Abstract: Our experience in distance learning has shown us how important it is to have well structured materials which are designed from a pedagogical point of view, and keeping in mind what, how and when we want to teach or encourage learning. That is why we have created an authoring tool, which will meet the needs of our institution.

Introduction

The Methodological Resources Assistant (MRA) is a project being developed by the Universitat Oberta de Catalunya (UOC), which is a distance learning university based on the concept of the 'Virtual Campus' and the use of multimedia teaching materials.

We must place this project in the context of the task developed by the UOC and other institutions and companies created from the Foundation for the Universitat Oberta de Catalunya. In only few years the growth of services offered by our university and its associated institutions has created the need to contact a high number of collaborators, subject specialists, professors from other universities as well as professionals from the world of business, who could act as authors of our material or develop specific training tasks.

We have become aware of the need to train these authors (usually specialists in a field of science or other areas of study) in how to elaborate teaching material for distance learning. This implies a training task, centred not only in the understanding of the distance teaching-learning process, but also in the knowledge of resources and tools to make the elaboration of material easier. The MRA was created to answer the above-mentioned needs.

The Methodological Resources Assistant

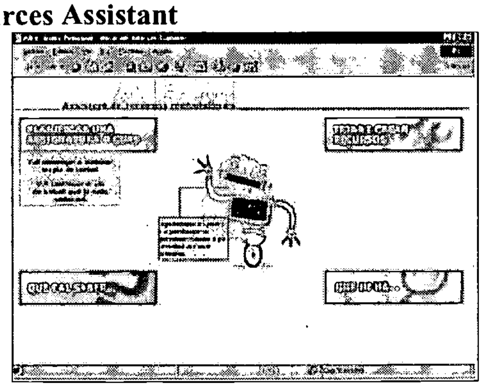


Figure 1: ARM main interface

MRA main features

1. What is the MRA?

It is a system for the design and elaboration of methodological resources adapted to different objectives and training needs, in a virtual learning environment. Its aim is to provide a wide range of distance learning methodological resources as well as tools to facilitate material creation, for professors and authors.

2. What can be found there?

The MRA enables:
- Looking for resources
- Accessing to a concrete resource report by selecting its name.
- Acquiring / Offering ideas
- Consulting methodological aspects
- Creating activities: programs and templates
- Giving guidelines or advice of use

Every resource report provides information about the typology or category that the resource belongs to, the goals that can be reached with it or the activity given; the resource description – structure, stages, functioning, etc.-; the application – guidelines or directions to improve the possibilities the resource offers; the work dynamics to follow; the view of concrete examples; the elaboration guidelines for the resource; the bibliography reference; and templates and programs to create resources easier.

3. Which is its structure?

The MRA is structured as a system composed of different elements:
- A communication space: a forum, a mailbox, FAQ's...
- Help or Guidance about methodological aspects
- The searching form (the tool that helps the professor or the author to know the best resource features for their material elaboration)
- The result of the searches' list
- The resource reports
- The examples
- The templates
- The data base that supports the system

Conclusions

- This space allows educators to gain access to up-to-date information concerning educational activities and the student body.
- The tools used in the evaluation process are also incorporated which allow educators to introduce and consult information concerning the progress and qualifications of students.
- The exchange of ideas and collaboration are encouraged between all of those people who participate in the teaching process by means of the environments that are reserved for telematic intercommunication.
- Another function of this integrated space is to grant direct access to the university's administration services and to help in solving educators' problems and doubts.
- Furthermore, educators are involved in an on-going process that is intended to improve the educational model through surveys and in this way detect strong and weak aspects.

References

- Harasim L., Roxanne Hiltz S., Teles L., Turoff M (1995) *Learning Networks.* Cambridge, Massachusetts: The MIT Press
- Hall, B. (1997) *Web-Based Training Cookbook.* NY: Wiley Computer Publishing
- Collins, B. (1996) *Tele-learning in a Digital World: The Future of Distance Learning* London: International Thomson Computer Press.

Rethinking Education:
How we Make our Learners Instructors

Prof. Dr. Mr. Ir. S.C. Santema, s.c.santema@io.tudelft.nl
Ralph Genang genang@scgroup.nl
Delft University of Technology Department Industrial Marketing, The Netherlands

Abstract

This paper describes a pilot research-project that will be carried out during our courses at the Delft University of Technology in March and April 2000. After this pilot we plan to internationalize the project to interested foreign universities.
We believe the project "How we make our learners instructors" will make better learners, learners who learn to educate themselves and to educate each other, and learners who know how important knowledge sharing can be in obtaining better results.
We facilitate our learners to define their own learning paths through the knowledge and additional information in our learning environment. We focussed on the self-expression and judgement of the learner. This resulted in a dynamic knowledge interaction between the learners and the instructor, meanly led by the learners.
We would like to present the results of this project during our presentation at Edmedia2000

Introduction

As ICT practitioners for educational purposes, we feel that a new phase is coming up. The past years the learners learned to work with the tools and learned how to use them in the field, today our learners become more and more self-confident and self-instructing. For educational purposes this means that the discussion on ICT shifts from the techniques –how, to the content –what, and the instructors role (as compared to the learner's role) –who. In this article we focus on the role of the learner and the instructor.
In the first paragraph we describe how we educate our courses at the Delft University of Technology. In the second paragraph we will briefly describe what we have done in the past three years to understand more about the roles of the instructors and the learners. In the third paragraph we formulate the project in 2000. We will summarise the results of the project in the last paragraph.

Education at the Delft University of Technology, Business to Business marketing

In this paragraph we will briefly describe our thoughts about education and the social dimension of education.
Education:
Education in our opinion is an instructor-learner relation where individuals challenge each other with new ideas. As Francois Jacob (1991) has put it, human beings are programmed to learn, they are curious beings, a characteristic without they could not know. So education is learner orientated as well as instructor based. Our

main question at this point is: *How can we challenge the learners, in order to make them so curious that they become their own (and each other's) instructors?*
Before the use of ICT we graded our learners on their problem solving capacities, their personal opinion, their theoretical founding and their knowledge on the subject itself. Our experience with this type of examination is that most students were used to reproducing content an instructor or book had told them, they were parrots. ICT changed students from parrots reproducing content into supporters of the knowledge. It gave us possibilities to improve the learner – instructor relationship. ICT offers solutions to warm up the knowledge flow between learners and instructors. We are mainly talking about the way knowledge is brought across.
In the next paragraph we will come back on our experiences with ICT based education.

Social dimension

According to Josef Schubert (1983) the activity specific to human beings is the cooperative use of "tools" in the production of "goods". Our main question in our courses is:
How can we motivate the cooperative use of "content" in our classes to create "new knowledge" among the participants (learners and instructors)? Before the use of ICT we had no idea how the learners cooperated whit in their group to solve the assignments. In the next paragraph we will come back on how ICT enabled us to monitor the participation of the learners with the content and with the other learners in the course.

ICT based education at the Delft University of Technology (1996-1999)

The Delft University of Technology, Business to Business marketing development project on the use of ICT instruments started in 1996. The first instrument was the use of e-mail as a means of interactive communication between instructor and learners. The second instrument, videoconference (PictureTel), enabled us to interact real time with learners on a remote basis.
Streaming media: In 1998, the use of real-media resulted in the first online course (on the Internet) in the Netherlands. Next to the 80 regular students, 2500 individual people logged in on our course and followed the course Business to Business Marketing live on a remote basis.
Learning environment: During the last two years we developed a third instrument the learning environment based on WebCT. (http://webct.io.tudelft.nl:8900/public/B2B_online in Dutch). WebCT offered us an environment where we could easily upload our content in. It also contained all the tools we created ourselves for our first live online Internet course, like chat and a whiteboard. Besides these tools, WebCT made it possible to create student groups in which the learners could make their assignments. The most interesting tool of WebCT is the student tracking option. With this tool we can measure the earlier mentioned participation of the learners. We can monitor the learning path of each individual learner. How much time did he or she spend on the course site, how much questions did the learner ask and answer? Did the learners cooperate online? Of course we could not monitor the face-to-face discussions learners had about the course material or the time the learner spend on a document he or she printed but this monitoring tool actually made us change the way we taught our courses in 1999.
Bodies of knowledge: In December 1998 we divided the course material in 100 subjects. Each of the subjects represents a body of knowledge. We recorded a video clip for each subject where the instructor explains the subject in about two minutes, and we started building a database of related publications to the subjects. By the time our next course started in the spring of 1999, all the course content was available online in multimedia mode. The instructor did not teach in the classroom anymore. All we had to do is challenging the learners with

actualities and cases presented by the instructor or invited speakers or actualities the students themselves heard about in the news.

Dynamic content: According to their own learning habits, students who use our online learning environment are free to choose the medium that fits them best. The content has become dynamic. Their options are: textbook material on the subject, sheets (transparencies) with streaming media explanation by instructor, with bullets on the subjects, articles (papers) on the subjects, streaming media (realmedia), video of last years lectures, news forums, where students can discuss a subject, cases, other subjects (if any), e.g. links to companies working in the field or famous for their marketing efforts, or links to other universities

In practice students choose their own paths through all this possibilities, media and content. The instructor coaches them, challenges them and tries to motivate them to learn more from the available material or each other. As we now have over 80 learning paths of former students, we have clues how to digitalize the content of our course. We feel that in digital courses the non-linearity of the chosen learning path of learners and the possibility to monitor this path is very important. The dynamics are in the path, not in the content.

The multiple media approach has resulted in better grades for our students as compared to the traditional classes. The commitment, time spend and the grades did statistically significant change with previous years.

The ICT based education project at the Delft University of Technology in 2000

For educational purposes we use ICT as an open knowledge transfer tool, or perhaps better put: we facilitate the learners to define their own learning paths through the bodies of knowledge and additional information in our learning environment. The shift we created in these years' classes was a shift to dynamic interaction between the learners and the instructor.

So actually we want the learners to become instructors of each other.

The educational purposes of the 2000 project:

We have different levels of knowledge in our environment: commodity data, commodity knowledge and new knowledge. (Santema, Genang, 1999) Actually all the bodies of knowledge are just bodies filled with interesting data, or as we call it "commodity" data. As Karl Marx (1957) quoted, a commodity is a mysterious thing, a hierorglyphic – a picture thing, a "beautiful" system now taken to be difficult or impossible to decode. Last year we succeeded in motivating the learners to react on this "commodity" data in order to "learn" it, to deepen it and make their own knowledge of it. But this is not enough. The learner should be able to share his or her knowledge with other learners following the course. Can we motivate them to state what data they found (and where) and what they did to process it in order to make it knowledge for them. And what happens when they discuss it with other learners. Will they motivate their progress, will they change it, will they convince others and therefore deepen the knowledge they derived from the data? Can they add new knowledge?

In order to achieve this we have to reward the learners on information and knowledge sharing. We deliberately instruct groups of learners to look at a subject from different angles and using "knowledge" out of our learning environment or any available medium to substantiate their opinions. The focus of education shifts more to the self-expression and judgement of the learner. (Sakamoto, 1999). There will be no instructor-based lectures but student-based lectures. The lectures of the instructor are recorded and accessible through ICT. The time we save by not giving lectures anymore is now for learners. They can discuss face-to-face their learning moments, ideas with other learners or experts. Learners prepare their own subjects, they have to use their own hunger to learn to motivate their fellow learners, they become their own instructors. This is how we motivate the cooperative use of "content" in our classes to create "new knowledge" among the participants. We summarise this set up in figure 2, model 2000.

	classic lectures	**Workshops**
Commodity knowledge (teachers perspective) = Commodity data (students perspective)	Learning environment, (bodies of knowledge)	Learner groups
teacher **New knowledge** student	Via - Learners - www - instructors	Discussion learners amongst themselves, and with instructor(s) or guestspeaker(s)
	ONLY ICT	**FACE to FACE**

Figure 2: model 2000, possibilities for ICT based classrooms, Santema Genang, Delft

Objectives of the 2000 project:

1. Monitor the interaction/exchange of commodity knowledge
2. Monitor the interaction/exchange of "www"-knowledge
3. Monitor the interaction/exchange via questions and discussions
4. Monitor the use of references stated by the learners

The interaction/exchange of commodity knowledge: We achieved that learners used the course content published in the learning environment to teach the other learners.

The interaction/exchange of "www" knowledge: The learners did look for information outside our WebCT-based environment. They had to find literature on the topics in our learning environment

The interaction/exchange of questions: Last year the 80 students created a huge database of questions on the 100 topics in our course. Each student had to post 10 questions and answer 10 other. We were surprised of the level of the questions. Actually the students really asked very difficult questions and the answers were also good to very good. They used examples out of multiple media resources to substantiate their answers. In the end each student could look up their posed questions and read the given answer. We would like to optimise this "self-examination" system more and we will create a database where students can look up last years questions and answers by topic. An interesting experience we have with questions posed by students is our Frequently Given Answer (FGA) list. Instead of making an Frequently given Answer list, which is actually not a personal way of communicating, we are able to personalize every answer we give to question of a student by copy-pasting the right answer from our FGA-list to his question in a personalized e-mail. The students like this way of communicating because they feel they get a personalised answer to their very important question.

Monitor the use of references stated by the learners: The more a learner shares his knowledge or uses one of the earlier described ways to offer "new knowledge" to his fellow learners, the more points he will get. In order to reward our students on their information and knowledge sharing, we have to monitor the use of references they stated in their new knowledge; this could be a reference to each other. So the graduation principle is based on sharing knowledge instead of reproducing it. At this point we have no idea how we can monitor this and how much time an instructor has to spend in this process, but we think it is worth trying.

Summary of the expected results of the 2000 project

The project "How we make our learners instructors" will make better learners, learners who learn to educate themselves and to educate each other, and learners who know how important knowledge sharing can be in obtaining better results. Especially this last point is a very big issue in companies around the world: What to do with knowledge.

As the course will take place in March and April 2000, the results will readily be available at Ed-Media 2000.

References

Santema S.C. (1999). Delft University of Technology, Rethinking Education, Ed-Media paper.
Sakamoto, T. (1999). Educational Reform by Information and Communication Technology, National Institute of Multimedia Education, Japan
Jacob, F. (1991). Nous sommes programmes, mais pour apprendre. Le courrier de L 'Unesco
Schubert, J. (1983). The implications of Luria's Theories for Cross-Cultural Research on Language and Intelligence. In Bruce Bain, ed., The Sociogenesis of Languagae and human Conduct. New York: Plenum.
Freire, P. (1999). Education and Community Involvement. In Donalde Macedo, Critical Education in the new Information Age.
Marx, K. (1957). Capital. Translated by Samuel Moore and Edward Aveling, London: Allen and Unwin
Tony Bates.(1997). Crossing Boundaries, Making Global Education a Reality, UBC

Links

B2B_online (1999), http://webct.io.tudelft.nl:8900/public/B2B_online/index.html (Dutch only)
Teletop, http://projects.edte.utwente.nl
WebCT, http://www.webct.com

Austrian Literature Moving to Cyberspace - A Framework for Building an Open Distance Learning Website using Platform Independent Standards Like XML

Alexander Schatten
Austria, Vienna University of Technology
Favoritenstr. 9-11 / 188, 1040 Vienna
aschatt@ifs.tuwien.ac.at)

Klaus Zelewitz
Austria, University of Salzburg
Akademiestr. 20, 5020 Salzburg
Klaus.Zelewitz@sbg.ac.at)

A Min Tjoa
Austria, Vienna University of Technology
Favoritenstr. 9-11 / 188, 1040 Vienna
tjoa@ifs.tuwien.ac.at)

Johann Stockinger
Austria, Ministry of Science
Rosengasse 2-6, 1010 Vienna
Johann.Stockinger@bmwf.gv.at)

Abstract: Due to the steadily growing interest in Austrian Literature, we had initiated an Open Distance Learning (ODL) course. For this purpose, we build a framework that allows to record the data required for publication in a highly generic form. The aim was to separate data from presentation, to prevent information loss and to gain flexibility for future use of the data in other (scientific) projects. We decided to store data in a database using a GUI for easy access. The database is then transformed into XML using Java and DOM/SAX libraries for flexible generation of different presentation formats like HTML and PDF. This guarantees usability in other contexts. With this approach, we anticipate the possible direct use of XML using XSL in the future.

Basic Ideas

Experiencing a steadily growing interest in Austrian Literature, Prof. Zelewitz, German language and literature scientist at the University Salzburg, initiated an Open Distance Learning (ODL) course in cooperation with a team of technicians in Vienna. A set of basic ideas were taken into consideration when starting the joint project:
Storage of generic information instead of direct publishing was required for having the option to reuse the data for future projects. So a highly generic representation of the data with a minimal loss of information was pursued. Furthermore, for the processing of the data, platform-independent tools were preferred (Java, XML, DOM, JDBC). Metadata initiatives like Dublin-Core and RDF should be considered for easy interoperability with other information systems (Lassila 1997, DublinCore 1997).

Besides this set of conditions further requirements for our co-operative work are: The two teams are located in two cities (Salzburg and Vienna) and therefore a good concept for information exchange and documentation is needed. Additionally colleagues from the Austrian Ministry of Science and from institutes of other european countries were interested in information exchange. Hence both results, discussions and also technical information and instruction into new software tools or database interfaces had to overcome a long distance.

Generic Concept

In our project it was our goal to avoid common problems of poor planning, i.e.: *Loss of information*, *Low flexibility* (reuse of data is not possible without a huge effort), *Layout and content get mixed up* (keeping a consistent layout in the whole website is a serious issue). We decided to use a *generic data concept*, where Information is structured and entered into a relational database management system (RDBMS); We try to collect and structure not only on the surface "hard" structured data, but even "soft" data like lecture texts. Following this approach we avoid the mentioned problems and it is again easier to add meta-information (metadata) like: keywords, subjects, abstracts, links, etc. and maintain the data (like URLs, image-links, and so on). The next step is the generation of XML files, which contain the information for publication and the meta-information. The XML data is then used to generate the files for publication (HTML and PDF).

Data Structures

Besides some "free" elements the data in our project could be divided into a set of main components, namely *Biographical Articles*, the "main" information for distant learning: *Lectures*, *multimedia elements*, *original literature* (Citations, Full Text) and an *index*.

Technical Details

We decided to use Microsoft Access 97 as *database system*. At the moment there is no need for a multi-user solution so Access is used as frontend as well as for data storage.

We recognized (beside others) the following advantages of *XML* for our project: XML is a text-format, hence platform and system independent (Bray 1996). This is an important factor to consider because we want to emphasize durability in the storage of information. XML offers the possibility to store all our data without a loss of information as well as handling flexibility which allows an easy publication of the XML data.
The optimal way of *publication* would be using XML directly! This seems possible as a part of the XML standardisation efforts is dealing with style-languages, particularly DSSSL and XSL. The conceived method is to keep the data without information loss in XML and publishing this data "through" a style "filter". The problem is, that at the moment neither Netscape Navigator nor Internet Explorer are capable to perform this task in a stable way, but it should be possible with the next browser generation.

The *conversion problem* can be divided (at least) into two sub-problems: The building of the XML files out of the database and publishing the information as HTML and PDF. As Java has adopted XML as a kind of *standard data format*, lots of free XML parsers of high quality are available and also the database linking using JDBC (Java Database Connectivity) works reliable, we decided using Java as platform independent scripting language (Sun 1999, Leventhal 1998). So the XML file creation as well as the HTML/PDF publication were done using Java programs and conventional libraries like JDBC, LotusXSL, ProjectX and others.

For technical details please take a look at: http://www.ifs.tuwien.ac.at/~aschatt/pubs/ed_media2000/paper.html.

References

Bray, Tim and Sperberg-McQueen, C.M. (1996), *Initial XML draft*, http://www.w3.org/TR/WD-xml-961114.html
Dublin Core (1997), *Dublin Core Metadata Initiative*, http://purl.org/dc
Harold, Elliotte Rusty, *XML Bible*, IDG Books (1999)
Lassila (1997), *Introduction to RDF Metadata, W3C Note* (1997), http://www.w3.org/TR/NOTE-rdf-simple-intro-971113.html
Leventhal, Michael and Lewis, David and Fuchs, Matthew, *Designing XML Internet Applications*, Prentice Hall PTR, Upper Saddle River (1998)
Sun Microsystems (1999), *JavaTM Technology, XML: A Perfect Match*, http://java.sun.com/xml/

Support Environment for Distributed Case Studies

Freimut Bodendorf & Manfred Schertler
Department of Information Systems
University of Erlangen-Nuremberg
Germany
bodendorf@wiso.uni-erlangen.de, schertler@wiso.uni-erlangen.de

Abstract: This paper outlines a multimedia based and telecommunication oriented approach to a case study concept. The scenario consists of different phases supported by online computer conferencing and offline groupware tools. It brings together technical and didactical concepts to overcome educational lacks of traditional learning scenarios and to achieve active learning processes. This research work is part of a project to develop teleteaching reference systems supported by the DFN-Verein (Association for Promoting a German Research Network).

Introduction

In higher education at universities the transfer of how to apply knowledge is not satisfying. The challenging combination of learning and practice is missing in many educational scenarios. Case studies are known as elements of a successful and efficient learning environment using special didactical strategies. In combination with new telecommunication technologies the case study concept leads to a modern educational arrangement, which we call "telecooperative case study".

Active Learning with Case Studies

As one of the major aims in pedagogy, active learning has its steady place in the learning process (Euler 1992). To create effective case studies, the contents have to be chosen from real situations. To match this requirement cooperation agreements with companies have to be formed. Companies provide up to date and real life problems which the students are supposed to solve working together in small teams (~ 5 to 8 students in each team). This kind of learning is active because the students need to collect information, find solutions and present their results. The didactical and pedagogical approaches of distributed case studies are based on principles of the curriculum theory, which determine the choice of contents within a case study. The principle of active learning closes the gap between the case study concept and other concepts of learning, e.g., learning by discovery or learning by doing. A combination of face-to-face and computer mediated communication is used to create synchronous and asynchronous communication scenarios. Groupware tools offer the possibility to control contents, time and sequence of the computer mediated communication.

Technical Approach

The technical concept of telecooperative case studies supports a wide range of different synchronous and asynchronous teleteaching scenarios. Flexibility and scalability are offered to all participants. On the one hand telecooperative case study environments have to meet high quality standards that are necessary to display all types of teaching media without loss of didactical effect. On the other hand, for reasons of cost effectiveness and flexibility in terms of location, it makes sense to use as much of the infrastructure as possible. At the University of Erlangen-Nuremberg a technical infrastructure has been set up for multiple kinds of access (Klein 1999). The infrastructure supports low end solutions based on the Internet protocol TCP/IP, medium quality solutions using one or several ISDN channels and high end solutions like transmissions over ATM (Asynchronous Transfer Mode)-Codecs, which use the B-WiN network (Broadband Research Network of Germany) (Hoffmann 1996). The technical infrastructure of the telecooperative case study concept has to support the didactically coordinated phases of each case . A single case study consists of six phases (Kaiser 1983). In the first phase an overview of the case is given. An external presenter explains the important aspects of the problem and provides the students with additional information. During the second phase the students use different information sources which they discover by themselves or by the help of tutors. In the following phase each student develops an individual solution. As the result of the resolution phase a team solution has to be selected by each group of students. The teams present their solutions during the disputation phase. Finally the students and the external presenter compare the team solutions with the real life solution closing up the case study. Each phase is supported by the telecommunication and telecooperation infrastructure. A more detailed explanation of the realized multimedia infrastructure at the University of Erlangen-Nuremberg is given in (Bodendorf et. al. 1996, Grebner 1997).

Synchronous and Asynchronous Support Tools

To support synchronous presentation and videoconferencing at the university as well as on the company side a multimedia managing terminal has been developed. With a special pen and a touch screen the teacher can write and draw as he/she usual does on paper. The editing on the screen is displayed by a local beamer and transmitted to remote access points via the network. The teacher can prepare computer-based presentations with animations, software demonstrations as well as hyperlinks to web pages. Annotations and other presentation material developed during a lesson can be saved and reused later. For distance education scenarios with a high degree of interaction the teleteaching terminal is equipped with feedback lamps beside the control monitors. If a remote participant has a question, he/she indicates this through the feedback lamp.

During the asynchronous phases of the case study the participants use information retrieval tools (e.g. Web-browsers) and Groupware tools to create the team solutions. To support asynchronous cooperation a multimedia repository is provided. The repository works on a database and integrates recorded lectures together with additional learning materials, e.g., presentation slides, graphics, animations, lecturer's annotations or Web links.

Conclusion

The concept of telecooperative case studies offers various starting points to improve educational efforts. The students benefit from this form of teaching because they gain real problem solving abilities. The flexibility and success of this educational arrangement is strongly increased by adding telecommunication technology.

In the near future attention is being paid to new stages of network technology. The research on telecooperative case studies over broadband networks is part of a research project supported by the DFN-Verein called " Teleteaching/Telelearning Reference Systems and Service Center within the German Research Broadband Network". Within the bounds of the project different technological aspects of distributed teaching and learning are integrated and reference systems are being developed. The service center supports and evaluates synchronous and asynchronous teleteaching scenarios, e.g. telecooperative case studies.

References

Bodendorf, F., Grebner, R., Langenbach, C. (1996). The Virtual Lecture Theatre – Practise and Experience, In: Swiridow, A. P., Widmayer, P., Oberhoff, W.-D., Unger, H. (Eds.). *New Media for Education and Training in Computer Science*. Sankt Augustin.

Euler, D. (1992). *Didaktik des computerunterstützten Lernens*. Nürnberg: BW, Bildung und Wiss. Verlag und Software.

Grebner, R. (1997). Use of instructional material in universal teleteaching environments. *Computer Networks and ISDN Systems, Vol. 29*. Amsterdam/Lausanne/New York/Oxford/Shannon/ London.

Hoffmann, G. (1996). B-WiN – The ATM-based high-speed network for the DFN community. *Computer Networks and ISDN Systems, Vol. 28*. Amsterdam/Lausanne/New York/Oxford/Shannon/ London.

Kaiser, F.-J. (1983). *Die Fallstudie: Theorie und Praxis der Fallstudiendidaktik*. Bad Heilbrunn: Obb Klinkhardt.

Klein, A. (1999). ATM-Based Infrastructure for Teleteaching at University. *2nd International Conference on ATM, 1999,* Colmar.

Creating an On-line MBA Program

Robert Schramm
Business Education and Office Systems, College of Business and Economics
schrammr@mail.uww.edu
L. Roger Yin
LEARN Center, Graduate Studies and Continuing Education
yinl@mail.uww.edu
University of Wisconsin-Whitewater
United States

Introduction

The Seminar in Business Communication course was piloted as the first On-Line MBA course offered at the University Of Wisconsin-Whitewater in the Fall of 1997. The College of Business & Economics has made a commitment to offer all courses necessary to complete the MBA degree on-line in a two-year period. The growth of the program coupled with the required availability of courses to enable students to earn their degree in two years has resulted in 12 courses scheduled to be offered on-line in the Spring of 2000. Nine more courses are scheduled in the Fall of 2000.

In addition to the On-Line MBA program, UW-Whitewater is partnering with the University of Wisconsin-Stout Hospitality and Tourism Department, Nottingham Business School, at Nottingham Trent University in the UK, the School of Hotel and Restaurant Management at Oxford Brookes University, Oxford, UK, and the University of Paderborn in Germany to form an international partnership to offer a new concentration in Global Hospitality Management for the Hospitality and Tourism Masters Degree which began in Fall, 1999.

We believe the On-Line MBA is quickly becoming recognized as an acceptable method of earning a quality education at an AACSB accredited school. The increased acceptance of on-line courses will continue to increase demand for our On-Line MBA program into the foreseeable future. The following case study outlines the process used at the University of Wisconsin-Whitewater to plan, develop, and implement the On-Line MBA program.

Defining the customer

The benefits of distance education are well documented. The most often cited benefits are the ability to break down the geographic and time barriers required in traditional classes. When defining your distance education customers, you must analyze their needs and combine those needs with your school's ability to meet those needs. To excel in on-line courses, students must possess minimal technical skills or the ability to learn these skills quickly and become self-sufficient and self-motivated learners.

Recruitment

Recruitment techniques for on-line programs range from contacting current and past students to placing banner ads on the Internet. An adequate advertising budget is required for a successful on-line program. Tough decisions must be made on how best to use limited monies to recruit the most students possible who possess the capabilities to succeed in an on-line program.

Software

One strong force to push the on-line programs is the popularity and gradual maturity of the World Wide Web. To consolidate information sharing, scheduling, threaded discussion, e-mail, quizzes, gradebook, performance and participation tracking, and other teaching and learning activities, more and more integrated Web-based learning systems have become available. At this point in time, the major contenders in the academic market are WebCT, Web Course in a Box, CourseInfo, and Learning Space. Each of the solutions has strengths and weaknesses, and none is perfect for everybody to use. As the cyber evolution continues, we advise that you evaluate them and weight the pros and cons for your situation, and select the system that best fits your program development needs, considering the scalability and technical support accessible to the local as well as the remote/on-line users.

Hardware and Network Infrastructure

It is essential that both faculty and students should have access to adequate computer systems to handle the demands of the software solutions. For those students and faculty who do not have access to the Internet via local area networks, a 56K modem is the minimum requirement to get on-linc.

Uninterrupted network connections and communication channels are the key to maintain continuous interactions among faculty and students. The site where the servers reside should have at least a T1 (1.5Mbit date throughput rate) line to go to the outside world. If more and more streaming video and audio are requested to distribute course content and relevant materials, then multiple T1 lines or even faster communication lines (e.g., T3) should be considered. Carefully planned switching Ethernet may be implemented to relief the bandwidth requirement for the on-campus network traffic. Faster and more robust application and Web servers also add importance to a reliable and speedy communication line.

Teacher acceptance/resistance to change

Resistance to change is an extremely powerful force in any organization. Many people fear change for personal and political reasons. The faculty must adopt on-line programs as their own if the program is to be successful. Training sessions, workshops, individual faculty support, and peer support network are required to gain acceptance of the program. Most successful on-line programs have started with a small core of enthusiastic faculty who were willing to overcome the start-up obstacles present when launching any on-line programs. Once this core of faculty is able to demonstrate successful teaching/learning, other faculty will gradually follow to form the critical mass.

Technology Training

Student and faculty training are critical. One of the most common student complaints is the frustration with using distance education tools. Student and faculty training may take the form of a video presentation, on-line presentation, small group training workshops, or individual training via the phone or Internet.

Student Learning

Effective distance learning depends on the presence of self-directed learning abilities of the students which can be considered both a component and result of distance education classes. While virtual classes require independent thinking and exploration, community interaction is equally important.

A question related to the level of student interaction is that of asynchronous and synchronous instruction. One major drawback of virtual classes is the isolation of students. Synchronous communication can help overcome isolation and allow students immediate feedback from faculty and other students.

A third question pertains to the level of open-ended learning vs. directed learning in distance education courses. Faculty dependence on one-way communication in distance education systems, tends to promote transactional distance between students and faculty creating little more than a correspondence course. Faculty must learn to be the facilitators of learning, providing students with small modules of directed instruction to be followed by open-ended learning opportunities for students.

Finally, when students are first exposed to the non-linear, individual-mediated learning environments created using distance education tools, they are often confused concerning how to interact with the technology. Many students also require training on how to develop independent learning skills.

The NURAXI Web-Based Learning Environment Architecture

Lorenzo Sommaruga°, Nadia Catenazzi°, Sylvain Giroux*, Claude Moulin°
°Mediatech S.r.l., C.P. 100, 09018 Sarroch (CA), Italy
{sommaruga,catenazzi,moulin}@mediatech.didael.it
*CRS4, VI Strada OVEST Z.I. Macchiareddu 09010 UTA (CA), Italy
giroux@crs4.it

Introduction

The fast evolution of today world impels corporations to provide their employees just-in-time training, adapted training and more generally continuous education. To be able to satisfy this demand, authors need means to specify once didactic material and then to reuse, select, adapt and distribute it to different users in different contexts.
Since September 1998, Mediatech is developing the NURAXI multimedia research platform aimed at the design, generation, deployment, management and use of intelligent distance learning environments. NURAXI interacts with the user on the basis of the competency assessment (initial, on-going progress and final), the individual learning style and collaborative learning. Our solution is departing from a document type based organization of courses and training material towards a functionality and competency based model. We consider models and structures for information, knowledge and competencies more appropriate to the new on-line delivery environment than the document-based old one (html-based or not). From a technological point of view, this was made possible by the recent arrival of XML technology, coupled with Java and Web application technology.

Services, Actors, and Core Structures in NURAXI

NURAXI is a flexible platform, built in such a way that the borderline, which separates tasks done by humans from tasks done by machines, is a moving one depending on the context and on the people needs. We use the notion of service to model this moving frontier. You can see services in NURAXI as points where humans can take the control over the system in order to inject more sophisticated information. At the same time, these services release authors and learners from complex tasks. For instance, an author can decide to select solely the competencies he/she wants to teach, letting NURAXI decide the pedagogical activities. Alternatively, the author can decide the competencies and precisely specify a path through pedagogical activities.
NURAXI supplies many services including: effective individualized courses based on competency models, ontologies for documents, learning styles, teaching strategies, adaptive interfaces, and dynamic computation according to previous actions; dialogue and communication support in groups; and didactic material creation using DTD as templates coupled with XML and XSL.
Different actors interact with the platform: the author of the didactic material, the student, the guest, the administrator, the librarian, and the tutor. The two main actors considered hereafter are the author and the student.

The NURAXI platform architecture is composed of various modules corresponding to actors and functionalities involved in the learning process. Every action and interaction in this process occurs around the same core elements that form both the basic structures of the teaching material and the basic infrastructures for the learning process. The author and the student use these common structures in a different way. The main structures introduced in NURAXI include: competence, knowledge, course, pedagogical activities, contents and student model.
A **competence** is the ability to do something well or effectively. In particular, in our pedagogical context, competence is an abstract concept which can be reified through attributes or properties that qualify and quantify the ability. Within NURAXI competencies are classified according to the domain area (e.g. Computer Science, Languages, Mathematics) and to Bloom's learning outcomes (Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation) [WestEd 1999]. A competence is connected to other structures, including the **knowledge**, and activities. When actuating a competence to perform a task an individual makes consciously or unconsciously use of a certain amount of information and knowledge.
A **course** is defined by an author as a list of learning objectives which aim to a particular pedagogical goal. The learning objectives are the same for all the students attending the same course; therefore they may represent a

predefined shareable set of learning objectives. Thanks to this nature, a course can be certified, assuring in this way the individual ability in the specific field. The course structure contains information such as the list of competencies that must be the training target for the student; the audience to whom the course is addressed; a description of the certification that is obtained; the authors of the material, and the creation and last updating dates.

Pedagogical activities are associated with each learning objective that they aim to reach. At the highest level, activities have been classified into two broad categories: individual, e.g. answering, problem solving, and collaborative activities, e.g. brainstorming, debates, etc. A number of properties are associated with each activity in order to specify learning outcomes, learning styles, competence objectives, complexity, and contents.

The **contents** represent the didactic material and constitute the basic bricks of the NURAXI platform. The contents are used to generate the activities presented to the student, and may be used in different ways in several activities. Contents can be created by authors or imported from external sources and integrated into the system by means of meta data. The innovative idea is to re-use the same contents, appropriately filtered, in many activities. This could be easily achievable if the content is formalised in XML.

The **student model** is made of a static and a dynamic part. The static part contains information such as personal data. The dynamic part contains information about the initial learning objectives, the learning style, the learning status of the student, and the competence level.

Processes

The author is responsible for creating a course. The steps involved in the **authoring process** can be summarized as follows: the author will select a list of competencies for a course; he/she will select or create a number of pedagogical activities that the student may undertake to get that competence, and create or integrate the associated didactic contents. The authoring process is supported by services that the NURAXI platform provides in the form of visual tools, such as competence, activity, and content editors.

The student uses the platform with the purpose to reach some learning objectives, i.e. to acquire new competencies (**learning process**). These learning objectives can be associated to a course (in this case a certification can be obtained) or be selected independently from a course by the student. The most interesting aspect of the environment is that the training path can be dynamically created. The training path is a trail through pedagogical activities that are created on the fly by combining various contents. The path is determined on the basis of the student learning objectives, competence level, and learning style.

Conclusions and Developments

The NURAXI learning environment is designed to provide content re-usability, adaptability, modularity, and interoperability, thanks to the integration of technologies such as the XML, DOM, XSL, servlets, software agents, distributed databases, UML modeling technique, JSP and JAVA programming. Some of these technologies have been already tested in various demonstrators ([Moulin 1999], [Cenati and Sommaruga 1999]) implemented to show particular functionalities or potential features of the NURAXI platform.

References

- Cenati, M., and Sommaruga, L. (1999) Interaction and Dialogue in the NURAXI On-line Education Environment: an Example of Collaborative Learning with Jigsaw, *Roles of Communicative Interaction in Learning to Model in Mathematics and Science, C-LEMMAS 1999, Ajaccio, Corsica, 15-18 April*
- Moulin, C. (1999) Typology of shared documents in a Web-based learning environment, *Proceedings of the AIED'99 workshop on "Ontolgies for Intelligent Educational Systems"*, pp. 58-65
- WestEd (1999) Bloom's Taxonomy http://www.wested.org/tie/dlrn/blooms.html

Web-Based Courses Improve English-Language Skills of Foreign University Science Students

Yvonne Stapp
University of Tsukuba
1-1-1 Tennodai
Tsukuba, Ibaraki 305, Japan
stapp@sakura.cc.tsukuba.ac.jp

Abstract: Three English courses for first-year Japanese science majors were designed to accelerate reading skills and acquisition of science concepts by using Web-based materials. The Web materials were selected especially for high quality illustrations (graphics, pictures, simulations) that clarified unfamiliar scientific concepts. To evaluate the effect of such materials on students' reading comprehension in English, an experiment compared students' comprehension results from three types of texts: (a) paper text, no illustration (b) paper text with an illustration; and (c) text on Web with more elaborate illustrations. The best comprehension scores were associated with Web materials. The positive effects of the Web materials were especially significant for the most abstract concepts.

Science concepts in a foreign language

For today's science and technology students in foreign universities, English proficiency and Internet skills are now almost as important as quality training in the students' respective majors. Web-based English-language reading courses can develop language and Internet skills, and simultaneously provide students everywhere with the most current and authentic learning materials in their subject areas. However, because of curriculum structure, these students may encounter unfamiliar science concepts as freshman in their English courses before they study them in their departmental programs. Since many science concepts are complex and abstract, reading about them first in English instead of the native language may be difficult. The potential obstacles to comprehension, however, may be offset by the quality and array of illustrations available for almost any science or technology topic. Well designed graphics (including pictures, diagrams, photographs, animations, simulations, videos) often accompany or link from science articles on the Web. With a little experience, an English instructor can assemble a set of illustrative resources for any given topic in a modest amount of time. Nevertheless, many instructors are reluctant to shift to Web resources, and many feel that there is very little difference in comprehension effect between standard paper texts and readings on the Web. Although this perspective may be valid for some types of reading, it may not be true for science and other types of technical material (Simpson, 1994).

What, exactly, is the effect of illustrative material on comprehension, especially where unfamiliar science concepts are introduced? Most science texts include illustrations of various types, clearly with the objective of reinforcing difficult ideas. If illustration does matter, the difference between standard texts and the offerings on the Web is staggering.

Mental concepts: Naïve learners vs. experts

There is usually a substantial difference between the naïve learner's mental representation of a concept and that of the expert. This differential has been studied extensively (e.g., Kumar, Helgeson & White, 1994; Larkin, 1983; McClosky, 1983) with a specific interest in bringing the learner's understanding into alignment with the expert's understanding. Where concepts are particularly complex and abstract, this is not an easy task. Perhaps as a kind of recognition of this problem, scientists often create metaphoric labels that conjure up images: the big bang, black holes, string theory –to name a few of the familiar ones. But what these metaphors represent to experts is quite distinct from what they represent to naïve learners. So to further clarify ideas experts also include diagrams and other graphics in instructional material. If graphic elaboration of abstract concepts facilitates learning substantially, then the offerings on the Web easily justify the use of Web-based materials.

Testing the effect of Web materials on comprehension

To test the effects of illustration on comprehension, freshmen majors in science fields in a Japanese university were presented with three types of English texts in rotation: (a) text only; (b) text with picture; (c) Web-based text with selected and varied illustrations (e.g., simulations, graphics, photos). For each timed reading (e.g., Black Holes) one group read (a)-type, another group read (b)-type, and a third group read (c)-type. The group that read (a)-type for the first topic rotated to (b)-type for the second topic, and (c)-type for the third reading.. In this way, all groups read three separate topics in three separate formats. Students indicated by 1-5 rankings on their test sheets the level of difficulty, whether the topic was new or familiar, and whether the topic was interesting. Comprehension for each reading was tested by multiple choice questions which targeted the respective concepts.

The results were most interesting where readers were most naïve and topics were most abstract. For the real novices, comprehension was substantially better for the Web-based material than for either of the standard written materials, that is, (a)-type or (b)-type. Where readers were more familiar with the target concept the differential was not so great. This initial investigation suggests that the Web materials were most helpful in presenting challenging concepts to naïve readers. Further refinements of the experiment are underway, which include a larger set of readings at two levels. This will help to clarify the potential of Web-based materials for accelerating comprehension at different reading levels; that is, for both the novice and for students who already have some familiarity with a given concept.

References

Barsalou, L.W. (1992). Frames, concepts and conceptual fields. In A. Lehrer & E.F. Kittay (Eds.), Frames, fields, and contrasts. Hillsdale, New Jersey: Lawrence Erlbaum.

Greeno, J.G. (1983). Conceptual entities: Problem representation in physics. In D. Gentner & A.L. Stevens (Eds.), Mental models. Hillsdale, New Jersey: Lawrence Erlbaum.

Kumar, D.D., Helgeson, S.L., & White, A.L. (1994). Computer technology-cognitive psychology interface and science performance assessment. Educational Technology Research and Development, 42 (4), 6-15.

Larkin, J.H. (1983). The role of problem representation in physics. In D. Gentner & A.L. Stevens (Eds.), Mental models. Hillsdale, NJ: Lawrence Erlbaum.

McClosky, M. (1983). Naïve theories of motion. In Gentner & Stevens (Eds.) Mental models. Lawrence Erlbaum..

Simpson, M.S. (1994). Neurophysiological considerations related to interactive multimedia. Educational Technology, Research & Development, 42 (1), 75-81.

Educational Technology and Learning and Teaching: Pedagogy, Process and Culture

Alison Hudson
Learning and Teaching Institute,
Sheffield Hallam University
Adsetts Centre, Howard Street
Sheffield, UK, S1 1WB
a.r.hudson@shu.ac.uk

John Steel
Learning and Teaching Institute
Sheffield Hallam University
Adsetts Centre, Howard Stree
Sheffield,UK, S1 1WB
j.a.steel@shu.ac.uk

Abstract: The focus of this paper is on the preliminary findings of research into the perceptions and experiences of educational technologies of teaching staff and students at Sheffield Hallam University in the UK. These findings explore the relationship between educational technologies and pedagogic processes as well as wider social and cultural aspects. Initially this research stresses the importance of an ongoing dialogue between teaching staff, students and university management concerning the appropriate, context specific use of educational technologies, as unconsidered approaches on the part of practitioners can impact negatively on the quality of the student learning experience.

Introduction

As a result of research commissioned by the Learning and Teaching Institute at Sheffield Hallam University (SHU), this paper will present the initial findings arising from research into perceptions and experiences of staff and students using educational technology as part of their learning and teaching at SHU. The primary objective of the research is to gain a qualitative insight into the 'real lived' learning and teaching experiences of students and teaching staff using educational technologies as part of their educational life at Sheffield Hallam University. Fundamental to this task is an investigation into social and cultural factors that shape their perceptions of educational technology *and* the pedagogic processes of teaching and learning within the framework of specific learning contexts.

Methods

The first key stage of the research was based around interviews of members of teaching staff and centred upon uncovering and exploring learning and teaching within given contexts. These interviews were structured so as to allow the participant to describe in an open ended manner their experiences and perceptions of educational technology. The themes on which the participants were encouraged to talk included notions of value of educational technology in learning and teaching; perceptions of changing roles and relationships with students; views on changes within higher education and finally, perceived negative aspects of educational technology use. The findings of this section of the research point to a multiplicity of perceptions of educational technology. However, the overwhelming theme that emerged, was that considered and appropriate use of learning technologies should be encouraged as the quality of student learning can be enhanced and enriched. It was considered that the view that educational technologies as a 'quick fix' solution to the problem of student numbers should be challenged as this can only demean the potential of educational technologies within the learning and teaching process.

The second stage of the research is primarily, but not exclusively, focussed on the learning experiences and perceptions of students at SHU, with reference to the use of educational technologies. Five separate case studies or 'contexts', which seek to investigate different elements of the teaching and learning from the perspective of the student have been developed. These research contexts are being formulated in order to investigate particular aspects of the teaching and learning experience of the student body. These contexts are centred around the following areas:

- Web Based Material, 'Enriching' the Student Learning Experience.
- Tackling the Issue of Student Motivation with Educational Technology: An Action Research Model.
- Student Expectations
- Reflections on Computer Conferencing from Lecturers as Students.

Conclusion

The material from the interviews, coupled with the four research contexts, provide a detailed introduction to a number of issues that face students and lecturers when engaging with educational technology in a learning and teaching context. The data that will be produced from this research will provide an insight into how students and lecturers *deal* with educational technology, in terms of their experiences and perceptions of educational technolgy's roles and functions; as well as how it is incorporated into pedagogic processes. Finally, an understanding of the staff and student perspective of educational technology in relation to wider culture is generated from this research.

References

Ashworth, P., Bramall, M., Cook, M., Payne, R.: (1996). *Portfolio Assessment in Engineering: An Evaluation from the Students' Perspective*. Internal SHU Paper.

Forsyth, I. (1996). *Teaching and Learning Materials and the Internet*. London: Kogan Page.

Hudson, B. (1998). *A Social Perspective on Learning in the Context of Computer Mediated Communication in Education*. Awaiting Publication.

Kemmis, S. 'Action Research'. In Keeves, P. (1997). *Educational Research, Methodology and Measurement*, Oxford, Elsevier Science Ltd. 173-179.

Laurillard, D. (1993). *Rethinking University Education*. London: Routledge.

McCain, C. (1996). *Plugged In and Turned On*. California: Corwin Press Inc.

O'Rourke, R.: (1998) 'The Learning Journal: From Chaos to Coherence'. *Assessment and Evaluation in Higher Education*, 23, (4) 403-413.

Sandholtz, J.H., Ringstaff, C. & Dwyer, D.C. (1997). *Teaching with Technology – Creating Student Centred Classrooms*. New York: Teachers College Press.

Schon, D.A. (1983) *The Reflective Practitioner: How Professionals Think in Action*, London, Temple Smith.

Selwyn, N. (1997). The Continuing Weaknesses of Educational Computing Research. *British Journal of Education Technology*, 28, 4, 305-307.

Tait, W. (1997) Constructivist Internet Based Learning. *Active Learning*, 7, December, 3-8.

Thompson, R. (1999). *Student Guide to TopClass*. Internal Sheffield Hallam University publication.

Wilson, D.: (1995) Teach the Process, Not the Content. *Managerial Auditing Journal*. 10 (3) 15-18.

Woodward, H.: (1998) Reflective Journals and Portfolios: Learning Through Assessment. *Assessment and Evaluation in Higher Education*. 23 (4) 415-423.

A Web-based instruction model for open learning -A theorical and practical framework

Dr Armand St-Pierre
Professor at Royal Military College, Kinsgton. Canada

Abstract: As computers becomes more prevalent in the field of education, educators are obligated to plan and provide for classroom of computer technology. The combination of media and technology offer the possibility of developping a computerized virtual learning model. This paper describes a framework to develop Web-based instruction models (WBI) to help the teacher to deliver course materials on site and at remote. This WBI prototype will help the learners grasp a rich learning content and provide opportunities to do some collaborative work.

Introduction

Web-based instruction could be defined as the application of a repertoire of cognitively oriented instructional strategies implemented with a constructivist and collaborative learning environment using the attributes and resources of the World Wide Web (Lebow, 1993; Perkins, 1991). The teacher becomes a facilitator for finding , assessing and making meanings form the information discovered from a variety of media (Relan, Gillani, 1997). The Web can become a resource center for the teacher and the learner.

The objective of this paper is to present a theorical and practical framework for creating an WBI model.

Context

The Canadian Royal Military College, located in Kinston, Ontario, is an academic institution which provides education to young canadians who want to become Officers and at the same time obtain a University degree. Various academic programs in Engineering, Science and Arts are offered. These programs, given on site in Kingston, are delivered through traditional means and methods.

Cadet enrollment for the 1997-1998 academic year in the undergraduate programs is approximately 1000 students, from the age of 17 to 25. Graduate programs are offered to a small population of 400 students. The college is planning to add certificate degrees to help people in the rank get a University degree.

Military Men and Officers are located in different military units and participate in military missions overseas. They must to be retrained every five years to perform with a high degree of proficiency in their jobs. The Military College will have to use distance education and other forms of delivery to be able to educate its work force. A challenging and rewarding avenue for this institution to look into.

The vision of the Military College is to enhance learning through collaborative educational technological tools in the year 2000. Every student must be able to learn at remote and use interactive computer tools for a more enriched learning environment. This vision requires this institution to define a new mission. The Military College, the only high level military training in the Canadian Armed Forces, will be dedicated to the creation of knowledge and the advancement of learning in the Armed Forces.

The mission of the Canadian Royal Military College will be:

- To produce well trained personnel capable of using computer tools and skills in their working setup.
- To train professors in education technology and distance education in order to deliver rich training content at remote.

Identified Need

We are entering into the age of communication rather than information. Databases are easily accessible at a very minimum cost for our students. Computerized real-time teaching is possible due to a fast network infrastructure, but we need the players: the teachers and the learners who could use these educational tools efficiently and effectively.

One of the challenges we are forced to face as educators is that we have to upgrade our teaching skills using technology. Enhancing learning through technology requires more than just access to computers, software and networks, it also demands new ways of teaching, new rolcs for educators, new teaching and learning goals, and a strong educational support system for the teachers and students. Householder (1993) produced a vision statement which includes four goals to guide our work:

- Position technology as a basic area for academic teaching and learning.
- Provide leadership in developing curriculum using technology.
- Support teachers in implementing their programs using new teaching methods.
- Enhance participation of students in experimenting new educational learning media.

One of the primary goals in the year 2000 will be to support the mission of the Military academic institution through successful integration of technology into the educational process. The Military College has to maintain educational leadership in its environment in order to receive the proper funding from the National Defense Headquarters to achieve their mission.

For the purpose of this course, new medias will be introduced through Internet, which will facilitate, on one hand, the delivery of the contents by the professor and, on the other hand, the learning of the concepts of the course and the successful completion of the Marketing fundamentals course enrolled by students.

CONSTRUCTIVIST ENVIRONMENTS VERSUS BEHAVIOURIST DEMANDS

Geneen Stubbs,
School of Computing
University of Glamorgan, Pontypridd, Mid Glam, CF37 1DL
Email: gstubbs@glam.ac.uk

Mike Watkins
School of Computing
University of Glamorgan, Pontypridd, Mid Glam, CF37 1DL
Email: mwatkins@glam.ac.uk

Abstract: Constructivist approaches (Duffy & Jonassen, 1992, Boyle, 1997) advocate the provision of learning experiences which facilitate the students' learning acquisition, rather than the more behaviourist approach (Skinner, 1974) of deriving objectives and learning outcomes for the instructional material. However, there is both external pressure, from QAA audits and internal pressure, from students, to identify and assess learning outcomes and adopt a more behaviourist practice. This paper looks at a solution which seeks to accommodate both ideals.

Background

Constructivist approaches (Duffy & Jonassen, 1992, Boyle, 1997) advocate the provision of learning experiences which facilitate the students' learning acquisition, rather than the more behaviourist approach (Skinner, 1974) of deriving objectives and learning outcomes for the instructional material. The constructivist approach is admirable and aims to transfer the emphasis away from lecturer driven teaching, a central tenet of behaviourism, towards more student driven learning. The conflict in the adoption of this approach is derived from the lecturer's wish to facilitate learning and the student's wish to be taught. Students admit to being motivated by assessment and, to this end, they perceive a key factor in their learning as the provision of criteria to underpin the assessment process. Within the modules undertaken in an undergraduate or post-graduate course, the criteria are derived as learning outcomes which are used to assess levels of student performance. In an effort to provide an environment where more constructivist approaches are encouraged, a web interface has been developed which attempts to bridge the two ideals. One of the aims of this approach is to provide a gentle "nudge" for students who exhibit a high degree of dependence on lecturer centred teaching towards a more independent student-centred learning experience.

Using existing legacy material coupled to WWW facilities, amalgamating and delivering them as resources for an individual module, the lecturer and the student progress at a pace which allows both to feel secure with the innovative approach. Several elements from the conventional teaching approach, such as lecture notes and slide presentations, can be combined with WWW facilities, such as web pages via links and email communication, to provide a comprehensive learning experience.

Approach

The module chosen to pilot this approach was a level 3 (final year) undergraduate module entitled Computer Based learning (CBL). Existing resources include: Assignments (Word Documents); Lecture Notes (PowerPoint slides); Additional notes (Word Documents). To these were added WWW resources which include: access to the home pages of staff teaching on the modules (HTML); external Links (URL's); on-line tutorial systems for Authorware (internal and external links); sample CBL material (developed in Authorware, then "shocked" to allow its delivery via the WWW). Email facilities for students provide asynchronous communication between students and between staff and students. The module interface to the material is delivered via the WWW, is frame based and ensures that students may access the resources whilst remaining within the module framework. This allows exploration of the resources without the fear of getting "lost in hyperspace" (Conklin, 1987).

CBL Module Interface

Figure 1 http://www.comp.glam.ac.uk/pages/staff/gstubbs/tutorial.gif
Figure 2 http://www.comp.glam.ac.uk/pages/staff/gstubbs/staff.gif

The contents links frame provides selective access to resources, the links form a typical hierarchical structure as illustrated by the indented points below:

- Staff on the module;

- Documents available on the server;
  - Tutorial Exercises;
  - Assignments and Lecture Notes;
  - Papers;
- Weekly schedule (of lectures);
- Authorware Tutorial;
- Sample CBL material;
- Some useful links.

This structure is sufficiently flexible to be tailored to individual module and lecturer needs but is simple enough not to confuse students. The environment offers the student access to the assignments and hence the learning outcomcs but also provides additional learning opportunities such as on-line tutorials or links to external resources. Thus, providing constructivist opportunities for students to develop deeper learning and providing an extension to the conventional "chalk face" teaching and learning activities.

Staff Issues

The implementation of this interface raised some interesting issues from several members of staff who viewed and evaluated the facility. The two major issues raised were:

(i) "I don't want my notes to be an open access resource but I don't mind the other resources being open access"

This concern can be easily addressed, solutions include, provision of resources via local servers so that only local students may access them; protected tutorial groups where students have a login name and password; or a combination of these together with the open access resources.

(ii) "I haven't got time to convert my material to HTML".

This was not a problem as no legacy material was altered. Staff were impressed that materials were accessible in their original format and this engendered a more favourable attitude to use of the facility.

External Demands

An additional factor influencing the transition from traditional to more innovative delivery mechanisms for module resources comes from the external audit body the "Quality Assurance Agency" (QAA) whose primary function is "to review the performance of universities and colleges of higher education" . To fulfil this role the QAA visits Higher Education institutions to "assess their quality and standards of teaching and learning". Institutions are rated as excellent, satisfactory or unsatisfactory, these are based on several factors but the QAA report of 1994 stated that "subject providers judged to be excellent, and some others, were able to utilise high-quality resources to provide innovative and effective teaching and extensive opportunities for independent learning by students", (QO, 1995) this area is, thus, seen as an important factor in gaining an "excellent" QAA rating.

Conclusions

Within UK Higher Education institutions, there is a move to attract higher numbers of students and "to widen access". Attracting students is a complex process depending on location, courses and entry requirements but the additional advantage of advertising a School as "excellent" certainly confers a benefit over those rated as "satisfactory". Students are also more familiar with technology in the form of the WWW, email etc. and their expectations on a Computer Studies course extend to the use of these technologies within the courses, however, in a learning environment they often request the more behaviourist approach of providing learning outcomes. In the UK over the last two years the issue of the abolition of student grants and the introduction of student loans has initiated a "consumer approach" to education, the onus is being placed on staff to teach rather than students to learn. If this is continued, it will provide an impoverished learning experience for students in general. In order to accommodate the facilitation of learning whilst at the same time fulfilling the student demand for both technological innovation and provision of behaviourist principles, care must be taken to progress at a pace that supports both students and staff. The integration of legacy material within a constructivist environment seeks to achieve a satisfactory outcome for the two viewpoints.

References

Conklin, J. (1987), "Hypertext: An Introduction and Survey," IEEE Computer IEEE Computer, 2(9), 17-41.

Duffy, T. M., & Jonassen, D. H. (1992). Constructivism: New Implications for Instructional Technology. In T. M. Duffy & D. H. Jonassen (Eds.), Constructivism and the Technology of Instruction: A Conversation. Lawrence Erlbaum Associates, Inc.

Boyle, T., (1997) Design for Multimedia Learning, Prentice Hall.

Skinner, B. F. (1974) About Behaviorism, Knopf.

QO 8/95 (1994) Subject Overview Report - Computer Science, Quality Assessment of Computer Science, A Review of the Quality of Educational Provision in Higher Education.

Acknowledgements

Work to support this paper was conducted in the HEFCW funded Internet Technologies Research Lab.

Redesign a Biology Laboratory Experiment as a Multimedia Simulation

Jonathan Swallow
Centre for Learning & Teaching Through Technology
University of Waterloo
Canada
jswallow@watserv1.uwaterloo.ca

Norm Scott
Department of Biology
University of Waterloo
Canada
nscott@sciborg.uwaterloo.ca

Abstract: When undergraduate wet lab experiments are converted to multimedia simulations, opportunities become available for addressing old problems. The simulation described in this paper provides many of the same advantages that other lab simulations have in the past. However, "Frog Heart Physiology Lab" goes further. Lab activities were redesigned to achieve learning outcomes that were previously elusive. The distinguishing features of the simulation are described, along with examples of how the lab is used. When using the simulation, students are encouraged to generate and apply various methods of administering treatments, and to make better use of the resulting data.

Introduction

This paper discusses a set of biology laboratory experiments that are simulated using multimedia. The simulation is being used to replace a wet lab for a third year undergraduate physiology course. The "Frog Heart Physiology Lab" simulation shares advantages with other simulations of wet labs. It avoids the cost, effort and ethical issues of acquiring live animals for testing. The redesigned simulation gives students a look at the work involved in dissecting a frog and setting up the experiment, but avoids the technical problems which often occur when working with live animals. Simulations also provide opportunities for students to take chances in a safe environment. In addition, it allows students greater flexibility to move between activities, and allows them to stop working on the lab when they want, and to return to the lab as often as they want. Previously, they had to do all of their work in one lab session with one animal. There would be many advantages if the simulation simply replaced the wet lab. However, we wanted to go further.

We redesigned the lab in an attempt to achieve specific learning outcomes that were difficult to achieve in the wet lab. The addition of "matching" tasks enables students to relate mechanical and electrical tracings to the movements of a beating heart. In the simulated lab, students are encouraged to think critically, by drawing tracings to predict treatment effects, and deciding what is likely to change, and by how much (McCormick, 1998). In addition, students are asked to justify their predictions, thereby defining what they believe are the treatment mechanisms. They are asked to do this in an attempt to dispel naive patterns of misunderstanding which might otherwise persist. (Perkins & Simmons, 1988). The flexibility provided by the simulated lab allows these activities to be started a week or more before the chemical and electrical investigations are conducted. This gives students more time to think about and research their predictions and justifications. One desired result of these activities is that students' misconceptions are drawn out and confronted. Students are asked to compare the variations they observe with the data set they constructed, that is, their drawings. This in turn encourages students to explore alternative activities, and entertain alternative ideas. Another desired result is that students must make use of evidence to find relationships and support their arguments. That means that they are given responsibility for discovering "new" treatment effects. This approach, of asking students to make inferences based on their observations, rather than telling them what to look for, has been used successfully in the redesign of other undergraduate biology labs (Udovic, 1996). In general, we wanted to encourage a higher percentage of students to adopt a problem solving approach and to be more "playful."

Tales of two labs: students then and now.

In the wet laboratory, somewhere in the middle of the lab period. . .

> "Tracey and Ed read in their manual that they are to investigate the effects of calcium chloride on heart function. Unlike their last investigation with epinephrine, they are not sure what they are looking for. Ed applies one and a half droppers full of calcium chloride directly on the heart muscle. After less than a minute, there is a noticeable difference in the movement of the heart, and the mechanical tracing. Tracey and Ed examine the tracings produced by the application of CaCl2. In their lab report, they note that calcium chloride reduced the height of the tracing, and there was an initial increase in heart rate, before heart rate slowed. They go to the literature, and find an explanation of the mechanisms of CaCl2, which they paraphrase and add to their findings."

In the computer simulated laboratory. . .

> "Bill had written on one of the lab 'prediction' worksheets, 'the roof part of each cycle depends on the extracellular calcium concentration. The more extracellular calcium there is, the more Ca2+ will flow into the cells and so the longer the tracing in this part.' Bill had traced over the baseline wave on the worksheet, making the peaks of his new waves higher, and the valleys between cycles narrower. He and Marie are now surprised again to find that the data generated by the simulation don't match their predictions. Heart rate has slowed, and amplitude is reduced, not increased. They begin to examine the data more closely, and discuss the discrepancy. Marie makes an observation, 'if calcium chloride slows down the heart and shortens the height of the waves, then it must be pumping out less blood. So less blood comes back to the heart. And so the atria move less, and that part of the tracing is smaller, because it's not working as hard' . . . "

Students who used the simulated lab usually made mistakes when they first attempted the trace matching tasks. However these students stated that "(The tasks) did help in determining the contraction state for the chemical additions", and that "the exercise helped me realize the actual orientation of the hart during the procedure." Students also stated that they "particularly liked matching the video images with the tracings", and that "one of the most important things learned from the simulation was what parts of the . . . tracings corresponded with which contractions in the heart."

In addition to mistakes made during the trace matching tasks, students stated that "my predictions were also quite wrong. However, I think it was good to have done them, as it required learning about the potential effects . . . before actually performing the investigations", and that "discussing the tracings with other students with whom I worked was a good way to stimulate new questions about what was occurring in the investigations." Other students stated that "Predicting before performing the investigation really made me think. I put much more effort into this lab because of these instructions", and that they "found making the predictions very worthwhile because it made you sit and think about what was going on . . ."

It appears that the simulation created an environment where students enjoyed learning from their mistakes.

McCormick, B. (1998). Students' Conceptual Frameworks of Anatomy and Physiology of Digestion and Circulation. http://universe.uiwtx.edu/~mccormic/misconceptions.html Last retrieved March 22, 2000.

Perkins, D. N. & Simmons, R. (1988). Patterns of Misunderstanding: An Integrative Model for Science, Math, and

Programming. *Review of Educational Research, 58(3),* 303-326.

Udovic, D. (1996). *Exploring Hearts,* http://biology.uoregon.edu/Biology_WWW/Workshop_Biol/Newsletters/Spr96/Spr96contrib4.html. Last retrieved March 22, 2000.

Support for this work was provided by the Centre for Learning and Teaching Through Technology and the University of Waterloo's Learning Technology Innovation Fund. Special thanks to Tom Carey for input on this work.

Situated Learning and its implications for instructional design – Perspectives from an apprentice

Sarah Teo
Singapore Computer Systems Limited
Teosc@scs.com.sg

Abstract: In this paper, we describe situated learning connoting the importance of context to meaningful learning. In particular, based on the writings of authors such as Brown, Collins, and Duguid (1998), we draw implications to instructional design and attempts to recommend practical situating environments as part of a holistic learning through the advent of technology.

The Situating Environment

John Seely Brown, Allan Collins and Paul Duguid in their paper "Situated Cognition and the Culture of Learning" (1998) said that learning must involve activity, concept and culture as they are interdependent. The model of situated cognition is based upon the notion that knowledge is contextually situated and is fundamentally influenced by the activity, context, and culture in which it is used. Moreover, such activity contexts are mediated by tools. Looi (1998/9) suggests the supportive roles of technology for the inquiry process (within the activity context) - as instructive tools, constructive tools, communicative tools and as situating tools. The instructive environment that holds the content, remains the central part of the learning environment. It would start from the didactic approach of posting the domain knowledge to the learner. As the learner picks up the knowledge, construct his own knowledge from it, he returns the newly-constructed knowledge back to the system, adding up to the knowledge base. Collins and Ferguson (1993) proposed epistemic tools as the basic building blocks for knowledge construction to help learners to recognize, judge and organise patterns of information, engaging learners in constructive inquiry. In addition, the communicative dimension of tools and environments provides the hub for community exchange, providing support to the learner, to the learning process.

In fostering meaningful learning within activity context, Figure 1 below shows the processes. There is a deliberate effort on the part of the Instructional Designer to provide opportunities for the learner to engage, not only in the content, but also in his life: activities and situations of his life. A situating environment is thus an essential part of a total learning environment for the learner. The application of meta-cognitive skills will raise the learner to a level that he will be able to exercise cognitive dexterity in transferring the knowledge acquired to many situations in his life.

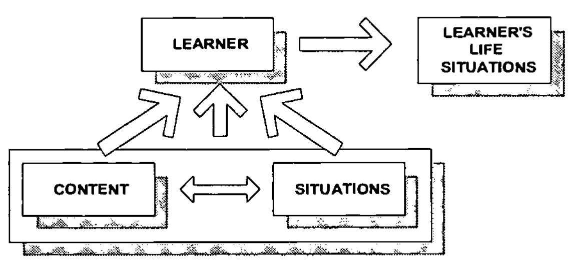


Figure 1: The learner and his context for learning

In the following sections, we describe what needs to be situated, ways of situating, and we discuss implications to the instructional design process.

On what to situate?

Context, Culture, Activity are three components as recommended by Brown, Collins and Duguid (1989) to be essential in learning as they are interdependent on each other. To situate the learner to the "hardware" and "software" of the situation, the lesson should provide not only the hard facts in the content, but also the peripheral knowledge. By "hardware", the author refers to the tool, which the learner is supposed to learn to use. This could be an equipment, a machine, a word processing tool or the control panel in a cockpit. By "software", we mean the surrounding environment, in the form of climate, smell, heat, water, room, people, etc. This places the learner in the context and culture of the ultimate application of the lesson. We attempt to provide not only the cognitive situationing, but also (if possible) the physical, emotional and mental situationing.

Ways to situate

Various ways have been recommended to situate a learner. The "Adventures of Jasper Woodbury" (Pellegrino, et. al, 1990) is a well-designed videodisc program to exemplify situated learning. It requires the learners to consider real-life needs. Opportunities are embedded for the learners to explore, discuss, articulate possible problems and solutions, ultimately to "transfer" his classroom knowledge to a near real-life situation in the program.

To bring students to a deeper immersion to the culture, context and activity, tertiary education for most students (in Singapore) have included industrial attachment as part of their curriculum. The civil engineering students are sent to work for 6 months in the construction site. Secondary schools send teenagers to experience the rigour of work in the real world outside school. Simulators are developed to bridge the gap between textbooks/manuals and the real environment. In computer-based training, situating the learner takes place by presenting multiple scenarios (including the use of immersive and non-immersive Virtual Reality) that trainee would be likely to encounter. Variables in the scenario are identified and changed for the various scenarios to vary complexity and to increase diversity. Interactive hardware is now attached to desktop computers so that the trainee can be brought to a step closer to the real situation by touching the actual equipment.

Implications for Instructional Design

To bring the discussion to a practical level for a hypermedia Instructional Designer, how then can we design for situated learning? The authors suggest the following considerations appropriated from notions of cognitive apprenticeship.

1. Past and present situations and predict areas of future application

Presenting past, present and future nodes for linking to the current point of learning is a strategy for situating to enculturate the learner. Presenting a meaningful relevant past node provides the association from a new and unknown area to be taught on a known area. The present node would be one that the learner is experiencing and would require the new knowledge to have immediate application. This should bring about an 'uh huh" effect in the student. A future node must be one that is foreseeable by the learner. Taking the learner on a untouchable trip, to an unreachable destination will result in the student, learning for learning sake, for the sake of satisfying the teachers' demand and for passing examinations only.

2. Complexity and diversity and multiple practice for each situation

Increasing complexity can be done by gradually increasing the variables in the simulation. In the use of equipment, where knowledge is structured, multiple practice under different conditions should be provided, so that the students become competent in the job. However, one must be careful not to over-situate. (Over-situating is a condition when the learner is provided intensively with only some very specific situations, where he becomes very conversant under this condition. The extreme result of over-situating is that the learner is not able to perform the same activity given a changed condition.) To prevent over-situating, diversity in the situations is created through various different situations, through the varying of each dependent parameter for both the "hardware" and the "software". In the teaching of wave characteristics, the sequence starts with the simple wave equation of $C= \lambda/F$. A picture to represent the equation is shown. Simulation is shown of the effect of a change in the λ, keeping C constant, causing a change in the F value. The student is allowed to suggest any value of the parameters to view the effects on the other parameters. This allows the student to quickly grasp the implications of the variation. Then, the complexity is increased by introducing another wave of the same frequency, followed by the intervention of another wave at different frequency. The learner would see the change in the overall effect. To further increase the complexity, as in a real-life situation, we would show the attenuation of the wave due to interference caused by obstacle such as a tall building or the occurrence of rain.

3. Opportunity for learners to situate themselves

Having the student to reflect on his own past experience and associating with the new knowledge that he has just picked up are applications of the knowledge learnt or related to the knowledge learnt. This deliberate effort involves the student's active participation in relating his own experience to that learnt. He may even be able to construct his very own knowledge based on his unique culture and context. In the study of Pythagorus theorem, the student may consider a route that his father normally takes to drive from school to home. He can calculate the amount of petrol saved if his father uses the "hypotenuse" road rather than the 2 adjacent roads. Real life problem of having to go through more numbers of traffic lights, become the deciding factor that the father did not use the "hypotenuse route" - a peripheral knowledge. Allowing the students to explore into the various possible real-life situations also help to elicit erroneous concept of the knowledge, which the expert-teacher can then correct.

4. Situations in opening and closing and within main content of the lesson

Situating the learner at the opening of a lesson provides him with an end in mind as he begins the lesson. Providing multiple situations within the main content brings his focus to the culture, context and activities of his required performance, so that the content will not be "dead" knowledge, but truly knowledge alive, used by the experts and practitioners. At closure, there is a need to highlight as divergently as possible, the many situations of application. Transfer of the skills and knowledge from the simulated situation to real-life situation must be emphasised.

5. Environment for learners to learn from the experts and practitioners

In situating the learner in an expert's environment, the learner is exposed to the multiple perspectives from various experts in the same area, providing him with a rich context. With the advent of technology, we throw open an environment for the learner to have access to the interested experts and practitioners. In the learning process, an environment where the students can hold discussion with other experts and practitioners should be provided. This would help build a virtual community for the students. Principals and teachers in schools who are interested in this area of constructive learning, situated cognition, cognitive apprenticeship, should also access to this site to collaborate to provide synergy in joint projects.

Conclusion

Situated learning is beneficial for the learner in providing the *culture*, *context* and *activities* that are inseparable from the domain knowledge, for meaningful learning. Diversity in all the three elements provides richness in the learning environment. To ensure cognitive apprenticeship, there needs to be expert to provide the modelling, coaching, scaffolding. Activities for collaboration must be designed. Opportunities for learner to articulate their learning and experience must be provided, through writing their own stories or observations that he has made. Reflections on their learning, on other expert's work must be encouraged and facilitated. The advent of technology has compelled us to consider the best use of it for the overall benefit of learning effectiveness and efficiency. To be able to implement all that are described would mean that the teacher/instructor must be an expert in her areas of teaching, have experienced the richness of life in the subject matter, have many years of experience in authentic activities and be involved in current works in the industry. It is thus recommended that the teacher must have rich experience in the community, in the industry. Schools should be encouraged to employ people from the industry and these candidates should be remunerated more than those who have no experience at all.

References

Brown, J.S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher. 18(1),* 32 - 34.

Collins, A., Brown,J.S., & Newman, S.E. (1989). Cognitive Apprenticeship: Teaching the crafts of reading, writing and mathematics. In L.B. Resnick (Ed), *Cognition and instruction: Issues and agendas.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Collins, A. & Ferguson, W. (1993). *Epistemic froms and epistemic games: Structures and strategies to guide inquiry.* Educational Psychologist.

Looi, C. K. (1998/9) *Interactive Learning Environments for promoting inquiry learning.* Journal of educational technology systems. Baywood Publishing Company, Inc.

Pellegrino, J.W., Hickey, D., Heath,A., Rewey,K., Vye,N.J. & Vanderbilt, CGTV (1991). *Assessing the outcomes of an innovative instructional program: the 1990-1991 implementation of the "Adventure of Jasper Woodbury".* Vanderbilt University, Learning Technology Centre.

Preliminary Investigation of IMM Evaluation Instrument

Jennifer D.E. Thomas, Ph.D.
Associate Professor, Pace University
1 Pace Plaza, N.Y., N.Y. 10038
Email: jthomas@pace.edu

Introduction

The suggestion has previously been made that an instructional multimedia (IMM) application will support learning to the extent that it offers support to user performance speed, memory, effort, comfort, content and course management. (Thomas, 1998). An instrument based on this model was then proposed (Thomas, 1999). A preliminary study using the qualitative measures of the model is presented in this paper. Subjects evaluated an interactive multimedia application to teach children how to draw. The results indicate that users were quite consistent in their evaluation of the application and that these opinions did not change a week later, after discussions of good design principles. The only exception was a change in the perception of the support of memory provided by sound.

Model and Instrument

In applying the proposed dimensions to evaluating instructional multimedia (IMM) , speed is considered a function of how fast one can learn the material or search for answers. Support for memory would be indicated by the ease with which encoding of information can occur as a consequence of the integration of multimedia. The extent to which images, sound and text contribute to conveying ideas or concepts to be taught will determine, in part, the efficacy of the application design. The amount of effort which must be expended in learning can be gauged by the structure and the levels which must be navigated, that is, the hypermedia components. The comfort dimension measures the aesthetic appeal of the images, sound and text included in an application. These will be a function of the number and quality of various features, for example, resolution, clarity, font style and size, layout, navigational tools, help aids, etc.

The instrument, based on the model, suggests that the dimensions can be assessed objectively as well as subjectively. (Scriven, 1990; Teng and Jamison, 1990; Roberts and Moran, 1983; Holcomb and Tharp, 1991; Davis, 1989; Schneier and Mehal, 1984; Murphy, 1992; Khalifa, 1990; Polson and Kieras, 1985; Preece and Keller, 1990). In this paper, the focus is on the subjective or qualitative assessments and asks users to assess Speed, the time needed to complete or learn the application, as fast, moderate or slow. Support of memory, as a consequence of integrating text, images and sound into the application, may be assessed as high, moderate or low. The structure of an application will dictate the effort required in navigating it. The more links and branches there are, the more complex the application and the more effort required in finding answers and in making associations among the various concepts. Users are likely to view this effort as extreme, moderate or minimal. The aesthetic appeal of an application, its comfort level, will be a function of the quality of good package features included in it, and can be rated as excellent, good, or poor. The quality of the content of the application can be assessed in terms of completeness as complete, adequate or superficial and, in terms of relevance as relevant, peripheral or inappropriate.

The Study

The instrument was tested with information systems students in a graduate introductory multimedia course who used the instrument to evaluate the qualitative aspects of an application to teach children how to draw. The instrument was administered during the first lecture prior to the presentation of any material, and then a week later, after discussions of good design principles. In this preliminary study, the research questions investigated were:

1. Are users' evaluations consistent using the instrument?
2. Do these evaluations change after exposure to good design principles?

Results

The sample was mostly males in the 20-29 age group. In total, there were twenty-three users filling in evaluations in the first lecture and twenty-one a week later after discussions of good design principles. Most had extensive computer experience, moderate computer assisted instruction experience and minimal multimedia design experience.

Users rated the application as "Average" on most of the dimensions initially. Their opinions did not change after discussions of good design principles, except with respect to support offered by sound to memory which went from high to moderate. This is puzzling. Perhaps users have more experience with the use of text and images for learning, while the purpose of sound may be less evident without instruction as to its use and merit.

Conclusion

The instrument would seem to be stable in eliciting qualitative assessments of interactive multimedia by end users. This would need to be validated with a larger sample size and across different applications. The results, however, are encouraging and suggest continued research along these lines.

References

Davis, F.D. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology". MIS Quarterly, September 1989, p. 319-340.

Doll, W.J. and Torkzadeh, G. "The Measurement of End-User Computing Satisfaction". MIS/Quarterly, June 1988, p. 259-274.

Holcomb, R. and Tharp, A.L. "What Users Say About Software Usability". Int. J. of Human-Computer Interaction, 1991, 3(1), p. 49-78.

Khalifa, M. A Quantitative Model for Predicting Ease of Learning of Interactive Computer Systems. Unpublished Doctoral Dissertation, Wharton School, University of Pennsylvania, 1990.

Murphy, M. A Model and Tool for Testing the Learning of Cognition-Based Human-Computer Interfaces. Unpublished Doctoral Dissertation, McMaster University, Hamilton, Ontario, Canada, 1990.

Preece, J. and Keller, L. (Eds.). Human-Computer Interaction. Hemel Hempstead:Prentice Hall, 1990.

Polson, P.G. and Kieras, D.E. "A Quantitative model of the learning and performance of text-editing knowledge". Proceedings of CHI'85: Human Factors in Computing Systems, New York: ACM, 1985, p. 207-212.

Reeves, T.C. and Lent, R.M. "Levels of Evaluation for Computer-Based Instruction". In D.F. Walker and R.D. Hess (Eds.,), Instructional Software - Principles and Perspectives for Design and Use, Belmont, Calif.: Wadsworth Publishing, 1984, p. 188-203.

Roberts, T.L. and Moran, T.P. "The Evaluation of Text-Editors". Communications of the ACM, 1983, 26, p. 265-283.

Schneier, C.A. and Mehal, M.E. "Evaluating Usability of Application Interfaces". In G. Salvendy (Ed.), Human-Computer Interaction. New York, N.Y.: Elsevier Publishers, 1984, p. 129-132.

Scriven, M. "The Evaluation of Hardware and Software". Studies in Educational Evaluation, 1990, 16, p. 3-40.

Teng, J.T.C. and Jamison, W. "User Evaluation of Database Query Languages: A Comparison of SQL and DBASE III". INFOR, 1990, 28(3), p. 282-296.

Thomas, J.D.E. "An approach to interactive multimedia evaluation for end-users", Invited Speaker First Annual Congress on The Impact of Technology Upon Learning, Wake Forest Universtiy -ICCEL, Winston-Salem, N.C., Mar. 1-3, 1999.

Thomas, J.D.E. "Evaluating software ease of use based on speed, memory, effort and comfort". CD-ROM Proceedings of the Association for the Advancement of Computng in Education ED-MEDIA/ED-TELECOM 97 Conference, Freiberg, Germany, June 20-25, 1998.

The Emergence of 'School' as a Factor Influencing Patterns of Navigational Choices in Hypermedia

Denise Tolhurst
School of Information Systems, Technology and Management
The University of New South Wales
Australia
d.tolhurst@unsw.edu.au

Raymond L. Debus
School of Educational Psychology, Literacies and Learning
The University of Sydney
Australia
r.debus@edfac.usyd.edu.au

Abstract: This paper focuses on the qualitative results of a study that examined the effects of learner characteristics and the learning environment on students' acceptance of control opportunities while using hypermedia software. A covariance structure analysis revealed substantial effects of the school which students attended on their navigational choices within the software. Analysis of data from student interviews and audit-trail data collected during use of the hypermedia software suggest that three possible factors may have contributed to the strength of the variable of school. Specifically, they may have been the genders of the students, students' epistemological beliefs and different the learning environments created by the cultures of the two schools the students attended.

Introduction

A related paper entitled 'The Effects of Activity Structure and Learner Characteristics on Acceptance of Control Opportunities in Hypermedia Environments: A Report of Quantitative Findings', in this proceedings, introduces a study which explored the effects of activity structure and individual characteristics on student acceptance of control in an hypermedia environment. The quantitative analysis identified that the school which students attend was a factor influential in navigational choices made by students. This paper focuses on the qualitative findings of the same study, identifying possible reasons for the strong influence of the school variable.

Analysis of the qualitative data and examination of relevant literature identified three possible factors that may have influenced the strength of the school factor. Specifically, these were the gender differences of students at the two schools, the epistemological beliefs of students and the different cultures and learning environments that existed at the two schools.

Qualitative Findings

In an attempt to determine the reasons for students' navigational choices and their adoption of particular navigational strategies during software use, interviews were conducted with eighteen students directly following computer-based lessons. During the interviews students were asked to explain their reasons for particular navigational choices when required to demonstrate how they would locate particular information in the software. In addition to the interviews a detailed analysis of the audit-tail data of software interactions for those students interviewed helped to identify patterns of choices that represented particular navigational strategies.

Gender: Gender differences between the two school populations is the most obvious interpretation of the large influence of the school variable. Analysis of audit-trail data showed the boys more likely to engage in focused information seeking and girls more likely to explore. Interview data also revealed gender-related patterns of responses, with most girls expressing the opinion that they enjoyed the autonomy offered in the computer-based lessons. In contrast, most boys indicated that the computer-based lessons were 'better' than normal lessons. Also consistent with the responses regarding autonomy, most girls interviewed also expressed the opinion that they would like the opportunity to explore the software in addition to completing worksheets, while the boys mostly considered the worksheets of prime importance.

Epistemological Beliefs: Comments made by students in interviews and the information seeking behaviours they exhibited when using the software suggest that the majority of students may have possessed naive epistemological beliefs, beliefs that knowledge is absolute, is simple, is handed down by authority and is acquired quickly or not-at-all. Those exceptions were girls who were more likely to make larger numbers of choices and engage in exploration of the software, suggesting that they sought more detailed information, and possibly alternative, supportive data for answers to questions (either their own, or questions set in the tasks).

The Cultures of the Schools: A third potential area that may offer explanations for the differences in the information-seeking is the distinctive differences in the learning environments of the two schools. While both schools adopt a holistic approach to the development of the person, the girls' school aims to create an environment in which co-operation and group work are valued and promoted. The boys' school however, aims to create a different learning environment in which individual academic performance is valued, and one in which students are encouraged to observe the discipline standards in willing co-operation rather than from a fear of breaching them. These different environments may have contributed to students' different approaches.

Discussion

An important outcome of the study is that the findings of the research have identified some implications relevant to classroom practice. Awareness of the three identified factors will help educators to consider the possible effects of learning environments they create and the tasks they set students on usage of complex computer-based software and learning outcomes. Future research could also productively investigate the effects of gender, epistemological beliefs and school cultures on learner acceptance of control opportunity.

Acknowledgements

Many thanks to Dr Mike Bailey and Bob Baker for their support of this work in the form of encouragement, advice on research design and invaluable comments on previous versions of this work. Their time, effort, input and willing help is greatly appreciated! This paper contains work undertaken for a doctoral thesis at The University of Sydney, Australia.

Cultural and gender differences in computing among secondary school children

Johan van Braak
Department of Education
Vrije Universiteit Brussels
Pleinlaan 2
1050 Brussels Belgium
Johan.van.Braak@vub.ac.be

Abstract: In this study, some figures are presented on the presence of a home computer, frequency of computer use and computer tasks among a large group of secondary school children in Belgium. In particular, relationships have been sought between the variables mentioned above and two demographic variables: gender and cultural background. In correspondence to previous studies, differences between boys and girls in the field of computing remained visible. Figures on cultural background differences in computing were less pronounced than gender differences, but still apparent.

Background

In the last two decades, a great amount of literature has been produced on gender issues in the field of computing. Many researchers have pointed at differences between males and females, with males generally showing more favorable attitudes towards computers, having greater access to computers and spending more time using them. Gender inequality is discussed in many reviews of the literature and meta-analyses (Sutton, 1991; Whitley, 1997; Kirkpatrick and Cuban, 1998; Liao, 1999). Although research conclusions are not always similar, overall, males seem to have more favorable attitudes towards computers than females (Martin, 1991; Okebukola, 1993; Shashaani, 1997). For example, Okebukola (1993) demonstrated that boys in high school show less computer anxiety and have more interest in computers than girls. Shashaani (1997) confirmed that male students show more computer interest.
In contrast to the interest in gender issues in computing research, less attention is paid to the impact of social background on computer access and use at home. In a review of computer research in the eighties, Sutton (1991) stated that besides female students, socially disadvantaged and minority students had less access to computers both at home and at school.

Methodology

The purpose of this study was to examine the existence of inequalities between adolescent boys and girls and the effect of cultural background on the accessibility of computers and computer use at home. A brief questionnaire was administered to 1500 children (age 12-20). Information on demographic variables was collected (age, gender, cultural background). Furthermore, respondents were asked to indicate their computer experience, frequency of use and computer use for school and/or leisure activities. After removing missing data from the sample, descriptive statistics and tests of significance were performed on data from 1305 children.

Results

The average age was about 15 years. Of the sample, 51.6 % were male and 48.4 % were female. To indicate the cultural background of the respondents, the nationality of the parents was measured. For 215 respondents at least one of the parents were not of Belgian nationality (16.5 %).
In total, 81.1 % of the respondents owned a computer at home. The group of children of 16 years had the highest percentage of computer ownership (87.5%). A linear increase of computer ownership by age might be expected, but could not be confirmed. Computer experience of secondary school children in this study was 33 months on average. Children of 16, 17 or 18 years old had more or less the same amount of computer experience (40-41 months). Of the

subgroup of children with a home computer, 20.1 % never of rarely used a computer, 15.3 % used the computer about once a month, 37.9 % on a weekly basis, and 26.6 % daily. The older the respondent, the higher the frequency of daily use ($X^2 = 13.9$, $p < .05$).
Chi² testing revealed significant differences between gender and computer presence at home ($X^2 = 14.1$, $p < .001$). Of the males, 85.0 % had a home computer, as compared to only 76.9 % of the females. Although more boys owned a home computer in all age groups, the gender gap was only statistically significant for 12-, 16- and 17-year olds. So the assumption that gender disparities are increasing with age could not be confirmed. Overall, girls had significantly less computer experience (29.3 months) than boys (37.1 months) ($F = 23.2$, $p < .001$). When controlled for computer presence at home, this association remained significant ($F = 10.8$, $p < .01$). In addition, males (32.2 %) were found to make more use of a computer on a daily basis than girls (12.0 %) ($X^2 = 78.8$, $p < .001$).
Results indicate that gender disparities depend on the nature of tasks being performed with computers. The use of computers for leisure activities is clearly reported as being a masculine activity. Significantly more boys (73.7 %) reported to use a computer for leisure activities than girls (58.6 %). This gap remained significant when children without a home computer were excluded from the sample: 86.3 % of the boys versus 75.5 % of the girls ($X^2 = 20.2$, $p < .001$). The situation appears to be different when considering computer use for school activities. Similar proportions of girls (58.5 %) and boys (58.1 %) use a computer at home for school activities, but if respondents without home computer were not taken into account, significantly more girls (75.3 %) reported to use computers than boys (67.9 %) ($X^2 = 7.17$, $p < .01$).
The presence of a home computer was significantly lower among children of non-Belgian origin: 73.9 % versus 82.5 % ($X^2 = 8.0$, $p < .01$). The association was only apparent for the oldest among the respondents (17 years or older).
Overall, Belgian respondents reported to have six months longer experience with computers ($F = 6.8$, $p < .01$). However, when the effect of computer ownership was imported as a covariate in the test, no significance was found between the two groups ($F = 1.4$, $p = .23$). Moreover, no differences between groups could be demonstrated for frequency of computer use variable. Respondents of Belgian origin did not report to use the computer more often on a daily basis than non-Belgian respondents. This finding is confirmed for both males and females. Comparing Belgian and non-Belgian respondents, in general Belgian students accounted for a wider use of computers: 8 % more made use of a computer for school activities ($X^2 = 8.8$, $p < .05$) and 12 % more for leisure activities ($X^2 = 12.3$, $p < .01$). The presence of a computer at home seemed responsible for the difference in use for school tasks. In other words, if respondents without a home computer were removed from the sample, no significance was found. This finding could not be confirmed for leisure use: non-Belgian respondents made significantly less computer use for free time activities, even when controlled for computer presence at home ($X^2 = 4.1$, $p < .05$).

Discussion and conclusion

The present findings confirm other studies which clearly have demonstrated gender differences in computing. Besides, this study suggests the existence of cultural differences in computing. Although there are many social and psychological factors responsible for gender and cultural inequalities, the absence of a home computer seems to accentuate the differences between groups.

References

Kirkpatrick, H., & Cuban, L. (1998). Should we be worried? What the research says about gender differences in access, use, attitudes and achievement with computers. *Educational Technology, 38* (4), 56-61.

Liao, Y.-k.C. (1999). Gender differences on attitudes toward computers: a meta-analysis. *Proceedings of the SITE 99 Conference, 10,* Texas, San Antonio, 1388-1393.

Martin, R. (1991). School children's attitudes towards computers as a function of gender, course subjects and availability of home computers. *Journal of Computer Assisted Learning, 7* (3), 187-194.

Okebukola, P.A. (1993). The gender factor in computer anxiety and interest among some Australian high school students. *Educational Research, 35* (2), 181-189.

Shashaani, L. (1997). Gender Differences in computer attitudes and use among college students. *Journal of Educational Computing Research, 16* (1), 37-51.

Sutton, R.E. (1991). Equity and computers in the schools: a decade of research. *Review of Educational Research, 61* (4), 475-503.

Whitley, D.E. (1997). Gender differences in computer-related attitudes and behavior: a meta-analysis. *Computers in Human Behavior, 13* (1), 1-22.

Evaluation of IT Course Material in the Context of an Acoustic Design Project

Pieter Vandaele, Dick Botteldooren, INTEC, Ghent University, Belgium
Els Van Zele, Josephina Lenaerts, Center for research in physics education, Ghent University, Belgium
Raoul Meuldermans, KaHo Sint Lieven, Belgium
Marc Van Overmeire, WERK, Vrije Universiteit Brussel, Belgium
Gerrit Vermeir, Laboratory for Building Physics, K.U.Leuven, Belgium

Abstract: To evaluate the use of newly developed IT course material in the domain of acoustics, (http://educinno.rug.ac.be/wetenschapsmuseum), the students had to perform an open design project. The way engineering students at Ghent University tackled the problem and used the available tools to do so, is evaluated through their results and their opinion expressed in a survey. At the same time, their global ideas about the usefulness of information technology in education are explored.

Introduction

To evaluate the learning environments from the project "Distributed Development of a Virtual Science Museum with Guide Applied to education in Acoustics" [1] and test their effectiveness in improving students' insight in complex formulas and concepts, a suitable student project had to be built. A design project seemed the ideal option considering the numerous alternatives and various possible ways to achieve an acceptable result and the different learning paths and styles to be used. The specifications of the project corresponded to what an engineer can expect in real life situations. Students were instructed to design Helmholtz resonator: basic acoustics were known in advance, but the students had to explore more specific information on the Helmholtz resonator themselves. The IT project provided them with learning objects containing illustration of concepts, mathematics, models, model limitation, simulation tools, etc.

To solve the problem the students could follow five different problem solving paths. The path of ...

1. the rote experimenter: look briefly at the general operation principle and use the virtual experiment to accidentally come up with a reasonably good solution.
2. more intelligent trial and error: derive a mathematical relation between a few design parameters from the general operation principle and investigate only valuable combinations experimentally.
3. a meaningful experimenter: start with some trial and error, realize there must be a reason why some parameters do not seem to have any influence, turn to the theory to find out if there is a theoretical background for this and eventually return to experiments to determine the last degree of freedom.
4. a theorist (pure mathematics): combine the available mathematics to come to a result possibly using some numerical solvers.
5. an expert: use the formula to relate some parameters, investigate more detailed theory to find some physical and technical restrictions, solve the last degree of freedom using mathematics and their own software or the applet, finally turning to the derivation to find out if their design is well within the limits of applicability of the theory.

Survey and exam results

The students reported their ideas about the importance of the several factors for solving the problem: the virtual experiment, derivation of equations, limits of the theory, other Internet pages, communication with peers, literature, and their perception of the insight they gained in some acoustic concepts. Despite a small statistical population of 27 students, some interesting conclusions can be drawn:

- Part of the goal of the design project was to urge students to learn the theoretical background by exploration of additional resources. About 66% of the students state that they gained insight into the theoretical background. We consider this a reasonable success.

- Students focussing on experiments affirmed they gained insight in the problem at hand but they did not learn about the theoretical background. They probably followed paths 1 or 2 mentioned above.
- The more students perceive the equations and underlying derivations as important (solution paths 3, 4 and 5), the more they get the impression they understand related theoretical topics. However the correlation with their impression of understanding how a Helmholtz resonator really works gets lower and even becomes negative, although this tendency is not reflected in the students' exam result of questions related to the topic. Perhaps students only realize the complexity of the matter when they study the topic thoroughly.
- There is a negative correlation between the student's global result and his perception of insight gained. This can mean several things: the material is not good enough and better students are left somewhat unsatisfied, or better students do not easily state understand something completely, or the students who perform well in the current educational system are not inclined to put much effort in an alternative project. One thing is sure: it is a question of perception since there is no negative correlation with their examination score on the question related to the subject.

This project forced students into using IT. After this (for some students 'first') IT-experience for educational purposes some general questions about the appreciation of IT were asked. The following trends reflect their ideas:

- there is a strong negative correlation between the wish to get more interactive multimedia material (as was presented to them) and the student's performance in the current system.
- the students almost unanimously approve the usefulness of self-assessment tools to evaluate the level of understanding they have reached.
- applets allowing students to explore the influence of parameters in a mathematical theory are highly appreciated, as are additional self-assessment tools.
- the possibilities of hypertext to hide unessential information or to cross-link different topics is not estimated very high by the average Flemish engineering student.

Conclusions

In general students appreciate the collaboration and the exploration type of approach of a design problem on a subject they had no prior knowledge of. The exploration stopped at an earlier stage than hoped for. This could be due to the way the problem and the tools were presented, but "the study culture" of Flemish engineering students probably explains a lot. It is not a habit of these students to consult literature, search the web, etc. When using IT in education one has to be considering the study culture of the students, which is hard to change.

There was an unexpected negative correlation between the general performance of students in the traditional educational model and their appreciation of the project and IT in education in general. Since one of the initial goals of this project was to make sure "better" students had the opportunity to learn more than in the traditional educational approach, some tuning seems appropriate, in order not to loose those students.

As we expected, there is some fear of loosing track and of doing things that are not really essential in order to be able to pass the exam. In the first semester of 1999-2000 we try to respond to this by structuring the software agent we called "the guide" in such a way that a clear path through the material is outlined and that the structure becomes more evident. Hyperlinks are applied in a more structured way by the use of icons indicating which type of hyperlink can be expected: example, practical application, additional explanation, more background, etc.

References

[1] Botteldooren D., Vandaele P., Pottie S. (1999). Distributed Development of a Virtual Science Museum with Guide Applied to Education in Acoustics: First Year's Experience. *Proceedings of ED-Media 1999,* Association for the Advancement of Computing in Education, Seattle, VA. 1515-1516.

Malaysian Smart School – Vision Vs. Reality

Vijaya Kumaran K.K.Nair
Multimedia University
Cyberjaya, 63000 Selangor, Malaysia
vj@hypermedia.com.my

Abstract: The Smart School Project is one of the flagships of the Multimedia Super Corridor. The Malaysian government has established partnerships with the private sector through the Concept Request for Proposals (CRFP) process. This paper will critically analyze the concept of Smart School in the Malaysian environment and look into the issues relating to implementation of this concept as per the vision of the Ministry of Education Malaysia. The paper will go further to provide empirical proof with regards to the mind set and the response to the Teaching-Learning component of the Smart School Concept, from the view point of in service teachers.

Introduction

In July 1997 the Prime Minister launched the Flagship Application documents to invite proposals for solutions from the private sector within and from outside the country. The Education Ministry based on critical and creative teaching-learning approach planned the Smart School concept. Technology as an enabler became an important component of this flagship. The exercise is to help the Malaysian student community to cope with the Information Age.

The main components in the Malaysian Smart School are:

1. Teaching - Learning Process - here self-accessed and self-directed learning will be encouraged
2. Management and Administration - the school Management and Administration will be technology driven for efficient and effective management of resources and to support the teaching-learning process in 1 above.
3. Human Resources, Skills and Responsibilities - active role play by Parents, Community and the private sector as Stakeholders
4. Processes - review of input and output
5. Technology - to be used as an enabler i.e. as a means to the end and not as an end to the problem
6. Policies - changes in existing policies and regulations over and above new policies and regulations

Objectives

The objectives of the Smart School Project are:
1. To produce a thinking and technology - literate workforce
2. To democratize education
3. To increase participation of stakeholders
4. To provide all-round development of the individual
5. To provide opportunities to enhance individual strengths and abilities

Implementation

The Ministry of Education has planned for a three-year Smart School Pilot Project through the CRFP process. Ninety (90) pilot schools have been picked for the pilot stage which will involve three levels of technology, i.e. level A, B+, and B.

Level	Total Number of Computers	Description
A	Primary – 406 Secondary – 479	Schools in this level will be equipped with state –of-the-art technology. Each school will have two computer labs and each classroom and science lab will be equipped with computers.
B+	86	This level is based on classroom model. This model is based on group-based activities and project work. Computers are available whenever needed for information access, writing reports, developing presentations, e-mailing etc.
B	42	The majority of schools will implement technology supported learning by use of a computer lab. Students will use the facility to access information, use software application for various purposes and work on available courseware in the four subjects.

The Government intends to play a role as an architect and driver for the Smart School Project. The Ministry of Education will prepare guidelines and provide the basic amenities to schools according to their individual needs. The Ministry is also actively encouraging schools to become Smart Schools on their own initiative by using their own financial resources and expertise. The Pilot Project period is three (3) years from 28th July 1999 to 22nd July 2002. It is projected that all schools in Malaysia will be Smart Schools by the year 2010.

Reality

The Malaysian government is spending over RM. 300 million for only 90 schools to be wired, of which RM. 183,573,737 for Capital Expenditure and RM. 116,426,263 for Operating Expenditure. As per the time line set, from 13th March – 22nd March 2000, the installation of Release 1 software (Teaching-Learning Materials and the Smart School management System) is to take place.

However on 20th February 2000, The Star (National Daily) reported the Director – General of Education saying that the "smart school" project in 90 schools nationwide will be further delayed because of hitches in the software development for the lessons. He had said that the "slight delay" was due to the fact that it took time to develop the courseware. The pilot project was suppose to take off on Jan 1st 1999, but was delayed for several reasons including lack of funds and courseware. The infrastructure for the implementation is ready in `80 of the 90 schools for the full implementation. The Education Deputy Director General stated that the software for the 4 subjects took time to write, and to evaluate them. He went on to say that it will take about 4 years to fully develop and implement the program.

Among the reasons for the delay were:

- lack of fully developed smart school curriculum
- lessons being rejected several times
- difficulty in contacting evaluators(Ministry of Education)
- lack of communications
- rejection after many rounds of evaluation
- evaluators not exposed to technological limitations

Should the consortium entrusted with the development of the courseware implement software engineering principles in developing the courseware? If the basic software engineering principles had been incorporated, couldn't most of the above reasons for rejection be done away with?

Evaluation throughout the Life Cycle of a Multimedia Tutoring System

Maria Virvou, Victoria Tsiriga
Department of Informatics,
University of Piraeus,
Piraeus 18534, Greece
E-mail: {mvirvou | vtsir}@unipi.gr

Introduction

One of the primary aims of educational software is to be used in real school classrooms. However, a lot of educational software has been criticised that has not been designed to meet the needs of real schools settings. The above criticisms show that there is a need to introduce research results of educational technology into the environment of real classrooms. A solution to this problem may be the involvement of school teachers in the development of an ITS (Virvou & Tsiriga 1999a) and the application of evaluation methods on every stage of the tutoring system's life cycle. In this way we can ensure usability and learning effects.

For the purpose of this research, a multimedia tutoring system was developed. The system is called EasyMath and incorporates intelligence. EasyMath's model of life cycle has been based on Object Unified Process (Kruchten 1999), an object oriented process that suggests multiple iterations of the software development phases. In this way, we have ensured multiple iterations of evaluation of the design and executable releases of EasyMath.

Evaluation of the Design

Evaluation of the design of EasyMath was considered very important in order to ensure that the expertise incorporated in the error diagnosis component would be acceptable by the majority of school teachers. EasyMath's error diagnosis and student modelling have been based on reconstructive approaches which have been used in many ITSs such as (Brown & Burton 1978). These systems reconstruct the problem solving process and generate mal-rules from hypothesized faulty solution paths which are used for the modelling of students' misconceptions or procedural bugs.

At this stage we aimed at evaluating the error diagnosis component in terms of its cognitive principles and completeness. Therefore, ten school teachers were given a computer based questionnaire with questions that had been answered erroneously. The faulty answers were produced using the library of the most common misconceptions that were encoded in EasyMath. The questions covered the whole range of exercises included in EasyMath. The questionnaire consisted of ten questions. In each one of the questions, each teacher had to provide a justification of what s/he thought the underlying misconception was. One problem in this stage of the evaluation process was that many teachers did not provide any explanation and just gave the correct answer to the question.

Evaluation of a Primary Executable Release

In an early stage of the development, a prototype of the tutor was ready to be used by its end users. This prototype was used in order to perform a primary evaluation of the system. In the phase of the primary release evaluation, two school teachers along with ten students were involved. The evaluation methods employed comprised qualitative techniques, such as direct observation and questionnaires.

The main focus of this phase was on the evaluation of the user interface and the several types of the exercises provided by the system. Teachers and students were asked to comment on the working environment of EasyMath. Furthermore, they had to express their opinion about whether the amount of different exercises encoded as well as the form of these exercises were adequate.

The teachers and the students involved in this phase were introduced to EasyMath and were then asked to use it for about an hour. During their interaction with the system, an evaluator was present, trying to note down the difficulties that the users had encountered while performing predefined tasks. After the interaction with EasyMath, both the teacher and the students were given a questionnaire to answer. The questionnaire was designed taking into account a set of "usability heuristics" presented in (Nielsen 1994). The questionnaire included questions such as:

1. Were instructions for use of the system visible or easily retrievable whenever appropriate?
2. Were the symbols and the words used in the different components of EasyMath consistent?

The first question corresponds to the need for recognition rather than recall, while the second question is related to the need for consistency and standards. The comments made during this stage of EasyMath's development were used as the basis for the refinement of the requirements of the system and the construction of the final product.

Formative Evaluation Using a Set of "Learning with Software" Heuristics

The involvement of school teachers in the phase of the evaluation of an ITS was considered crucial. In addition, it is also important to track students' use of resource based packages very closely to uncover the problems and successes. For the above reasons, in the phase of the formative evaluation of EasyMath, 10 school teachers as well as 240 students were involved. Both students and teachers were asked to evaluate EasyMath in terms of the purpose of education. In addition, teachers were asked to evaluate the overall performance of the system and express their opinion about the usability of such an ITS in a real classroom.

In the stage of the students' evaluation of EasyMath, the students were separated in two portions. The first 120 students were introduced to EasyMath and were asked to use it for an hour. Then, they were given a questionnaire to complete. For a more detailed description of the results of the questionnaire, the reader is referred to (Virvou & Tsiriga 1999b). As for the rest 120 students, they were taught half of the syllabus in algebraic powers without the use of EasyMath and they were given a written test. Then they used EasyMath while being taught the rest of the syllabus. In the end they were given another written test and the grades of their first and second test were compared. The results showed that 46% of the students obtained a better grade in the second test, 43% obtained the same grade and only 11% obtained a lower grade in the second test.

The evaluation questionnaires used in this phase were constructed based on a set of "learning with software" heuristics, introduced by (Squires & Preece 1999). These heuristics are an adaptation of "usability heuristics" (Nielsen 1994), so as to relate to socio-constructivist criteria for learning. "Learning with software" heuristics have been suggested by their inventors as a method for performing predictive evaluation. However, we have used them to construct a formative evaluation questionnaire, that would give us insight about the integration of both usability and learning issues.

In the phase of the overall evaluation of EasyMath, the teachers who participated in the evaluation were asked to role play an average student interacting with EasyMath. Next, they were given a questionnaire to fill in. The questionnaire was carefully designed so as to ensure that questions are related to as many of the "learning with software" heuristics as possible.

Conclusions

To produce efficient educational software, there is a need to ensure the correctness of the domain knowledge as well as to evaluate the usability of the product. One way to achieve the above goals may be the application of evaluation methods on every stage of the tutoring system's life cycle. In addition, evaluation should involve both human teachers and students in order to maximise usability in real classroom settings.

References

Brown J. S. & Burton R. R. (1978). Diagnostic models for procedural bugs in basic mathematical skills. *Cognitive Science*, 2, 155-191.

Kruchten, P. (1999). *Rational Unified Process-An Introduction*, Addison-Wesley.

Nielsen, J. (1994). *Usability Inspection Methods*, John Wiley, New York.

Squires, D. & Preece, J. (1999). Predicting Quality in Educational Software: Evaluating for learning, usability and the synergy between them. *Interacting with Computers*, 11(5), 467-483.

Virvou, M. & Tsiriga, V. (1999a). A Role for School Teachers in the Development of an ITS. *Proceedings of the 8th International Conference on Human-Computer Interaction (HCII 99)*, Munich, Germany, 2, 691-695.

Virvou, M. & Tsiriga, V. (1999b). EasyMath: A Multimedia Tutoring System for Algebra. *Proceedings of ED-MEDIA, ED-TELECOM 98, World Conference on Education Multimedia and Educational Telecommunications*, 2, 933-938.

Neuromance, Or Is The Old Flame Still Best?

Simon Walker
School of Post Compulsory Education and Training
The University of Greenwich
UK
S.H.Walker@gre.ac.uk

Abstract. This work in progress paper reports on whether hybrid CD-ROM technology used to train or supplement the training of mentors of beginning teachers in Vocational Education and Training is an improvement upon traditional face to face and print-based delivery. It argues that the shifting ground in pedagogical models can confuse educational software developers but an understanding of a theoretically driven level of explanation of learning may assist decisions about learning approaches and choice of technology.

Introduction.

Faced with a climate of change, educational institutions are under increasing pressure to explore new ways of learning. Emerging trends in Information and Communication Technologies (ICTs), combined with national governments initiatives to use ICT and widen participation in lifelong learning (in the case of the UK, the influential Dearing, Higginson and Kennedy reports), have created a framework for supporting an increasing community of participants in education and training.

The development and introduction of ICTs into the further and higher education and training sectors has stirred debate about pedagogical performance versus educational efficiency. In training, the debate has focused on issues of *Return on Investment* (Hawkins, et al 1997). Factors of cost and value for money versus amount of learning and quality of learning characterise educational and training evaluations A lack of separation of these factors has created a cloud of confusion, and decisions about allocations of scarce resources are not always made in a manner that maximises the collective benefit of the community.

Many would contend that ICTs are not only cost efficient (Boulet & Sene,1997; Greenwood & Recker, 1996) but they also promote more effective learning (Resnick, 1987; Fjuk & Dirckinck-Holmfield 1999). Others call for more caution to be exercised about such claims. In the UK, the push towards the integration of computer-based education within education and training has been made at the highest levels with funding to match. The premise is that ICT can deliver more effective learning than traditional media.

There is no one single recognised right way of thinking about learning; theories constantly change and tend to reflect the attitudes and technologies of their time. The literature points to shifting ground in pedagogical models.(Reiguluth 1999; Herrington & Standen, 1999). Currently the debate is influenced by ICT.

It is of some concern therefore, that educational software developers have an understanding of a theoretically-driven level of explanation that identifies the kinds of cognitive activities (such as learning, memory tasks and problem-solving) that could take place through the physical activities provided by an interface. To produce successful tools for learning, it is necessary to understand the nature of the learning process and the impact of context within which learning operates.

Background

There is a particular need at the University of Greenwich each year to train up to 250 new and existing workplace mentors who support trainee teachers on the Post Graduate Certificate of Education (PGCE) in Post 16 Vocational Education and Training (VET) during their teaching practice.

The learning demands and needs of these mentors are relatively different to the more conventional learner and it may be argued that the instructional approach is different. Firstly, it concerns the training of trainers. Secondly, there is no set curriculum to follow, or assessments to be made; thirdly, there are no prerequisites other than being a teacher/trainer within the selected institution and lastly, whilst the institution is paid for the efforts of their staff, the mentors personally go largely unrewarded either by time, cash or qualification inducements.

Although some mentors may work within the same organisation, many others do not and generally they work largely independently of one another. Institutions span a large geographical area across London and the South East of England and mentors rarely meet with one another to discuss their role.

There is no substantial proof to suggest that a trained mentor is more effective than an untrained one (Jowett 1998), however, training does enhance an understanding of the stages of a relationship, the mentoring process and it enables critical reflection on professional practice. Conventional mentor training, by virtue of location, time and resources, can only address a small number of aspects of the mentoring process - the tip of the iceberg. Malderez and Bodoczky (1998), take the image of the iceberg further and draw a parallel between the tip, which is out in the air and represents the visible 'good professional' and the main body of the iceberg, which lays unseen and represents all that the professional engages in as an expert in their subject and as a mentor. The submerged part represents the mentor's thinking, planning, and engagement in process, and draws upon their knowledge, understanding, values, feelings and attitudes. The mentor's ability to respond to the student teacher's professional development hinges on their understanding of the role and on their own development as mentors. An analysis of these elements forms the content of the interactive tool.

Project Objectives and Scope.

In its current form, training is administered through a combination of print-based distance material and a single workshop session for *some* mentors at the beginning of the academic year. Our initial research showed that the majority of mentors would be willing to use IT for training purposes, although we identified a number of constraints; some were institutional such as the limitations of the technical specification of equipment provided by colleges (processor speed, CD-ROM drives, soundcards, the ability to play video, etc) and some personal constraints such as knowledge about ICT and confidence in using the computer. The pursuit of a technological solution to provide support and training, independent of time and location was compelling.

In 1998 the *Mentor in cyberspace* project undertook to produce an alternative means of supplementing the existing mentor training and support. Interactive multimedia, it appeared to us, offered the best chance of developing a range of tools and resources to support mentor processes such as thinking, creativity, self-reflection, problem solving and the development of professional attitudes & approaches over time. At the start of the project only a small number of academic institutions which were not universities had organised individual internet access for their staff. We considered the lead-in time for the project to be sufficiently long to utilise the hybrid function of CD-ROM technology with its ability to connect on-line. Furthermore, the University's on-line Campus (OLC) was under construction and the idea of extending the range and type of tools available to mentors was attractive.

Learning approaches.

Selecting instructional methods on the basis of the theories has not easy because little agreement exists between the main protagonists. The constructivists attack instructivist design approaches as formulaic and mechanistic. Defenders of instructivist design have attempted to re-establish its authority at the expense of all other approaches. They take a staunch position against the infringements of, in Merill's words, "these persons who claim that knowledge is founded on collaboration rather than empirical science, or who claim that all truth is relative" (Merill, cited in Wild and Quinn 1998, p 74). In much of the current and recurring debate about the role of learning theory in educational interactive multimedia there appears to be a readiness to assert one theory of learning over another - to present one as being deficient and the other as the only credible explanation of learning.

The important issue is to match the instructional approach to learning need whatever the level, whether this is the efficient dissemination and testing of knowledge, the creation of new personal knowledge or the development of opportunities for networking and collaboration. In a professional context where the goal is to encourage the acquisition of reproductive *and* productive skills and knowledge, a balance must be struck between those methods that appear to work best.

Our approach has been to try to strike a balance between these two ostensibly opposing theories and adapt the technology to suit the perceived learning needs of the mentors. On analysis of the strengths of each learning approach in relation to our purposes, we saw that instead of contradicting and negating each other, these two approaches could be complementary. We perceived that the use of hybrid CD-ROM would combine both learning approaches. CD-ROM is a relatively closed technology, limited by its content and design. Our design here draws upon the strengths of Instructional Systems Design (ISD): its emphasis on presentation, information, structure and reinforcement is useful for the reproduction of knowledge (Boyle 1998) and is suited to interactive multimedia on CD-ROM. Web technology, on the other hand, is characterised by an open, explorative architecture. Accordingly we have used web technology, specifically Computer Mediated Communications (CMC) which supports a more constructivist approach: it is able to provide a set of tools and methods for the mentor to construct new knowledge within ill-structured, authentic, real contexts (Brown,J.S., Collins, A., & Duguid 1989). Hybrid CD-ROM offers the possibility of combining the reproduction of knowledge with the production of 'knowledgeability' (Guile & Young 1998).

This work in progress will report the findings of a pilot study ending in June 2000 with approximately 20 mentors who will have utilised the various tools and approaches during this academic year. The particular focus of the research will examine whether:

- mentors preferred to use the hybrid CD-ROM or the print based material for learning about their role
- one instructional approach or technology was more successful than the other.

I will attempt to draw conclusions about the success of introducing interactive multimedia and whether the use of ICT in this context is an advantage for training and supporting mentors of beginning teachers in VET

Bibliography

Boulet M & Sene L (1997) Investing in Computerised Training: The Interactive Decision Aid System. *Conference Proceedings*- Ed Media/Ed-Telecom. Calgary Canada 1998, p186.

Boyle T. (1997) *Design for Multimedia Learning*. Prentice Hall

Brown, J. S., Collins, A., & Duguid, P. (1989). *Situated cognition and the culture of learning. Educational Researcher, 18*(1), 32-42.

Dearing (1997) *National Inquiry into Higher Education*. HMSO

FEFC (1996) Report of the FEFC Learning and Technology Committee (The Higginson Report), Further Education Funding Council.

Fjuk A,& Dirckinck-Holmfeld, L: "Articulation of Actions in Distributed Collaborative Learning". (To be published in *Scandinavian Journal of Information Systems*) (online) http://www.infostream.no/?192

Greenwood J & Recker M. "Networked, Asynchronous Student Evaluations of Courses and Teaching: An Architecture and F . *Proceedings of ED-MEDIA 96 & ED-TELECOM 96*. Boston, USA, 1996

Guile & Young (1998) Journal of Education and Training 50 (2) (online) http://www.triangle.co.uk/vae/index.htm

Hawkins C, Gustafson K & Nielsen T. "Return on Investment for Electronic Performance Support Systems: A Case Study". *Conference Proceedings*- Ed Media/Ed-Telecom. Calgary Canada 1998, p1519.

Jowett, V 1998. *Working for a degree – a mentoring project in work based learning* Facets of mentoring in higher education 2. SEDA paper 103.19 –34.

Malderez,A. 1998. *Addressing tensions in the mentoring relationship – interpersonal skills training.* Facets of mentoring in higher education 2. SEDA paper 103.49 -57.

Herrington & Standen 1999. *Moving from an Instructivist to a Constructivist Multimedia Learning Environment.* in Ed Media 99 Proceedings. Seattle, USA 99 AACE Virginia.

Kennedy, H (1997) *Learning Works; Widening Participation in Further Education* Coventry; FEFC

Reigluth C (Ed). (1999) *Instructional-Design Theories and Models Volume 2*. Lawrence Erlbaum Associates, London

Resnick,L 1987 "Learning in School and Out". *Educational Researcher*(16), 13-20

Wild M. & Quinn C, (1998) "Implications of Educational Theory for the Design of Instructional Multimedia". *British Journal of Educational Technology* 29 (1) 73-81.

Visual Lab - A Multimedia Virtual Experiment Environment on WWW

Chao-Chiu Wang
Department of Information and Computer Engineering
Chung Yuan Christian University, Chung Li, 32032 Taiwan
mfc42@ms24.hinet.net

Maiga Chang
Department of Information and Computer Engineering
Chung Yuan Christian University, Chung Li, 32032 Taiwan
maiga@ms2.hinet.net

Chang-Kai Hsu
Department of Information and Computer Engineering
Chung Yuan Christian University, Chung Li, 32032 Taiwan
ken@mcsl.ice.cycu.edu.tw

Jia-Sheng Heh
Department of Information and Computer Engineering
Chung Yuan Christian University, Chung Li, 32032 Taiwan
jsheh@ice.cycu.edu.tw

Abstract: This paper proposes an open architecture of Visual Lab on WWW and focuses on scientific experiment for the asynchronous mode of distance learning. Visual Lab is a virtual experiment environment by using video-media. A complete scientific experiment in Visual Lab includes four essential stages: phenomenon observation, experiment process observation, data measurement and experiment recording. In Visual Lab, students can carry out experiments remotely with the toolbox designed on Internet. A system architecture built on World-Wide Web demonstrates the feasibility and flexibility of our idea.
Keywords: Distance Learning, visual lab, scientific experiment, World Wide Web.

1. Analysis of Scientific Experiment in Visual Lab

For a full scientific experiment, there are several essential stages: *phenomenon observation, experiment process observation, data measurement* and *experiment recording.* These essential stages are analyzed details in the following.

Phenomenon Observation: With such knowledge, phenomenon observation can be divided into two categories

(a) **Static Observation.**
(b) **Dynamic Observation.**

Experiment Process Observation: It is very important to practice with one's own hands. After experimenting themselves, students can gain much impression.

(a) **Traditional Process Observation.**
(b) **Video Observation.**

Data Measurement: Data measurement is the key to prove a physics theory.

(a) **Equipment Usage in a Traditional Lab.**
(b) **Usage of Simulation Tools.**

Experiment Recording: The formats of experiment records have to be designed.

Problems Analysis of Four Essential Conditions on WWW: The formats of experiment records have to be designed.

(a) **Video Format:**

	Compress	Network Transfer
MPEG	No	No
Real Video	No	Yes

AVI	Optional	No

Table 1: Video formats comparison.

(b) **Component Format:**

	Download	Security	Control Operation	Browser Support
Java Applet	Light	No	Can not access local files	Both IE and Netscape
Real Video	Heavy	No	Can not control	Both IE and Netscape
Window Object embedded in Web page	No	No	Can not control	IE
ActiveX	Heavy	Yes	Full control	IE
Application	Heavy	No	Full control	Both IE and Netscape

Table 2: Comparisons table of web technologies.

(c) **Experiment Record:** Students can record data what they want to measure and send out these data to teacher. Then teachers can gather all the student learning information via the function provided by experiment record.

2. Design the Platform of Visual Lab

In this section, several toolboxes will be discussed. Each measurement and observe components must applied these toolboxes in Visual Lab platform.

Measuring and Observing Tools: For a Visual Lab System, measuring and observing tools are helpful to both students and teachers

(a) **Video Controller:** To play some experiments video.
(b) **Scale:** In order to measure the actual length from the experiment video.
(c) **Ruler:** Students can adjust the length of this ruler tool to can get the length what they adjust when they saw in the video.
(d) **Protractor:** Students can measure the angular magnitude.
(e) **Calculator:** Students can input the data and get the result just like a calculator.
(f) **Timer:** A timer is needed to measure time in scientific experiment.

Components of Visual Lab: Each learning work is implemented by an independent component, and our architecture can be illustrated as (Fig. 1) shown.

3. Implement the Visual Lab on WWW

We designed a platform using open architecture technology. Our purpose is that all of the physics experiments can apply in Visual Lab without any modification. As long as teachers film the experiment and join in Visual Lab, students can experiment in Visual Lab environment and record with Microsoft Excel 2000, as show in (Fig. 2).

4. Conclusion

This paper proposes an open and reusable architecture of Visual Lab on WWW. All of the scientific experiments can apply to Visual Lab based on the architecture of Visual Lab had been accomplished. Learners can learn knowledge by experiment in the Visual Lab even they are not at school. Solution for transferring video stream through network should be the next research direction to enhance Visual Lab.

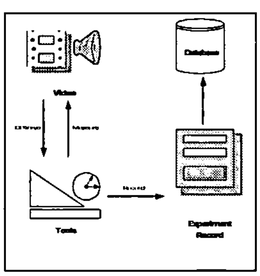


Figure 1: The architecture of Visual Lab.

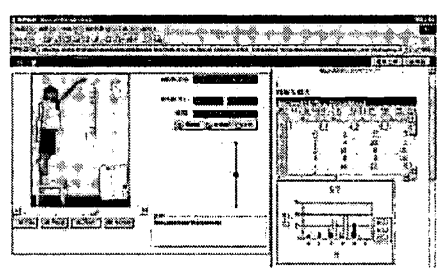


Figure 2: Scientific experiment

Professional Development Institute vs. On-line Course: Comparing Two Online Collaborations for Designing Technology Integrated Instruction

Elizabeth Wellman, Ed.D.
Graduate School of Education and Information Studies, Center X, UCLA, USA
ewellman@ucla.edu

Maya Creedman
Graduate School of Education and Information Studies, Center X, UCLA, USA
creedman@ucla.edu

Jana Flores
California History - Social Science Project, UCLA, USA
jsflores@ucla.edu

Abstract. Two groups of teachers, 50 K-12 History teachers from California and 20 K-12 teachers in a Masters program in Massachusetts, participated in an online experience to develop instructional materials which integrate technology into the curriculum. Each groups' level of participation in online communication activities and the method that their instructional design process was developed predicted the quality of the final materials. Recommendations for structuring online collaborative activities for teachers to develop instructional materials are given.

Introduction

This is a comparison of two on-line collaboratives with the same purpose -- to have teachers develop K-12 technology-integrated instructional materials -- but significantly different approaches. The two projects we are using for this comparison are a California statewide professional development project in K-12 History (CH-SSP) and an on-line course in Project Based Learning for a Masters degree program in Educational Technology at Framingham State College in Framingham, Massachusetts.

Key Factor - Participation in Communication Activities

For all participants, developing instructional materials was a process that involved participant to participant, and participant to facilitator/instructor communication using an online space and several forms of electronic communication. There were six different forms -- online chat, face-to-face, online submission of original written material, online response to others written material, participation in the online discussion forums and e-mail. The greater the participation in online activities, the more probable that the lesson plan was completed and the more likely that those lesson plans were of high quality. There were significant differences between the groups in their participation in on-line activities. The professional development group participated significantly less than the online course group. There were two primary reasons for this. Although both groups were required to participate, there was no tangible consequence for not participating for the professional development group. Second, technical resources and technical help were more readily available for the online course participants than the professional development participants.

The greatest disparity between the groups was in the discussion area. The postings for the professional development group were sparse to non-existent. No discussion ever emerged. For the online course, this was unquestionably the most successful communication. The discussions were interesting, in-depth, meaningful and at the Masters level. The major difference between these groups is that the discussion was participant driven for the professional development group and instructor driven for the online course group. We find this to be problematic, as one of the goals of the professional development is to have the participants drive the interaction.

Key Factor - Instructional Design Process

An important component of the CH-SSP project was the development of the instructional design process. CHSSP was interested in having the different grade level groups develop their own process for the development of the lesson plans. In the Project Based Learning course, conversely, the instructor strictly imposed the process and the students were, in part, evaluated on how they used this imposed process. We refer to this difference as a self-generated process (CHSSP) vs. an imposed process (Framingham).

The different process experience led to significant differences in the final product. The self-generated process group spent a great deal of time developing the process. As this was a new experience for them, there was confusion regarding what was being asked of them. This detracted from the application of those processes to the instructional materials development. We still feel strongly that we would like to see the process of materials development arise from the teachers that are using the materials. We feel changes need to be made to focus more on the development of the materials themselves.

Recommendations

We have several recommendations. There were many difficulties with the professional development institute, most of them centered around participants actively engaging in the online communications, and participants understanding facilitator expectations in relationship to the process of instructional materials development. We would prefer, encourage and work towards that process being developed by the participants themselves. However, many of the participants, from both groups, felt the need for more structure and more direction in how to go about developing the materials. We do not know if this was because they were using a new environment and felt unsure about how to proceed, or if they would have difficulty developing instructional materials without an imposed process in any environment. In the future, In the professional development project, some direction needs to be provided for the development process, however, this process should remain fluid for the participants. In the online course, we would recommend that a portion of the beginning of the course be spent with the participants examining their own practices of instructional materials development.

The professional development institute needs to provide a more concrete reason for the participants to actively participate in the online environment. Providing participants with a 'reward' at the end, such as a stipend, University Extension credit towards salary points, or the like may be an important component to motivate participants. Technical support is also essential. It may be best that technical support be pledged from the district as that is frequently the ISP for the teacher. It also provides a district commitment to the project.

In general, online instructional materials development, in a group, collaborative setting, needs a structure to support it which includes facilitator support for the multiple forms of online communication, technical support, and clear guidelines for the participants process. In addition, participants need a tangible motivation for completing the project, such as salary points or a stipend. These online development projects differ from traditional development projects in that they can be conducted asynchronously and between participants who are at a geographic distance. For the future, we hope that the communities that are formed can continue on, develop further materials and expand to provide online support for other teachers in their subject areas or grade levels.

Becker, J. (1994). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. Journal of Research on Computing in Education, 26 (3), 291-321.

Office of Technology Assessment. (1995). Teachers and technology: Making the connection (GPO stock #052-003-01409). Washington D.C.: Government Publishing Office.

State of California State Board of Education (1999). *History/Social Science Content Standards Grades K-12*. Sacramento, CA; Author.

Using a Wrench to Pound in a Screw:
The Misapplication of Communication Technologies in Education

Eric Wignall
Instructional Design & Educational Media Labs
Purdue University Calumet
United States
Wignall@calumet.purdue.edu

Abstract: This short paper illustrates a framework for examining the application, and misapplication, of media types and contexts in educational settings. It illustrates a relationship between form, format and function that is useful in determining the effectiveness of new media technologies in educational contexts.

Your home has a drawer or box in some convenient place where you can always reach the most useful tools; a flashlight, a ruler, a roll of tape. But there have been occasions where rummaging around in that drawer didn't get you the desired tools. You want to hang a picture on the wall but you can't find a nail, only some screws. You realize that a screw would work for hanging the picture, only to find you don't have a screwdriver. You rationalize that the picture isn't all that heavy so you could just pound the screw into the wall and take care of it, but there isn't a hammer to be found either, only a wrench. This tool, clearly not designed for the task, is pressed into service and with a little effort, hopefully without broken fingers, you indeed hang the picture. You may not have used the right tool for the job but the job was done. Because the picture now hangs over and covers the screw you are also able to hide this odd choice of a mounting device from visitors who would admire the picture.

This short paper is meant as a starting point for examining educational effectiveness of technology applications by matching format, function, and context. In far too many cases today the wrong tools are being used in the wrong context, supporting the educational process in ways that are left unexamined by educational researchers and instructional designers. We are getting the job done with whatever we have available and no one is looking at the inventory of tools in the drawer. The efficiency and effectiveness of technology in educational settings cannot be measured solely through the final output of an educational process. The latest studies of the use of computers for educational purposes, now focusing on the role of the Internet, have provided a confusing mix of contradictory results. Most of the studies are hopeful in tone but unclear about the benefits, or even the overall value, of using the Internet as a medium of education. It can be used, so it is being used.

Educators have a long history of adopting and adapting to new communication technologies as they enter society-- sometimes with great effect. Other communication technologies have been misused in specific applications by teachers and learners and abandoned for all other uses. The awareness that a communication tool can be used in an educational setting is related to the need that could potentially be satisfied by the new technology. If the tool does not not immediately satisfy the need, it runs the risk of being abandoned. If the tool can satisfy an educational need even through a use that was unintended, even inefficiently, it will be adapted to suit the purpose. The effectiveness of this use can be improved through an understanding of the educational process, its context, and the effects of communication tools on teaching and learning.

Communication formats and settings

Linking communication environments with educational settings is a valuable starting point for comparing the operational effectiveness of a new technology tool in context. the following six educational/communication environments are based on mass communication theories that grew from research efforts through the 1940s and 50s .

Figure 1. Formats & Settings

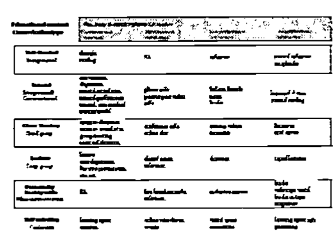


Figure 1. If the effectiveness of educational technology is to be measured it must take place, necessarily, at one of these levels, and perhaps be used as a tool at several levels. The understanding that different types of communication contexts offer differing levels of interaction with educational material, and thus provide a variable basis for learning, is essential for measuring the effectiveness of the application of technology tools at each level of interaction.

Figure 2.

BEST COPY AVAILABLE

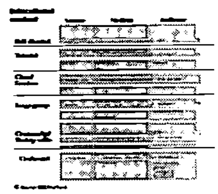


Figure 2. The quality of educational interaction breaks down when at lower levels of activity, and cannot be applied at all at higher levels of interactivity. Interpersonal communication cannot take place over mass broadcast technology, but lectures can be misapplied to interpersonal tutorials. Media technology is most effective for education when context and type match interactivity.

Media types and technology tools

The historical development of multimedia, the combination of moving images, sound, and graphic information, begins with the development of motion pictures and extends to today's subscription television cable systems. The impact of these multisensory media on viewers in the immersive environment of a darkened theater or near the electronic hearth of individual homes is complex and impressive. Multimedia technology has become more sophisticated and multilayered, allowing for multiple languages, commentary, text, and audio input and feedback. This is all the more remarkable in view of the almost total lack of feedback in early silent movie production, mass broadcast television monopolies, and linear videotape media.

Coalescent media is the result of both technology and media convergence. It represents the development of a new, digital, component-based medium. Coalescent media have emerged from the development of computational and data management tools, publishing software, digital audio and media, hypertext, and hypermedia. The linkage of different components occurs in contexts provided by the user in ways determined through navigational choices made on the spot by the user. Today web pages can be built by relational databases on demand. Users select options and the database engine places the requested information in an HTML document using preselected parameters. The limitations of current database technology combine with bandwidth restrictions to limit the potential of this early technology to combine and recombine data, in numerous forms, based on searches of worldwide resources. Coalescent media will be first relational, drawn together through user demand and user selected interaction parameters. Later developments may find hypertextual hypermedia coalescing into forms of communication that extends the capabilities of text, audio, or info-graphics by extending the interactions users have with new combinations of that media. This hyperlinking of other media types, in constantly shifting referential and contextual frames, is creating a new type of medium that demonstrates the characteristics of each level of interaction and uses each previous type of medium. As technology escapes the limitations of keyboards and screens we will see new types of interactions take place in contexts wholly created and invented by the user, not producer, of the content. New technologies being developed are allowing different types of interactions with content in contexts not imagined by the author. We are only beginning to see the curve rise in the growth of computational efficiency and the rise of new computational technologies.

Educational institutions are currently setting learning requirements, and designing the curricula to reach them, through interactions with government, professional and industry interests. These may be anything from international professional societies to locally elected school boards. What will education look like with information age learning requirements and learner-defined knowledge building? If the individualization of economic activity continues, what role will educational institutions play in defining or providing education? Does the personalization of education erode or enhance the role of educational institutions?

Conclusion

Driven by a need for improved commercial skills and abilities learners are rejecting the constraints of semesters and grades for the realities of deadlines and competencies. The growth of asynchronous distant learning systems has been dramatic, reflecting both the new availability of learning through new technologies, and the growing demand for training and education. Knowledge workers need to respond to demands for new, more valuable, knowledge on an accelerating time scale. Traditional educational institutions entering the distance education marketplace are now faced with a similar dilemma; the multifaceted role of information provider, curricular coordinator, skill assessor, and content producer. Institutions are now faced with competition not from other institutions or organizations, but from individuals operating outside of traditional knowledge production frameworks. Without the capital investment needed to create a scriptorium, library, or research lab entrepreneurs can respond to the demands of a new economy in ways that slow moving institutions cannot. Research into the improvement of learning using new media technologies, in different contexts, is not just important. It is vital to the improvement of educational systems that take advantage of each medium.

References

Everett M. Rogers, Diffusion of Innovations, 3rd ed. (New York: Free Press, 1963) pp. 81-83.
Weaver & Shannon's Mathematical Model of Communication (1949)
P.W. Holaday and George D. Stoddard, Getting Ideas from the Movies (New York: Macmillan, 1933) pp. 65-66.
David Pearl, Lorraine Bouthilet, and Joyce Lazar, eds., Television and Behavior: Ten Years of Scientific Progress and Implications for the Eighties, 2 vols. (Washington, D.C.: US Government Printing Office, 1982).
Leonard M. Adleman, "Molecular Computation of Solutions to Combinatorial Problems," Science, November 11, 1994 (Vol. 266, page 1021)
John C. Merrill and Ralph L. Lowenstein, Media, Messages, and Men: New Perspectives in Communication, 2d ed. (New York: Longman, 1979), p. 29.
Shirley Alexander, Teaching and Learning on the World Wide, a paper given at AusWeb 1995. http://www.scu.edu.au/sponsored/ausweb/ausweb95/papers/education2/alexander/
J. Tinbergen and H.C. Bos, "A Planning Model for the Educational Requirements of Economic Development' OECD Study Group in the Economics of Education, as reproduced in The Economics of Education, M. Blaug ed., (Penguin Books, England, 1969) p. 125-151
Steven Levy, "A Spreadsheet Way of Knowledge," in Computers in the Human Context: Information Technology, Productivity, and People, ed. Tom Forester (1989) p. 319.
Sources:
Bond, A. H., and L. Gasser, Eds. (1988). Readings in Distributed Artificial Intelligence. San Francisco: Kaufmann.
Clearwater, S. H., Ed. (1996). Market-Based Control: A Paradigm for Distributed Resource Allocation. Singapore: World Scientific.
Durfee, E. H., V. R. Lesser, and D. D. Corkill. (1992). Distributed problem solving. In Encyclopedia of Artificial Intelligence. 2nd ed. New York: Wiley.
Huhns, M., and M. Singh, Eds. (1997). Readings in Agents. San Francisco: Kaufmann.

Formative Evaluation of Learner-Centered Web Course Design: A Strategic Analysis

C. James Wong
Instructional Technology & Distance Learning, Learning Resources Division
Southwestern Illinois College
cjwong@mail.southwestern.cc.il.us

Introduction

A poorly planned and developed distance education program will lead to negative learning outcome. For example, when a Texas college began to offer on-line courses taught by instructors without the skills and experience to teach on the Internet, only about 40% of students who enrolled in the on-line courses completed them (Simpson, McCann, & Head, 1999). From the same logic, a poorly designed Web course interface will have a negative impact on the entire distance education program.

This paper discusses the roles of instructional design and interface design in the development process of a Web course. Although the principles of both instructional design and interface design emphasize the importance of formative evaluation, formative evaluation (which should be conducted to assess the quality of the Web course instruction and interface) is often overlooked or ignored in this process. Formative evaluation involves (1) collecting a third party content expert's feedback to the instruction and target learners' experiences with the instruction and interface and (2) taking these evaluation results into consideration when revising the Web course. The purpose of conducting such formative evaluation is to further improve the Web course instruction and interface to maximize learner comfort and thus their learning outcome.

Instructional Design and Interface Design

In the ideal context of Web-based instruction development, instructional design is a process in which a content expert (the instructor), a distance learning instructional designer, and a course production team (that composes of an editor, a Web programmer, and a multimedia developer) work together developing a pedagogically sound Web course. According to the Dick and Carey systems approach model (Dick & Carey, 1996), the instructional design process involves determination of the instructional goal, analysis of the instructional goal, learner and context analysis, development of performance objectives, development of assessment instruments, development of instructional strategy, development and selection of instruction, formative evaluation, revision of instruction, and summative evaluation.

In this instructional design model, if the instructional strategy has been determined to be Web delivery, then the next stage--development and selection of instruction--will focus on the instructional content level of the Web course, such as choosing the appropriate instructional materials for the intended learners, modifying the existing format, structure and sequence of these materials to which learners are presented, and adding links to Web-based instructional resources.

The literature indicates that an important factor to the success of Web-based instruction is the integration of interface usability design into the development process (Henke, 1997). A Web course interface design defines the surface level of the Web course (that is, the visible structure that helps learners accomplish the goal of content learning). Web courses produced by using HTML coding, Web Course in a Box, WebCT, or other tools appear differently, due to their unique interfaces. An interface includes the following features:
(1) what students will see and hear on a web page within the Web browser (e.g. hyperlinks, text, images, animations, audio and video clips, streaming audio and video media, frames), and
(2) any responses (e.g. feedback, change of web page, error message) to students' actions such as clicking on a hyperlink on a Web page or the "Back" button in the Web browser.

Regardless which Web course production tool one uses (HTML coding or Web course delivery software like CourseInfo, Lotus LearningSpace, Web Course in a Box, or WebCT), it is crucial that a learner-centered Web course interface should address the goals of user-interface design: time to learn, speed of performance, rate of errors by users, retention over time, and subjective satisfaction (Shneiderman, 1998). As mentioned earlier, Wedman is concerned of students' "subjective satisfaction" of his School's on-line master's program.

Formative Evaluation

In the Web course development process, an in-house review of a Web course that can be called an alpha testing (in software engineering, the first test that is often performed only by users within the organization developing the software) consists of instructional designer's initial review and feedback to faculty, faculty's revision, editor's editing, instructional designer's review and feedback to editor, editor's re-editing, programmer's HTML coding, instructional designer's review and feedback to programmer, programmer's revision, faculty's final review, programmer's final revision. What is usually missing is the beta testing which requires a group of learners who are representatives of the target learners due to practical difficulty. Beta tests, usability tests, or formative evaluations (in the instructional design process) have one thing similar--the evaluation of the use of instruction and interface by actual learners or users.

A formative evaluation can be conducted to assess the quality of the Web course interface that includes the Web pages of general course information, and the first two lessons (if time permits, the entire course). The following is an example of an ideal formative evaluation of a Web course based on Dick and Carey systems approach model of instructional design (Dick & Carey, 1996): (1) subject matter expert evaluation, (2) one-to-one evaluation, (3) small-group evaluation, and (4) field trial.

Data Collection and Analysis

Technology plays a number of roles in the data collection and analysis processes during the formative evaluation. First of all, for the subject matter expert evaluation, the subject matter expert may live in a remote town away from the institution, so frequent travel to the institution will not be a feasible practice. As long as the subject matter expert has access to the Internet, he or she can review and evaluate the course content on the web, and make comments, corrections, and/or questions in an e-mail message sent to the instructor who developed the course. Through e-mail exchange between the subject matter expert and the instructor when discussing possible revisions in the course, the instructional designer will eventually be notified on actual changes needed for the course based on these two parties consensus.

Second, for the one-to-one evaluation, the technologies used are similar to an interface usability test. The entire evaluation will be taped by using a video camera, and the video tape will be reviewed and studied to observe the learner's facial expression, emotion changes, body language, and spoken language (while the think aloud protocol will be used) which will be also transcribed into words for further qualitative text analysis. The text analysis will make use of a software called HyperQual or a similar text coding/analysis software.

Third, for the one-to-one evaluation, small-group evaluation, and field Trial, a web-based testing software (which can be used for survey purpose) like QuestionMark Perception will be used to collect both quantitative data and qualitative data. If a 5-point Likert scale of attitude questionnaire is used, the questions can be entered in Perception. After learners complete the questionnaire, Perception is capable of conducting basic statistical analyses of the quantitative data collected such as mean scores, medium scores, standard deviations, and frequencies. Such data can be also transferred to a statistical software (e.g. SPSS for windows) for further statistical analyses or a database software (e.g. Microsoft Access) for data storage and possible future retrieval for further analyses. Likewise, if the lessons contain some form of objective posttests, Perception can be used to administer these tests, and thus results of student performance can be obtained by looking at the test/measurement analyses Perception conducted and by further analyzing the data in other software packages mentioned earlier.

Perception can also allow learners to enter open-ended information when answering attitude questions or answering subjective lesson assignment questions. The answers will be either kept on the Perception database on the web or sent to the instructor or the instructional designer for grading or evaluation. Again, for responses to attitudinal questions, the responses can be sorted or coded in a text analysis that will make use of a software called HyperQual or a similar text coding/analysis software.

Fourth, for the one-to-one evaluation, small-group evaluation, and field Trial, the instructional designer can use e-mail or phone to follow up with the learners to check on the accuracy of the designer's interpretation of their comments, suggestions, criticisms, and/or questions.

Conclusions

In order for the Web-based instruction design department to process the same number of courses with the inclusion of formative evaluation, more staff members will need to be employed, and the Web-based instruction design department will need to identify sources that can allocate such money for additional staff recruitment. If it is impossible to secure adequate funding for more staff, a compromised formative evaluation will have to be tailored (that is, to cut portions of the evaluation as outlined above) to fit the existing monetary and human resource structure.

References

Dick, W. & Carey, L. (1996). The systematic design of instruction. (4th ed.). New York: HarperCollins.

Henke, H. (1997). Evaluating Web-Based Instruction Design. [On-line]. Available: http://scis.nova.edu/~henkeh/hciproj.pdf

Shneiderman, B. (1998). Designing the user interface: Strategies for effective human-computer interaction. (3rd ed.). Reading, MA: Addison-Wesley.

Simpson, J. D., McCann, J. E., & Head, L. L. (1999, October). Strategies to dramatically improve retention in your distance education courses. Paper presented at the League for Innovation in the Community College 15th Annual International 1999 Conference on Information Technology, Chicago, IL.

Implementing a Professional Development Program in Instructional Design & Technology

C. James Wong
Instructional Technology & Distance Learning, Learning Resources Division
Southwestern Illinois College
cjwong@mail.southwestern.cc.il.us

Introduction

As noted by Speziale and Kachurick (1996), "advances in technology have provided numerous opportunities for educational integration; however, inadequate professional development programs have seriously limited teachers' knowledge of techniques for integrating instructional technologies." In an effort to solve this problem, instructional technology professional development programs have been founded in many major universities and large community colleges in the United States (Stoloff, 1999).

Recognizing the emerging needs for distance learning and the integration of instructional technology, Southwestern Illinois College has launched a professional development program in instructional design and technology, an innovative service to its faculty, in the summer of 1999. The new program is operated by the Instructional Technology and Distance Learning department under the Learning Resources Division, with a mission to assist members in planning, developing, implementing, and evaluating their instruction and to facilitate innovative integration of instructional technology into their on-campus and on-line courses. This institution-specific case study describes the implementation process of this new program and reports its recent performance assessment.

Program Services and Facilities

The professional development program is led by the instructional technologist/design specialist with assistance from and collaboration with other staff members (including the associate director of distance learning, the Internet systems manager, a Web-based instruction coordinator, a Web programmer, an Internet support technician, and a network technician) in the Instructional Technology and Distance Learning department.

A. Facilities: The long-term goal of the program is to implement a faculty development facility called the "Instructional Design & Technology Center" that consists of a computer lab for training purpose and a multimedia work area for production purpose. To get things started, a computer workstation with a Pentium II dual processor has been built and is available for faculty use. Additional hardware includes: a video capture card, a flatbed scanner, a CD writer, a ZIP drive, a JAZ drive, two digital cameras, a color printer, and a laser printer. Software titles installed are Microsoft Windows NT 4.0 Workstation, Microsoft Office, Microsoft FrontPage, Adobe PhotoShop, OCR Software, and other multimedia applications. In addition, a Macintosh G3 computer has been recently included in the Center with some general purpose software such as Microsoft Office.

B. Consultation: The program offers one-to-one consultation to faculty with tailored information about theory and practice in technology applications for instruction. A customized small group session can be arranged when there are two or more faculty members interested in a certain design and technology issue.

C. Training: Hands-on instructional technology workshops on how to use various instructional software are offered to faculty, in addition to pedagogical seminars for faculty to facilitate information sharing and discussion of current issues on design, development, implementation, and evaluation of instructional technology applications.

Program Performance

A. Instructional Design Consultation: To increase the visibility of the innovation--the new professional development program, a small but concise Web site was built in the summer of 1999 to publicize the services and facilities being offered to the faculty. As words about the innovation regarding the professional development program spread out, the number of faculty who came to the program for consultation on instructional design and technology has increased:

June 1999: 1 faculty on 1 occasion
August 1999: 2 faculty on 2 occasions
September 1999: 2 faculty on 2 occasions
October 1999: 7 faculty on 14 occasions
November 1999: 4 faculty on 9 occasions
December 1999: 1 faculty on 2 occasions
January 2000: 2 faculty on 3 occasions

The average length of a consultation meeting is about two hours. It shows faculty's enthusiasm and willingness to devote their time commitment. Issues faculty members have brought to the consultation meetings are diverse. The following list demonstrates the variety of such topics:

- Developing web pages for a campus course in FrontPage
- Working with WebCT for an online course
- Discussing design issues on Social Science departmental website
- Discussing and planning a Faculty Web Directory
- Designing a welcome template for an online course
- Designing a telecourse support Web site in Frontpage
- Working with PowerPoint to develop a student orientation session

B. Training to Meet Faculty Needs: In order to understand faculty members' needs in instructional design and technology and to prioritize offerings of workshops and seminars, a needs assessment was conducted in the form of a brief survey (Dick & Carey, 1996) to 130 full-time faculty members in August, 1999. The survey included questions asking faculty to rate (on a 1-3 scale, with 3 being highly interested, 2 being interested, and 3 being not interested) their interest in a range of workshop and seminar topics derived from the text by Newby, Stepich, Lehman, and Russell (2000). 68 faculty members returned the survey. The response rate of the survey is, therefore, 52.3%. The top rated topics are listed below in the descending order of the mean of their rating:

Rating	Topic
2.27	Using presentation software in the classroom
2.24	Creating instructional web pages
2.1	Integrating instructional technology in the classroom
1.96	Using Internet communication tools
1.87	Digitizing and editing images
1.83	Lessons learned from teaching an on-line course
1.83	Creating an electronic gradebook
1.69	Fair use of copyrighted materials in on-line instruction
1.36	Introduction to distance education technologies

Meeting the faculty needs, the program developed and delivered four hands-on workshops and two pedagogical seminars till February 2000. Workshop training materials, with step-by-step instructions and screenshot illustration on how to use the software applications, were produced by the workshop trainer (who is the instructional technologist/design specialist) and pilot tested by other staff in the department. With the intention to reduce faculty's computer anxiety level and not to overwhelm faculty by teaching them every single feature of the software applications, the workshops and training materials were tailored to invite faculty members to practice some the most commonly used functions to get started. During the hands-on workshops, pedagogical issues such as design principles were discussed before the hands-on practice sessions.

The following table illustrates a brief evaluation of the training delivered from September 1999 till February 2000. The "No." column is the number of faculty who participated; the "Overall" column is the participants' average rating of the overall evaluation of the workshop based on a 1-5 scale (with 5 being the highest rating); the "Usefulness" column is the mean of their rating to the statement "What I learned in the workshop has useful applications for my classroom and/or work".

Title of Training	No.	Overall	Usefulness
Workshop - Creating Instructional Web Pages with Microsoft FrontPage 98: An Introduction	30	4.77	4.73
Workshop - Designing Classroom Presentations: Basics of Microsoft PowerPoint	23	4.87	4.96
Workshop - Designing Classroom Presentations: Advanced Microsoft PowerPoint	13	4.85	4.77
Seminar - Integration of Instructional Technology into Teaching & Learning: An Overview	15	4.13	4.40
Seminar - Interaction, Instruction, and Research Via the Internet	12	5.00	4.91
Workshop - Image Digitizing and Editing	26	4.92	4.77

More workshops and seminars are under development and will be soon offered to faculty members in the future so as to address one of the commonly complained drawbacks of a professional development program according to national findings regarding to professional development: infrequency of training (Speziale & Kachurick, 1996).

Summary

Instructional technology are great tools that offer possibilities for improving the learning process, but such possibilities will not be realized automatically unless the teacher will have to integrate these tools into the curriculum in a way to facilitate teaching and learning (Heinich, Molenda, Russell, & Smaldino, 1999). The professional development program in instructional design and technology fills this gap between the tools and the people by helping faculty use the tools to teach in a more effective and efficient manner.

References

Dick, W. & Carey, L. (1996). The systematic design of instruction. (4th ed.). New York: HarperCollins.

Heinich, R., Molenda, M., Russell, J. D. & Smaldino, S. E. (1999). Instructional media and technologies for learning. (6th ed.). Upper Saddle River, NJ: Merill/Prentice Hall.

Newby, T. J., Stepich, D. A., Lehman, J. D., and Russell, J. D. (2000). Instructional technology for teaching and learning: Designing instruction, integrating computers, and using media. (2nd ed.). Upper Saddle River, NJ: Merrill/Prentice Hall.

Speziale, M. & Kachurick, J. (1996). The I-MAST project: The institute for math, assessment, science, and technology. In J. Price, J. Willis, D. Willis, & B. Robin (Eds.), Technology and Teacher Education Annual, 1996. Charlottesville, VA: Association for the Advancement of Computing in Education (AACE).

Stoloff, D. L. (1999). Instructional technology professional development: Exemplary university settings. [On-line]. Available: http://www.ecsu.ctstateu.edu/depts/edu/stoloff/techpds.html

WALTS: Web-based Adaptive programming Language Tutoring System

Chong W. Woo and Jinwoo Choi
Kookmin University
861-1 Chongnung-dong, Sungbuk-ku
Seoul, Korea
cwwoo@kmu.kookmin.ac.kr

Abstract: Many recent web-based educational systems couldn't provide individualized instruction or interactive problem solving, since they are mostly built upon static hypertext. One possible solution for this problem could be adapting existing proven techniques from the stand-alone Intelligent Tutoring Systems(ITS) into the web-based educational systems. Recent web-based ITS research shows this direction by employing the existing ITS techniques minimally. And this needs to be studied further to support more adaptive instruction. In this paper we describe the development of a Web based Adaptive programming Language Tutoring System(WALTS) which is designed by ITS structure primarily, and adapting many successful ITS techniques into the system. In addition, the system adapted CORBA infrastructure to support the user more consistent and reliable performance. Together, the system behaves more adaptive and interactive than the existing static web-based educational systems.

Introduction

Many recent web-based educational systems could not provide an individualized instruction or interactive problem solving, since they are mostly built upon static hypertext. One possible solution might be adapting the existing techniques from the stand-alone Intelligent Tutoring System(ITS). However, most of the recent web-based ITS research show the efforts by employing the techniques selectively(Kay & Kummerfeld, 1994; Brusilovsky et al. 1996; Nakabayashi et al. 1997). And this needs to be studied further to enhance the overall capabilities of the system at the previous stand-alone ITS level. In this paper we will describe development of Web-based Adaptive programming Language Tutoring System(WALTS). The main goal of the development of the system is to provide the first year computer science student a comprehensive instruction for learning C programming language, by porting many successful ITS techniques into the system. In addition, the system is designed to support the user more consistent and reliable performance by employing CORBA(Common Object Request Broker Architecture) structure.

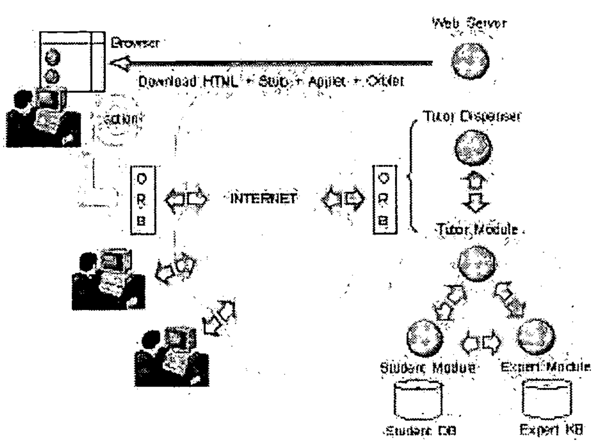


Figure1: The main Architecture of WALTS

BEST COPY AVAILABLE

Basic architecture of the system

The basic architecture of WALTS is designed by typical ITS structure primarily, including expert module, the student modeler module, and the instructional planning module.

The *expert* module consists of the *object-oriented knowledge base* and the *problem solver*. Since the domain of the system is the C programming language concepts, which may not require any complex causal relationships and only requires mostly simple concepts, we used the frame knowledge representation. The object-oriented approach of designing the knowledge base make it easy to understand and can provide more flexibility for updating or manipulating tutoring strategy in the construction of ITS. The problem solver creates problem table by referencing the problem template from the current *lesson unit* 's content table, which is the form of hashtable. The solver stores the correct answer, and then it presents the generated questions to the user in appropriate HTML form through the HTML generator. This method can provide different styles of questions for different users even though they are accessing the same lesson unit. Since the column name of the table is object's name, the planner can reply to the user's request, such as hint or help, by referencing this table.

The method of building the student modeler is the simple overlay. The modeler keeps all the necessary administrative information on the server, such as initial student's ID, password, e-mail address, the access time. And the information regarding the student's learning process is also stored in the student model. And each parameters has unique meanings; for example, the HelpCount, and HintCount can be updated only when the unitLesson is quiz, increase of ReferenceCount means the user is weak at the current unitLesson, the lessonLevel stores information about how many times the user visited the current unitLesson, and so on.

The Instructional Planning

The existing web based educational systems mostly employ the hypertext techniques, which is hard to make hyperlink in every HTML pages, such that it may be inappropriate for adaptive learning environment. Therefore we need to devise a method that can generate adaptive lesson unit dynamically. The instructional planning of the WALTS can be further divided into 3 steps, a curriculum planning, a lesson planning, and a delivery planning. The curriculum planning of WALTS generates a curriculum in tree structure; the curriculum planner extracts information from the knowledge base and creates a curriculum hierarchically in the order of prerequisites. Then the lesson planning sets up the lesson sequence within a single lesson unit. The role of delivery planning is limited to presenting the selected lesson content to the user.

Conclusion

The main goal of this paper is the adaptation of the existing ITS techniques to the web platform. Therefore, we have designed and implemented the system based on the major ITS architecture, and this brings us several advantages over traditional HTML-based educational systems. First, the main knowledge base is created as an object-oriented concept, which can provide more flexibility for updating or manipulating tutoring strategy. Second, the system can generate a problem dynamically by the problem solver and also can solve the problem intelligently. Third, the instructional planning mechanism can generate an instructional plan dynamically. The secondary goal is the designing of the system as a distributed infrastructure using CORBA as backbone. This structure solves the bottleneck problem of previous CGI dependent systems, and also gives some benefits of better performance and also gives flexibility in the case of further enhancement of the system.

References

Kay, J., & Kummerfeld, R.J. (1994). An Individualized Course for the C Programming Language. *The Proceedings of 2nd International WWW Conference*, Chicago, IL, 17-20.

Brusilovsky, P., Schwarz, E., & Weber, G. (1996) ELM-ART: An Intelligent Tutoring System on the WWW. *The Proceedings of ITS'96,* 261-269, Springer.

Nakabayashi, K., Maruyama, M., Koike, Y., Kato, Y., Touhei, H., & Fukuhara, Y. (1997). Architecture of an Intelligent Tutoring System on the WWW. *The Proceedings of AI-ED'97*, 39-46.

Online Learning Communities: Vehicles for Collaboration and Learning in Online Learning Environments

Stacey Ludwig-Hardman
University of Colorado - Denver
1583 Tabor Street
Lakewood, CO 80215
shardman@wgu.edu

Stephanie Woolley
University of Colorado – Denver
6401 S. Boston St. P105
Englewood, CO 80111
stephanie_woolley@ceo.cudenver.edu

Abstract: Online learning communities are an excellent means of integrating collaboration in online learning environments. After a brief introduction we [the authors] define collaboration and learning communities and address their theoretical foundations. We then discuss the benefits of collaboration and learning communities in online learning environments. Finally, we provide a case study of a new online learning community at Western Governors University.

Definitions and Theoretical Foundations

Learning communities are environments that encourage mutual exchange between the community members to support their individual and collective learning. Learning communities are founded on the aspect of social negotiation of meaning. Collaboration is the key tenet of constructivist and small-group theories (Springer Springer, Stanne, & Donovan, 1999; Grabinger, 1995; Duffy & Jonassen, 1992) that explains the social component of learning and demonstrates that "conceptual growth comes from sharing perspectives and modifying our internal representations in response to that sharing" (Grabinger, 1995, p. 669). Online learning communities provide the collaborative means for achieving the desired "shared creation" and "shared understanding" (Shrage, 1991, p. 40).

Benefits of Online Learning Communities

Collaborative learning and learning communities benefit learners because they encourage shared ways of knowing, promote active participation, improve achievement, contribute to the creation of knowledge, and challenge learners' cognitive abilities (Springer, Stanne, and Donovan, 1999; Moller, 1998; Lave & Wenger, 1991; Slavin, 1990).

Through new Internet technology, synchronous and asynchronous online collaboration now provides many of the benefits that exist in traditional face-to-face collaborative and learning community environments. Our recent literature review produced evidence that online collaboration and online learning communities:

- Allow learners and instructors to work together to create knowledge constructions from their combined experience (Jonassen, 1998; Reeves, 1997)
- Encourage learners to evaluate complex issues from multiple perspectives and change their perspective based on others' input (Sherry, 1998; Stone, 1996; Honebein, Duffy, and Fishman, 1993)
- Hold learners individually accountable while striving toward group goals so that students help one another and assess one another's learning (Springer, Stanne, and Donovan, 1999)
- Provide opportunities for learners to reflect on their learning experiences and upon others' input (Stone, 1996)
- Demonstrate that meaning and reality is socially constructed and negotiated through the exchange of ideas, information, and feelings among the members of the community (Hiltz,1998)
- Improve student achievement through increased motivation, peer support and communication, and commitment to participate and finish (Hiltz, 1998; Sherry, 1998; Stone, 1996)

The above evidence demonstrates that online collaboration and online learning communities can impact and enhance the learning process. We have personally witnessed the impact of a self-initiated online learning community at

Western Governors University. Although the WGU online learning community is relatively new, we have already seen positive effects ripple through the community members.

Case Study of an Online Learning Community at Western Governors University

In August 1999, Western Governors University (WGU) began enrolling students in its new competency-based Master of Arts in Learning and Technology program (MLT). A cohort of 50 students, primarily K-12 teachers, geographically dispersed throughout Utah were some of WGU's initial MLT students. In October 1999, a small group of 15 cohort students created their own collaborative online learning community utilizing a listserv since all students had ready access to e-mail.

The WGU online learning community provides a fascinating case study because it was initiated by the students themselves who by and large had no previous experience working together. Of the 15 original members of the community, only five had previous experience working with each other on previous projects; the majority of the learning community members had only met each other briefly at a WGU reception in September 1999.

As we watch the WGU online learning community develop, we are paying attention to the ways that the community members negotiate roles and establish rules and standards for communication, interaction, and entrance into the community. We are eager to compare learning community members' performance to the performance of students who do not participate in the online learning community. We are also interested in determining why some learning community members remain inactive or decide to leave the community.

Conclusion

Salomon and Perkins (1998) state that "learning to learn... fundamentally involves learning to learn *from* others, learning to learn *with* others, learning to draw the most from cultural artifacts besides books, learning to mediate others' learning not only for their sake but for what that will teach oneself, and learning to contribute to the learning of a collective" (p. 17). Collaborative online learning communities provide community members the chance to learn *from* and *with* others and to *contribute* to others' learning. As a result, they are important means of integrating the social aspect of learning into online learning environments. Our literaturc review and personal rcsearch of the WGU online learning community provide valuable insight into issues surrounding online collaboration and online learning communities' development, communication patterns, member roles, rules, flexibility, sustainability, and reproducibility.

Literature References

Grabinger, R. S. (1996) Rich Environments for Active Learning. In D. H. Jonassen (Ed.) *Handbook of Research for Educational Communications and Technology*. New York: Simon & Schuster Macmillan, 665-692.

Hiltz, S. R. (1998). Collaborative learning in asynchronous learning networks: Building learning communities. Paper presented at Web98, November 1998.

Honebein, P. C., Duffy, T. M. & Fishman, B. J. (1993).Constructivism and the design of learning environments: context and authentic activities for learning. In T. M. Duffy, J. Lowyck, , & D. H. Jonassen. (Ed.), *Designing Environments for Constructive Learning*. New York: Springer-Verlag.

Jonassen, D. H. (1998). Designing constructivist learning environments. In C.M. Reigeluth (Ed.), *Instructional design theories and models: Their current state of the art*, 2nd Ed. Mahwah, NJ: Lawrence Erlbaum Associates.

Jonassen, D. H., Peck, K. C., & Wilson, B. G. (1998). Creating technology-supported learning communities. [World Wide Web Document] Available: http://www.cudenver.edu/~bwilson/learncomm.html

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.

Moller, Leslie. (1998). Designing Communities of Learners for Asynchronous Distance Education. In *ETR&D*, vol. 46, No. 4, 115-122.

Reeves, T. (1997). Evaluating what really matters in computer-based education. [World Wide Web Document] Available: http://www.educationan.edu.au/archives/cp/REFS/reeves.htm

Scardamalia M. & Bereiter, C. (1996). Student communities for the advancement of knowledge. In *COMM ACM*, 39 (4), 36-37.

Sherry, Lorraine (1998). The nature and purpose of online discourse: A brief synthesis of current research as related to the WEB project. Available: http://www.cudenver.edu/~lsherry/pubs/dialogue.htm

Shrage, M. (1991) *Shared minds: The new technologies of collaboration*. New York: Random House.

Salomon, G. & Perkins, D. N. (1997). Individual and Social Aspects of Learning. In P. D. Pearson & A. Iran-Negad (Ed.) *Review of Research in Education*, 23.

Stone, Kathy (1996). Learning Online. In *Bulla Gymnasia Virtuales: A Bi-monthly E-mail Newsletter about Online Education and Training*.

Developing Collaborative Technology-Enhanced Programs To Create Learning Communities

Nancy Wyatt
njw@psu.edu

Matthew Bodek
mjb14@psu.edu

George Franz
gwf1@psu.edu

Karen Hill
klh7@psu.edu

Susan Ware
saw4@psu.edu

Penn State University Delaware County
25 Yearsley Mill Road
Media, PA 19390
United States

Abstract: Encouraging effective collaborative learning supported by computer technology requires coordination among faculty, administrators, technical and instructional support staff, and library staff. This paper describes the roles of each of these groups in the design and use of computer technology to support collaborative learning. This paper draws on collective experience from implementing Project Vision and Project Empower, two computer-supported collaborative learning programs in Commonwealth College, Penn State University.

Too often the discussion of collaborative learning and use of computer technology to support instruction focuses solely on the classroom; in fact, successful efforts in the classroom rest on a foundation of collaboration and support from administrators, technical and instructional support staff, and library staff. Over the last several years Penn State University Delaware County has developed teaching methods that incorporate the best features of distance education and collaborative learning in undergraduate education. The two projects most directly responsible for the development of collaborative, technology-enhanced instruction were Project Vision and Project Empower, both programs for freshmen and sophomores in general education courses.

Administrators

Important administrative support issues include motivating, training, and supporting faculty to take on new teaching roles and new responsibilities, since collaborative teaching and use of computer technologies differ significantly from the standard lecture/discussion format. Administrators must make sure that the reward system for faculty recognizes the effort necessary to change from the old to the new model; we provided release time and training for faculty to learn new roles. Administrators are also responsible for making sure that appropriate equipment and software for courses is installed properly and works efficiently. Persuading faculty to work cooperatively with librarians and with technical and instructional support personnel is also an administrative role. Administrators may also be responsible for the selection and orientation of technical and instructional support personnel, who must understand the academic mission and the instructional process. Finally, administrators must be well versed in designing and conducting collaborative learning in technology-enhanced classrooms, because they are responsible for the evaluation of the quality as well as the economic viability of these efforts.

Faculty

Graduate training seldom includes a component on teaching collaborative, technology-enhanced courses. Hence, faculty must learn how to design, manage, and evaluate collaborative assignments, as well as how to choose appropriate technologies to enhance learning in their specific venues. Faculty must be expert users of the technology in order to explain the technology to inexperienced students who are struggling concurrently with course content. Faculty always balance the advantages of new instructional media against many constraints, including the students' abilities and interests, classroom facilities, and the quality of technical support. They must also balance the time they spend in these activities against other responsibilities of teaching, service, and research. Computer technologies are constantly changing; therefore, faculty who are committed to these pedagogies know that the process of learning new technologies and the balancing act are never-ending.

Technical/Instructional Support Staff

Technical and instructional support staff work with faculty from a wide variety of disciplines, as well as with administrators and students. Math, social sciences, humanities, and business all have different content and different pedagogies. Technical and instructional support staff must understand a wide variety of technologies and software programs appropriate for specific disciplines to help faculty make informed choices. Support staff often advise faculty in designing assignments that make the best use of collaboration and computer technologies. Technical and instructional support staff must understand students' abilities and interests in order to recommend the most appropriate technologies for each particular instructional situation, keeping in mind budgetary constraints. They train faculty and students and trouble-shoot daily problems which inevitably arise. Close collaboration with faculty, administrators, and students requires superior communication skills. A sense of humor doesn't hurt either.

Library Staff

The new technology-enhanced and collaborative classrooms are changing the roles of librarians as well as faculty. Library staff must constantly keep up to date with emerging technologies, a not inconsiderable task with the rapid development of electronic media. Librarians are responsible for designing systems for accessing information that make sense to users. Increasingly, librarians find themselves acting as coaches and collaborators for instructors who are learning to teach in collaborative and technology-enhanced modes. Library staff also train, coach, and support students in learning to use search technologies to find information. Library staff share responsibility with faculty for teaching critical thinking skills as they teach students to evaluate the quality and usefulness of the information students are using.

Conclusions

Commonwealth College of Penn State University created Project Vision to encourage faculty to redesign courses to incorporate collaborative and active learning strategies supported by appropriate technology in teaching undergraduate education courses. The administration offered release time, extra compensation, and training to prepare selected faculty for the pilot program which was designed by faculty. Over the four years of this program, the faculty tried several models for offering courses. Once all the students took only Project Vision courses for the first year as a cohort; in other years, students took some Project Vision courses and some regular courses. For two years, the faculty offered courses coordinated across two different locations. Usually, the courses were offered as a package. For example, students took Speech Communication to learn how to work in groups, Library Studies to learn how to do research, and Health Science as the content of the research project. The technologies included FirstClass computer conferencing, Eudora e-mail, PowerPoint, and video conferencing.

Synchronized Notes for Digital Class Video

Michirou Yabuki
Faculty of Informatics, Meisei University, Japan, yabuki@ei.meisei-u.ac.jp

Akira Watanabe
Faculty of Informatics, Meisei University, Japan, akira@ei.meisei-u.ac.jp

Introduction

We proposed a method using digital class video for review and self-studying and applied it to some subjects. We believe our method is successful in actual education. Students will make their own notes watching digital class video in the same way they make their own notes during ordinary classes. If students watch digital class video for their study many times over, their notes will be essential. In addition to digital class video, we propose synchronized notes for digital class video.

Digital Class Video

In many educational organizations, networks are used for educational support. On the other hand, there are many traditional classes that have no educational support using computer networks. When one intends to utilize computer networks or the Internet for traditional classes, he/she will suffer from various problems such as time for investigating teaching materials, manpower, arrangements of equipment and preparation of presentation data.

To solve those problems, we proposed a method using digital class video for introducing educational support utilizing computer networks for traditional classes. Our five goals of the proposed method are: the purpose of the method is review and self-studying; the method could preserve the various teaching style of teachers; the method should be simple so that the number of staffs and a budget should not be large; the method is able to be adopted to traditional lectures and computer exercises; more than one simultaneous classes should be supported using the method.

To achieve above goals,

- The scene of a class is recorded on video tape as it is.
- The camera for recording teacher's movements has fixed view and never follows of teacher's movements.
- A written material or a computer screen of the teacher operates is also recorded on another video tape.

These two videos are synthesized to a single image for publication.

As experiments, we applied our proposed method to five subjects in 1998. The experiments are still continued in 1999. The number of total access times to the video was 1300 in 1998. We believe that our educational assistance method is successful.

Synchronized Notes

To study subjects, just watching class is not enough for studying. Students ordinarily make notes on class with a notebook and a pen. (Nowadays, some students use their own lap-top computer for their notes in classes.) When students watch class video on the computer, it is preferable for students to make notes on the computer. To make notes on the computer while watching digital class video is simple because they can easily use another window for a text editor or something like that. In that way, students are able to review their lessons again, by watching video and their notes. As Notes is, however, "static" information, students should synchronize notes and video by themselves during watching video.

To synchronize notes and video, we implemented a telop function to our MPEG video viewer software. Users are able to put comments or notes to video as a telop just when they are needed. Once users put comments or notes to video, the telop come up on the screen at the designated time whenever they watch video. Fig. 1 shows an example of telop function.

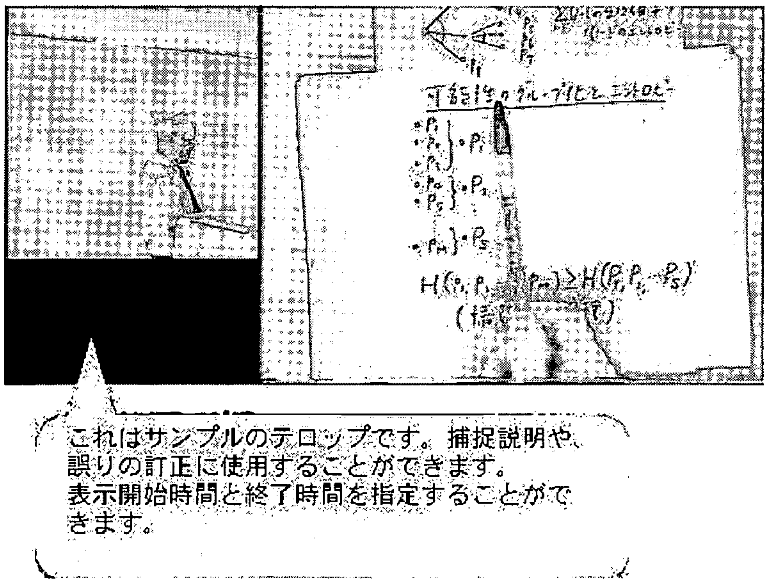


Figure 1. An example of synchronized notes

If user put comments to video, a mark is shown on the scroll bar so that users are able to find where they put their comments. Scroll bar of the MPEG viewer is used to forwarding and rewinding video.

The mark on the scroll bar is also used to find important points of the video. In our method, the entire class is recorded on the video. Usually teachers use a lot of time for thinking, joking or something like that. The mark is used to avoid overhead of watching unnecessary parts of video.

In the same way, not only users (students) but also teachers are able to put comments to video. After the class, teachers sometime notice there were mistakes or insufficient explanation during the class. In such case, teachers are able to add additional explanation or corrections to video as a telop.

Conclusion

We implemented synchronized notes to MPEG viewer. Users are easily able to add comments and notes to class video for their self-studying. After the class, teachers are also able to add additional comments or explanation to their class video. The softwares are implemented as WindowsNT and UNIX (FreeBSD) X-window applications so that students are able to study on any plathome.

Acknowledgement

We are grateful to Dr. Naomi Fujimura at Kyushu Institute of Design. He gave us valuable comments. We also thank Mr. Hideyuki Nagaoka of Information Science Research Center of Meisei University for recording class video.

The Development of Multimedia Kanji Dictionary for Non-Japanese on WWW

Kazuto YAMADA, Shinichi FUJITA, ChunChen LIN, Seinosuke NARITA
Department of Electrical, Electronics and Computer Engineering,
School of Science and Engineering Waseda University, Japan
Narita lab, Sci. & Eng., Waseda University 3-4-1 Shinjuku-ku Okubo, Tokyo, 169, Japan
kazuto@narita.elec.waseda.ac.jp

Abstract: In recent years, popularized technologies such as "Multimedia" and "Internet" came to be used in various fields. The field of education is not an exception either, and these technologies are adopted by CAL (Computer Assisted Learning). Especially, the successful introduction of these technologies into Japanese education is being looked forward to. Since Japanese as the 2nd language is said to be high in the degree of difficulty in acquisition, an improvement in the study efficiency through adopting such technologies is expected. This paper focuses on Kanji of Japanese language education and discusses the multimedia Kanji dictionary.

Introduction & Background

At present, there are many non-Japanese who are learning Japanese in the world. However, with a limited time allocated for study in classes, the present condition does not offer sufficient education for mastering Japanese. For, not only are there problems related to the basic grammar such as the word order in Japanese is sometimes different and the use of the auxiliary verb is more complicated in comparison with other languages but also there are three kinds of characters used: "Hiragana," "Katakana" and "Kanji." Especially, quantity in Kanji is voluminous and the shapes are complicated. Even for Japanese, it takes 6 years to learn over 1000 Kanji characters. Furthermore, so much information is contained in Kanji (for example, reading, meaning, radical and the stroke count, etc.). Therefore, the more efficient Japanese education system is necessary because it is excruciating for people in the countries where Kanji are not used to learn them in a short period of time. When people in the countries where Kanji are not used learn their mother tongue, they emphasize "conversation." Therefore, even when they learn Japanese, they emphasize "conversation." In comparison with Japanese, a one byte code language, in the first place, has a fewer number of characters but has a number of types of pronunciation. Therefore, such a language can be mastered mainly by improving conversation ability.

From such a reason, for people of the countries where Kanji are not used inevitably neglect learning of Kanji. To effectively learn Kanji, the multimedia Kanji dictionary was developed. Since the electronic dictionary facilitates the understanding of Kanji by using animation and sound, it can improve learning efficiency much more than a conventional paper dictionary. Also, the characters of the index are so small that we sometimes become fed up with looking up Kanji in the paper dictionary. However, people will become able to search Kanji more easily by just clicking if they use the multimedia Kanji dictionary. This electronic dictionary is functioning as the dictionary module of an integrated Japanese learning system called "Terakoya."

URL: http://www.narita.elec.waseda.ac.jp/~fujita/terakoya.html

Kanji Dictionary

This dictionary system can be divided into the Kanji searching part and dictionary database part. In the searching part, there are three kinds of functions "Read," "Stroke count" and "Radical." Here, we can find a Kanji character for which we are searching, and we can read out detailed information from the dictionary database that is stored as a CSV file. On the one hand, this system contains detailed information such as radicals and the stroke count for people who want to learn detailed information. On the other hand, this system facilitates easy learning of Kanji by including items for children such as pictures and figures that look similar to Kanji. This system has become an interactive system that has more mobile capability by using animation and sound, which is in contrast to the conventional dictionary system that emphasized text data. Animation is used to display the order of strokes of a Kanji, and voice is used to let the learner hear the data of "Reading" and "Examples." Furthermore, in order to have the users learn a large quantity of Kanji, this system understands Kanji through graphic means by recognizing each Kanji as a picture or a figure to improve learning efficiency.

And, because this system is using WWW, it is not dependent on a particular type of platform. A learner can use it through the Internet from PC regardless of whether the person is at home or in a class. Even if there was no such environment, in such case information of Kanji can be read by printing the contents out on paper as a conventional dictionary. Although this system is developed with Shockwave of Macromedia Company, the browser is not able to function as a printer when the movie that was made with Shockwave is loaded into the browser. Therefore, a page where Kanji information is transformed into an HTML has been made. If the hard copy of Kanji information can be made, it can be used at places where there is no computer nor a network environment. This function comes from the requests of the Japanese language teachers and also of Japanese language learners.

Future Plans

Although this dictionary system has searching functions of "Read," "Stroke count" and "Radical," these searching methods are used conventionally in the conventional paper dictionary. However, there must be cases where a beginner of Kanji learning has no idea about the reading, the stroke count nor the radical of the Kanji that he/she wants to find out. To this end, we are studying the functions by which a Kanji can be searched through handwritten letter recognition. If this searching method is created, a learner can search for the Kanji by thc action that is similar to drawing a picture of the Kanji whose detailed information is not known to the learner. Also, although the present system has registered 80 Kanji characters in the database, in order to maintain coordination with the "Terakoya" system, it is necessary to classify Kanji by the degree of difficulty or by the use frequency in daily life to offer data to the user in an easy-to-understand manner. Furthermore, because there are some cases where the requests of teachers differ from the contents of a dictionary, we should add such function that enables the teachers to freely select the words and pronunciations, etc. that he/she wants to use in the lesson. If there is such a function, a lesson will become very effective. At last, we need to evaluate this Kanji dictionary. This system will be tested by the Center for Japanese Language of Waseda University and the Richmond school in Portland. And, we want to advance to further improvement by asking advices from teachers and students.

References

[Fujita, Takahashi, Lin, & Narita 1998], Online Instruction System for Chinese Character Handwriting Using Vector and Stroke-Speed Information, Proceedings of ED-MEDIA98, pp.436-441

[Fujita, Lin, Yamada, & Narita 1999], The Development of Online Integrated Japanese Education System "Terakoya", Proceedings of ED-MEDIA99, pp.184-189

Teaching On-line Versus On-site: A Study of Instructional Delivery Modes in Foreign Language Education

Quan Yang
Distance Learning, Troy State University Dothan
qyang@tsud.edu

C. James Wong
Instructional Technology & Distance Learning, Learning Resources Division, Southwestern Illinois College
cjwong@bacnet.edu

Abstract: The purpose of this study was to identify the similarities and differences of online and traditional foreign language courses and to determine the advantages and disadvantages of the online courses. Using a random sample of 20 courses, ten on-line and ten traditional, this study examined the online and traditional courses in terms of five constructs and compared the methods and strategies used in online courses with regular classroom instruction. With a rubric developed for the study, the online and traditional course were rated in a 4-point scale and analyzed with independent t-tests. The findings of the study indicated that online and traditional courses had about the same weight in teaching foreign language and suggested that they each had its advantages and disadvantages. The study concluded that traditional courses had better defined and more specific goals and objectives for both teaching and learning and was more effective in teaching conversation and listening comprehension, while in online courses, students could learn at varying rates and explore material to whatever depth they desire, and Internet technology made it possible for students in different areas and from different countries to access online courses.

Introduction

With the rapid development and fast growing adoption of technology, the use of technology in education has been dramatically increasing over the past few years. In the area of language education, various technologies are being utilized by language teachers and learners in and out of the classroom (Warschauer, 1996). These uses would include the traditional use of audio and films; however they are now being supplemented by computer-assisted instruction and interactive media technologies (Richards, 1996). Computer-based programs, as well as other computer-related interactive technologies, have been specifically developed to provide students with visual and audio support. These applications have shown potential for helping students develop their language abilities and improve classroom performance (Pennington, 1996).

Among a variety of instructional delivery media, the Internet, especially the World Wide Web, has been commonly adopted by many educators in higher education (Khan, 1997; Porter, 1997). However, little research results have shown to support claims for the effectiveness of Web-based instruction (Nunan, 1999). The focus of this study was an analysis of existing web-based foreign language courses and a comparison of the methods and strategies used in online courses and regular classroom instruction to determine the common and unique methods and strategies used to achieve the educational objectives in each environment.

Purpose of the Study

The purpose for conducting this study was to identify the similarities and differences of online and traditional courses of teaching foreign languages and to determine the advantages and disadvantages of the online courses. Methods, strategies, and technologies used in online foreign language courses were examined and compared with those of the traditional foreign language courses. In order to achieve the purpose of the study, the current study addressed the following research questions:

1. Based on the courses examined, what methods, techniques and strategies were used for teaching online foreign language courses and traditional foreign language courses?
2. What were the differences between traditional foreign language courses and online foreign language courses in terms of goal/objectives, strategies, interaction, feedback, and resources?
3. What were the advantages and disadvantages of the online courses?

Method

The sample for this study consisted of twenty foreign language courses, with ten on-line courses and ten traditional courses. Thirty online courses were first identified directly from foreign language courses available on the Internet, which included listening, speaking, reading, and writing courses. The following systematic procedure was used to randomly select ten courses from the thirty previously identified online courses: First, a random list of the thirty online courses was generated. Then a start point for the selection was randomly chosen on the list. From that point every third course was selected until a total of ten online courses were identified for the study. Among the ten courses that were chosen were two listening courses, one speaking course, two reading courses, two grammar courses, and three writing courses.

With the same procedure, the ten traditional courses used for this study were randomly selected from foreign language courses offered by the Intensive English Programs and foreign languages departments at various universities. The course materials of these ten courses were available at the University of Louisville, the University of Alabama, Southeast Missouri State University, and North Carolina Wesleyan College. They were three listening courses, two speaking courses, two reading courses, one grammar course, and two writing courses, which comprised the traditional foreign language course group for data analysis. With a rubric developed for the study, the online and traditional course were rated on a 4-point scale and analyzed with independent t-tests.

Results and Discussion

The comparison by means of the rubric indicated that the online courses and the traditional courses had about the same weight in teaching foreign languages in general. Online courses had a total score of 147, while the score of the traditional classroom teaching was 153. However, the independent t-tests, which were performed to identify any possible significant difference between the online and traditional courses, found that significant differences existed between the two types of courses in two of the five constructs measured.

Conclusion

A foreign language acquisition process consists of listening, speaking, reading, and writing skills. In order to facilitate the success of second language teaching and learning, modern technologies have been used in the classroom to promote teaching performance and student learning. Online courses, which have been developed for that purpose, have proved their advantages in foreign language teaching and learning. However, when comparing traditional classroom teaching with online courses, the results of this study suggest that each had its advantages and disadvantages. For traditional courses, better defined and more specific goals and objectives were given for both teaching and learning. Delivering course material through the Web, on the other hand, afforded some advantages over traditional classroom teaching. In online courses, students could learn at varying rates and explore material to whatever depth they desire. There were new ways to guide students through tutorials and to provide them with instant feedback. Using Internet technology made it possible for students in different areas, different countries to use varying computer types to have access to the course.

However, as far as a foreign language is concerned, it is obvious that traditional classroom teaching was better in teaching conversation and listening comprehension courses when students needed face-to-face interactions with the instructor and instant verbal feedback from the instructor. Computer-mediated communication had been criticized as lacking the human social interaction necessary for human learning (Gilbert, 1996) although Lemke (1993) claimed that "cyberspace will be a virtual place FOR human social interaction." It seems that web-based courses might not be able to provide as effective or efficient a means of learning a language as one-on-one human interaction. Without such non-verbal cues as body language and the tone and pitch of one's voice, it is possible to misconstrue messages (Berge & Collins, 1995; Gilbert, 1996).

In summary, neither of the two types of courses is absolutely good or faulty. Each had its own advantages and disadvantages. As an instructional designer, we should be aware of the advantages and disadvantages of both types of courses and make full use of their advantages in the design and development of the courses, based on different student needs, student characteristics, and skill requirements, to achieve the goals of our education.

References

Berge, Z. L. & Collins, M. P., Eds. (1995). Computer-mediated communication and the online classroom. Cresskill, NJ: Hampton Press.

Gilbert, K. K. (1996). Grief in a family context: a for-credit university course delivered on the World Wide Web. Paper presented at the Annual Meeting of the National Council on Family Relations, Kansas City, MO.

Khan, B. H. (1997). Wed-based instruction. Englewood Cliffs, NJ: Educational Technology Publications.

Lemke, J. L. (1993). Education, cyberspace, and change. The Arachnet Electronic Journal of Virtual Culture, 1 (1) [On-line serial]. Available: http://www.monash.edu.au/journals/ejvc/lemke.v1n1

Nunan, D. (1999). A foot in the world of ideas: Graduate study through the Internet. Language Learning & Technology, 3 (1) [On-line serial]. Available: http://polyglot.cal.msu.edu/llt/vol3num1/nunan/index.html

Pennington, M. C. (1996). The power of the computer in language education. In M. C. Pennington (Ed.), The power of CALL. (pp. 1-14). Houston: Athelstan.

Porter, L. R. (1997). Creating virtual classroom: Distance learning with the Internet. New York: Wiley.

Richards, J. C. (1996). Preface. In S. Fotos (Ed.), Multimedia Language Teaching. (pp. ix-xi). Tokyo: Logos International.

Warschauer, M. (1996). Computer-assisted language learning: An introduction. In S. Fotos (Ed.), Multimedia Language Teaching. (pp. 3-20). Tokyo: Logos International.

The Road to Hell Or Wrong Turns on the Path to Cyberlearning

Stephenie Yearwood
Lamar University
P.O. Box 10023
Beaumont, TX 77710
Steffiy1@aol.com

Paula Nichols
Lamar University
P.O. 10034,
Beaumont, TX 77710
pnichols@tenet.edu

Abstract: The paper proposes and explains five common mistakes which institutions often make in implementing distance education: using packaged courses and low-level instructors, using one technology to deliver all distance education, not monitoring student satisfaction and retention, assuming that all courses can and should be offered via distance technology, and focusing marketing only on the technology-literate.

Racing along the Road

The shape of distance education is changing daily as more and more institutions embrace the technologies now available to deliver remote instruction. One estimate by Robert Tucker (1997) quoted recently in Forbes, is that about 90% of US four-year institutions will have technology-based distance learning offerings by 2000. Even in 1996, over a million students took distance learning courses of the 14 million attending post-secondary educational institutions. And, although these courses use many different technologies, there is rapidly-increasing focus on internet delivery. In this rush to get on the bandwagon, the authors, who have been involved with emerging distance education in Texas for the last ten years, have observed several common assumptions which cause great concern. The focus of this paper will be to identify and call into question some frequent phenomena which, we believe, threaten to undermine the success of cyberlearning.

Wrong Turn One: Buy a packaged course and hire a TA or two to run it

One of the driving forces behind the charge to cyberlearning is the common perception that cyberlearning will be a cash cow for traditional institutions, allowing them to cut costs. In a rush to milk, institutions are sometimes choosing to dispense with home-grown courses run by local professors. This choice threatens to result in a world of cyberlearning where there are many institutions to choose from, but all are teaching the same course. Losing the personal enrichment, the personal mentoring and the constant updating which an experienced teacher puts into a course is equivalent to losing the personal voice or identity of an institution. Cyberlearning should increase the diversity of the educational ecosystem, not decrease it.

Wrong Turn Two: Buy one technology and use it for everything.

Because the costs for establishing technology-based distance learning can be large, institutions are prone to make an initial commitment to a technology (VHS with two-way audio, or TV, or compressed video, or web) then force all course offerings to fit themselves to that technology. Institutions have been known to simply buy whatever was pitched to them most intensely in the hopes of not having to face the bewildering array of choices again for quite some time. However, close analysis of student needs, course content, and educational effectiveness has led us to believe that hybrid technologies evolved over time and respondent to individual courses and student audiences produce superior educational results. Educational needs and goals should drive technology, not vice versa.

Wrong Turn Three: Don't worry about student satisfaction; the learning is fine

Indeed, much past research on distance learning using all kinds of different delivery modalities from correspondence courses to web has indicated that students seem to learn as much from distance courses as they do from face-to-face instruction (Russell 1996). However, we cannot ignore that cybercourses vary enormously in learner-satisfaction and quality. In an ideal educational cyber-marketplace, learner-centered course design will eventually prevail. Courses which use technology well and flexibly to deliver their course content and achieve course goals, and courses which attend to a wide variation in student learning styles will have better success. Convenience of access is not enough; quality matters, too.

Wrong Turn Four: Move everything onto the cyber-track.

With the emergence of virtual universities and entire degree plans available by remote technology, the instinct of many institutions is to think of distance learning offerings as a substitute for face-to-face instruction, rather than an adjunct to it. However, a closer look shows quite clearly that cyberlearning has, thus far, leaned heavily in the direction of engineering, business, computer science and health sciences. (Miller 1998). According to Miller, all other subject matters account for only 10% of cybercourses. In spite of the pronouncement of Peter Drucker (1997) that "Universities, as we know them, won't survive," almost all lower-division and humanities courses continue to be offered in traditional fashion. One reason for this, we believe, is the need for greater flexibility in adapting to the goals of such courses and the needs of students. Cyberlearning should, we believe, offer additional choices to students and teachers--not force them into a course-delivery system alien to them. In fact, we go so far as to argue that cyber courses should, in most cases, have live, face-to-face versions running, too.

Wrong Turn Five: Just market the courses and the students will come

Certainly convenience, accessibility, and low cost are strong incentives for students to engage in cyberlearning. However, issues of equity and market penetration will become ever more pressing as institutions seek to draw increasing numbers of students. Access to computers is increasing daily, as is internet access; however individuals without home computers or internet access may be precisely the ones who most need access to "anytime, anywhere" post-secondary education. Institutions must attend to insuring access at public libraries, K-12 schools and community centers in order to insure equity for all ranks of society and to avoid widening the digital divide. Moreover, some segments of the market will need additional technology training in order to effectively use the access which is available to them, and institutions must provide appropriate training in technology if they are to draw high-school dropouts and retired persons into cyberlearning.

In a dynamic growth period such as we face now, the drive to implement cyberlearning will benefit many students and institutions, but only if decision-makers tread the path thoughtfully and with their eyes open for wrong turns.

References

Drucker, Peter. (1997) Quoted in "I Got My Degree through Email," by Lisa Gubernick and Ashlea Ebeling, *Forbes Magazine*, June 16, 1997, 84.

Miller, Inabeth. (1998) Graduate Degree from Home or the Office. *ED Education at a Distance*, March 12, 1998, 16-17.

Russell, T. (1996) The "No Significant Difference" Phenomenon. Raleigh, N.C. Office of Instructional Telecommunications, North Carolina State University.

Tucker, Robert. (1997) Quoted in "I Got My Degree through Email," by Lisa Gubernick and Ashlea Ebeling, *Forbes Magazine*, June 16, 1997, 85.

Dynamic Learning Patterns: Temporal Characteristics Demonstrated by the Learner

L. Roger Yin
LEARN Center/Graduate Studies and Continuing Education
University of Wisconsin-Whitewater
United States
yinl@mail.uww.edu

Abstract: This paper sought to identify learner-demonstrated learning patterns when undergraduate students were learning to use a computer-based presentation program in a multimedia learning environment without time constraints. Using analysis of patterns in time (APT), a methodology that can code event changes over time, the frequencies and the amounts of time of the five learning patterns were calculated. The data derived from the APT scores indicated two major findings: (1) The amount of time used by the participants ranged from 20 to 87 minutes. The amount of time spent did not predict mastery of the post test. (2) 'Following through error corrections', 'confirming actions', and 'trying new steps' were the patterns that did appear to predict mastery, and 'hand on mouse' and 'keeping up step-by-step with the video instruction' were indicators of learners' task engagement. The findings suggest that it is important to design flexible instruction to facilitate repeated, persistent, and successful practice in order to achieve mastery in a self-paced, computer-based learning environment, regardless of the amount of time spent.

Introduction

This study sought to investigate the existence of any significant temporal patterns of learner-demonstrated sequencing as learning styles that are related to the mastery of learning a procedural computer-based multimedia task.

The impact of how different learning styles affect human learning has concerned educational researchers for decades (Bruner, 1966; Gagné, 1967; Kolb, 1984; Wang and Walberg, 1985; Tobias, 1981, 1987). According to Cronbach and Snow (1977), learning style can be used to predict what kind of instructional methods or strategies would be most effective for a given individual and learning task. Such attempts to discover the predictors for content mastery were typified in Aptitude Treatment Interaction (ATI) research. In ATI studies, aptitude was defined as any learner characteristic related to instructional outcome, and treatment was defined as any variation in instruction to the learner (Cronbach and Snow, 1969). However, research to date on this problem has not identified many robust relationships between learning style and instructional method that are needed in order to generalize the assignment of instruction to different learners (Snow, 1989). Could this lack of robustness be caused by overlooking the means in favor of the ends of learning? Or perhaps the notion of aptitude needs to be defined differently when the means of learning (or learning process) is considered as a critical component in a learning experience.

Frick (1990; 1992) indicates that one of the fundamental problems of ATI is that the linear model approach (LMA) employed by ATI cannot explicitly demonstrate the different means of learning because the LMA was designed to estimate parameters of mathematical models and is not adequate in dealing with occurrences and relative frequency of temporal events. LMA is best for explaining the relation between two or more independently measured variables, but it cannot measure the frequency or duration of occurrences of a temporal path (Frick, 1983). This observation directly implies that there is a need for a methodology other than LMA when we investigate the temporal patterns in a learning process, especially with a concurrent attempt to examine aptitude in a different way.

Learning takes time. Learners take different amounts of time to perceive information in order to acquire knowledge. Knowledge is actively constructed through temporal sequencing of meaningful interactions between the individual and the learning context (Piaget, 1973; Dewey, 1916; Bruner, 1973; von Glasersfeld, 1991). But how can we move the learning-styles research away from the instruction-centered "how one should learn" to the learner-centered "how one does learn"? In order to make instructional systems more adaptive, researchers need to put more emphasis on learner-demonstrated learning styles, where the relationships between the sequencing, time duration, and nature of the media should be carefully examined. This need is especially important now that multimedia, productivity software programs, and the explosive growth of the Internet have entered our educational settings and homes (Nielsen, 1995), and the technological capabilities have caused us to reconceptualize the learning process and to design new instructional approaches (Duffy and Jonassen, 1992).

To understand the need to redefine learning styles, it is necessary to comprehend the nature and limitations of conventional learning styles. Sewall (1986) compares four popular instruments to measure learning styles: the Myers-Briggs Type Indicator (Myers, 1962), the Kolb Learning Style Inventory (Kolb, 1976), Canfield's Learning Style Inventory (Canfield, 1980), and Gregorc's Type Indicator (Gregorc, 1984). He finds that all of these instruments fall short generally in four areas: (1) no appropriate normative base for the valid interpretation of scores; (2) limited validity due to construction problem with the instruments; (3) reliability estimates are unstable, though one can argue that the dynamic nature of learning style makes high test-retest reliability unnecessary; (4) the normative frame of reference makes the interpretation of scores very difficult. Among his suggestions for future research, one suggestion particularly interests the present writer:

"Future research could also explore the issue of whether an individual's preferred learning style is modified by the educational environment. For example, do adult students learn better when instruction is adapted to their learning style preferences? Can people be trained to adopt a particular learning style? Do learning styles remain stable over time in the adult population? Does a significant change in life situations result in changes in learning styles?" (p.61.)

It is interesting to notice that all four of the above-mentioned learning-style instruments use lists of verbal statements or different visual forms prepared for people to choose or rank. This isolated "one size fits all" approach is decontextualized and artificial, and apparently biased on language skills and cultural backgrounds. The predefined assessment tools require people to fit in the limited and selective choices with "I think this is who I am" or "I think this is what I will do or how I will react," which may not predict how one actually reacts to or interacts with a problem in a specific learning situation. This predetermined and convergent assessment approach may be the fundamental reason that only limited reliability and construct validity have been found in existing learning-style studies.

Maybe, as Sewall suggested, human learning styles are constantly modified by the educational environment and social context and are too dynamic to measure on a predetermined and predictable scale. This notion leads the present writer to believe that to survey fully the dynamic nature of learning styles, rather than using artificial instruments, we can observe and faithfully record the event changes of a learner-demonstrated process over time. In other words, the result of this study may not verify that learning style is a stable trait (Bateson, 1979).

Research Questions

1. In the midst of the information explosion, multimedia has become the new learning environment. Learning how to interact with multimedia-based information or instructions has become our daily experience. It is important to note that multimedia is a combination of three forms of content: (1) abstract (e.g., verbal -- either text or audio -- explanation in a computer program window), (2) iconic (e.g., the screen capture of a computer program window printed on paper), and (3) concrete (e.g., the actual computer program windows displayed on a monitor screen). The main questions addressed in this study were as follows:Given the choice of instructional materials in different forms of content, what learning sequences are selected by the learners?

1.1. If the sequences differ, how do they differ?

1.2. Are any of these sequences especially likely to result in overall mastery?

1.3. Is there a difference in the amount of time spent learning for those learners who achieved mastery and those who did not?

In order to increase both reliability and validity in identifying the learning patterns (Denzin, 1970; Foreman, 1948), a triangulation method was used that involved observation of the learning process and think-aloud interview. "Triangulation" is to use multiple methods in data collection (Denzin, 1970). Merriam (1988) indicates that "methodological triangulation combines dissimilar methods such as interviews, observations, and physical evidence to study the same unit." An observation system designed and based on the analysis of patterns in time (APT) approach was used to code how and how long students use and switch the instructional materials, and their engagement during the processes of learning. Both the learning processes and the think-aloud interviews were recorded on videotapes for examination and analysis.

Twelve participating students from a midwest regional university were selected through a screening process using Kolb's Learning Style Inventory (Kolb, 1976) where three students were selected extreme cases in each of the four learning styles identified by Kolb (converger, accomodator, diverger, and assimilator). The participants were expected to create three electronic slides using Astound, a multimedia presentation software, during the learning process. They were told that there was no time constraint and that they could freely use the printed jumpstart instructions, the video demonstration parallel to the printed instructions, and the user manual and tutorial. They then created a fourth slide without instruction as the post test. Learning sessions were recorded on video, and participants subsequently watched their own videos and were interviewed using think-aloud methodology. Multiple observers watched the videotapes of the learning performances for patterns of interaction, which were illuminated by the think-aloud interviews.

In this study, the interview was semistructured. The interviews followed the observations, hence the interviews supplement and complement the outcomes of the observations, rather than forming a different set of data not related to that from the observations. The questions asked were open-ended so the students could explain fully and interpret any specific events that occurred in their learning performance.

As soon as the raw data from the interviews were collected, the data gathered from both the observation and the interview on each student were arranged into one case for analysis. As Merriam (1988) suggests, the "simultaneous analysis and data collection allows the researcher to . . . develop a data base that is both relevant and parsimonious."

Next, the data collected from both the observation and the interview were sorted into any repeated patterns that are common to more than one person or identifiable categories or themes. Some patterns and their variations were spotted faster than others. Some unexplainable events or sequences from the observation were explained when data from the interview were reviewed and compared. This step was repeated until all 12 cases were analyzed. Then, an analysis to reduce and refine the categories or patterns among the cases was conducted.

Result

The narrative temporal descriptions of each of the 12 cases were compiled. The descriptions included answers to the following questions: Who was the person (age, gender, race, academic major, Kolb's learning style, mastery of the post test, prior computer experience). What did s/he do with the instructional materials during different parts of the learning session? What comments (direct quotes from the think-aloud videos) did the person make about what s/he was doing? These thick descriptions (Lincoln and Guba, 1985) illustrated how the participants actually interacted with the instructional materials during the learning sessions. These thick descriptions (Lincoln and Guba, 1985) illustrated how the participants actually interacted with the instructional materials during the learning sessions. To demonstrate the uniqueness of these participants, the following is a complete set of descriptions recorded from one of the 12 students.

Student F

Student F was a twenty-two-year old white male. He majored in Secondary Education and had had four years of computer experience. He was a converger (with a tendency toward active experimentation and abstract conceptualization), according to Kolb's learning style. He was judged a master of the post test. He spent a total of 42.5 minutes in completing the learning tasks and the post test.

Student F spent nine minutes on Task #1. He began his learning session by playing the video demonstration while reading the instructions. Student F is rather reserved but well-mannered. Of his choices of instructional materials, he said, "I didn't mind it. I like to have something to follow along with [the printed instructions], and I can stop [the video] whenever I want, so that makes it a lot easier for me." When asked how he used the instructional materials, he answered, "I started by reading the [printed] instructions and watching the videotape step-by-step. But after a while, I was not even watching it, 'cause I know pretty much what to do by listening to it." He said of his reading strategy, "After a while, I was just reading ahead, and make sure that I wa

In a careful review of all the think-aloud interviews in which the learners answered open-ended questions to explain their learning performances while watching the video recording of their learning Astound, five learning patterns emerged: (1) following through error correction, (2) confirming actions, (3) hand on mouse, (4) keeping up step-by-step with the video instruction, and (5) trying new steps. Using analysis of patterns in time (APT), a methodology that can code event changes over time, the frequencies and the amounts of time of the five learning patterns were calculated. The data derived from the APT scores indicated two major findings: (1) The amount of time used by the participants ranged from 20 to 87 minutes. The amount of time spent did not predict mastery of the post test. (2) 'Following through error corrections', 'confirming actions', and 'trying new steps' were the patterns that did appear to predict mastery, and the other two patterns were indicators of learners' task engagement. The findings suggest that it is important to design flexible instruction to facilitate repeated, persistent, and successful practice in order to achieve mastery in a self-paced, computer-based learning environment, regardless of the amount of time spent.

Suggestions to Practitioners

First and foremost, the implications these dynamic learning patterns brought to the instructional designers and teachers are:

(1) Ideally, there should not be any time constraints in a self-paced computer-based learning environment. However, in classroom settings and even in corporate training settings, there are time limitations. As teachers and instructional designers, we should try to mitigate the way the timed classroom hour shapes learning. For example, in a traditional classroom hour, Student H, a master who took 87 minutes to finish the task, would have failed to master the task if she had had to stop after 50 minutes. We need to develop new ways of structuring the time of the class so that such failures would not be built into the classroom framework. Nevertheless, the immediate value of self-paced learning will be outside of the classroom where the learners or trainees can determine or have control over the time they use to learn the tasks.

(2) Those learners who have difficulty with following through error correction may have problems with a lack of lower-level computer skills. The present writer recommends that under such circumstances that the instructional designer needs to develop a mechanism to detect the problem quickly and refer the learner to simple optional lessons on the conventions of the operating system (e.g., Windows 95 in this study) and the basic features of the application software program (e.g., the tools featured in Astound in this study).

(3) If those learners who choose to use exclusively the text-only printed instructions and have difficulty finding the features, tools, push buttons, or have difficulty finding "where they are" from just a verbal description, then if space and format allow, the related graphical icons of the tools and the appropriate screen captures should be added to the printed instructions.

(4) Making the printed (verbal) and the video versions of the instructions as well as the computer with the software program available as options *at the same location* can accommodate most learners' preference in terms of forms of content and sensory modalities.

(5) For those learners who like to try new steps, the learning lessons should be flexible. However, for those who do not like to explore new things, more structured jumpstart lessons at the same or at different levels of complexity should be provided.

(6) Many participants in this study strongly suggested that more "context sensitive" hints or notes should be made available on both the printed and video instructions because the just-in-time hints or notes given immediately before or after the "problematic spots" helped some learners recover from errors quickly without getting frustrated. Therefore, it is important to observe where in the lesson learners tend to have problems with something, then design and position the "anticipatory fee

Discussion

In this study, there were five learner-demonstrated patterns identified in a self-paced environment in learning to take part in a computer software program. Although generalizations cannot be made for all people in all kinds of learning because of the relatively small and selected sample, the trends found in the data do suggest that a number of these learning patterns would be predictive of mastery in procedural learning. Future studies with a larger randomly-selected sample size will further test the character of these trends.

This present study used Kolb's Learning Style Inventory (LSI) as the screening tool to select samples because the LSI is a popular instrume

weaknesses as a learner" (Kolb, 1976) and used widely for career predictions. Comparing the activities from the emerging learning patterns identified in this study with Kolb's four learning abilities, we can draw some parallel relations between them: reading printed instructions is an example of abstract conceptualization (AC); watching a video demonstration, an example of reflective observation (RO); doing the steps as described in the instructions, an example of concrete experience (CE); and trying new steps, an example of active experimentatiun (AE).

Kolb's learning styles are generated from two combination scores (AC - CE and AE - RO) that indicate the extent to which an individual emphasizes abstractness over concreteness and action over reflection. However, the similarities between Kolb's learning styles and the identified learning patterns end here. One fundamental difference between these two is that Kolb assumes the learning styles are stable personality traits, whereas the learning patterns identified in this study are dynamic in nature. For example, while student F was designated as a converger with tendency to be abstract and active, according to Kolb, he actually demonstrated in his learning performance that he engaged in all four learning abilities over time. Student F was watching the video demonstration (reflection) and following each step as it was described on the video (concreteness). He also frequently checked with the printed instructions to see if he did the steps right (abstractness). After getting more familiar with the computer program, he started to try new steps that were not included in the instructions (action). Over all, Student F showed a dynamic learning sequence that involves several learning patterns that even he himself could not have predicted or repeated.

In the present study, the major finding is that regardless of the amount of time spent, repeated, persistent, and successful practice tends to lead to the mastery of the post test. This finding echoes the result found by Sze (1988) that repeated masteries during practice strongly affect student learning achievement and attitude in an adaptive computer-guided practice environment. Also, it concurs with the Academic Learning Time (ALT) research reported by Berliner (1979) that when students spend more time engaging in a particular curriculum content area, they are more likely to attain higher academic achievement. It is important to note that the above-mentioned findings strongly support Carroll's (1989) argument that aptitude is primarily a measure of time required to learn. This argument is in contrast with the classic models (based upon theories of intelligence) in which all learners are given the same amount of time to learn, and the focus is on differences in ability.

References

Bateson, G. (1979). *Mind and nature : a necessary unity.* New York: Dutton.

Berliner, D.C. (1979). Tempus educare. In P. L. Peterson, & H. J. Walberg (Eds.). *Research on teaching: Concepts, findings and implications* (pp. 120-135).

Bruner, J.S. (1966). *Toward a theory of instruction.* Cambridge, Massachusetts: Harvard University Press.

Bruner, J.S. (1973). *Going beyond the information given.* New York: Norton.

Canfield, A.A. (1980). *Learning styles inventory: Guide.* Birmingham, MI: Humanics.

Carroll, J.B. (1989). The Carroll model: A 25 year retrospective and prospective view. *Educational Researcher,* 18(1), 26-31.

Cronbach, L.J. and Snow, R.E. (1969). *Individual differences and learning ability as a function of instructional variables.* (Contract No. OEC 4-6-061269-1217). Stanford, CA: School of Education, Stanford University.

Cronbach, L.J. and Snow, R.E. (1977). *Aptitudes and Instructional Methods: A Handbook for Research on Interaction.* New York: Levington Publishers/John Wiley.

Denzin, N.K. (1970). *The research act: A theoretical introduction to sociological methods.* Chicago: Aldine.

Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education.* New York: Free Press.

Duffy, T.M. and Jonassen, D.H. (Eds.) (1992). *Constructivism and the technology of instruction: A conversation.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Freeman, P.B. (1948). The theory of case studies. *Social Forces,* 26(4), 408-419.

Frick, T.W. (1983). *Non-metric temporal path analysis: An alternative to the linear model approach for verification of stochastic educational relations.* Bloomington, IN: Doctoral dissertation, Indiana University Graduate School.

Frick, T.W. (1990). Analysis of patterns in time: A method of recording and quantifying temporal relations in education. *American Educational Research Journal,* 27 (1), 180-204.

Frick, T.W. and Reigeluth, C.M. (1992). *Verifying instructional theory through analysis of patterns in time.* Paper presented at the Annual Conference of the American Educational Research Association, April, 1992.

Frick, T.W. (1997). Artificial tutoring systems: What computers can and can't know. *Journal of Educational Computing Research,* 16(2), 107-124.

Gagné, R.M. (1967). *Learning and individual differences.* Columbus, OH: Charles E. Merrill Books, Inc.

Gregorc, A.F. (1984). *Gregorc style delineator: Development, technical and administrative manual.* Maynard, MA: Gabrial Systems, Inc.

Kolb, D.A. (1976). *The learning style inventory: Technical Manual.* Boston, MA: McBer and Company.

Kolb, D.A. (1984). *Experiential learning: Experience as the source of learning and development.* Englewood Cliffs, New Jersey: Prentice Hall.

Lincoln, Y.S. and Guba, E.G. (1985). *Naturalistic inquiry.* Beverly Hills, CA: Sage Publications.

Merriam, S.B. (1988). *Case study research in education: A qualitative approach.* San Francisco: Jossey-Bass Publishers.

Myers, I.B. (1962). *The Myers-Briggs Type Indicator.* Palo Alto, CA: Consulting Psychologists Press.

Nielsen, J. (1995). *Multimedia and Hypertext: The Internet and beyond.* Cambridge, MA: AP Professional.

Piaget, J. (1973). *To Understand is to Invent.* New York: Grossman.

Sewall, T.J. (1986). *The measurement of learning style: A critique of four assessment tools.* Evaluative/Feasibility Report, University of Wisconsin, Green Bay, Assessment Center.

Snow, R. (1989). Aptitude-Treatment Interaction as a framework for research on individual differences in learning. In P. Ackerman, R.J. Sternberg, & R. Glaser (Eds.). *Learning and Individual Differences.* New York: W.H. Freeman.

Sze, D., (1988). *The effect of different mastery levels used in adaptive computer-guided practice on student learning achievement and attitude.* Bloomington, IN: Doctoral dissertation, Indiana University Graduate School.

Tobias, S. (1981). Adapting instruction to individual differences among students. *Educational Psychologist,* 16, 111-120.

Tobias, S. (1987). Learner Characteristics. In R.M. Gagné (Ed.). *Instructional Technology: Foundations.* Hillsdale, NJ: Lawrence Erlbaum Associates.

von Glasersfeld, E. (1991). Introduction. In E. von Glasersfeld (Ed.). *Radical constructivism in mathematics education* (xiii-xx). Dordrecht, The Netherlands: Kluwer.

Wang, M.C. and Walberg, H. (Eds.) (1985). *Adapting instruction to individual differences.* Berkeley, CA: McCutchan.

BEST COPY AVAILABLE

Does the labeling of links assist user orientation?

Rolf Zajonc & Lutz Schön
Humboldt-University
Invalidenstr. 110
10115 Berlin, Germany
zajonc@physik.hu-berlin.de
www.physik.hu-berlin.de/ger/gruppen/didaktik/a06.htm

Abstract: Hypermedia learning material often makes broad use of links to information which goes beyond the learning objectives. But instead of being additionally motivated some students rather feel too much asked of. Within the Lilienthal project (www.pilotschool.net) links that don't follow the linear navigation are labeled with respect to their relevance for the learning objectives. First evaluations prove that the students welcome this assistance.

Introduction

"Information overflow" or "lost in hyperspace" are keywords, which also are frequently used to describe the difficulties of students using hypermedia for learning purposes. Indeed they give a good impression of what may hinder students from enjoying the new technical possibilities offered by the internet in contrast to their teachers expectations. When creating webpages instructors believe they can motivate their students by offering many links to further interesting or related aspects on the specific subject matter. But e.g. many lecturers report, that rather the opposite effect is shown by their students: learners tend to complain about the number of webpages they are supposed to visit (Dunlap 1999).

The problem faced is, that while the lecturer wants to offer the students the best chances to learn the subject matter as well as possible, the student also has in mind, that he needs to achieve certain learning objectives within a certain amount of time, e.g. to be prepared on time for an examination. Consequently students feel overwhelmed and frustrated by the amount of information, because they cannot differentiate between more and less important links as their teachers can. One possible solution to this problem might be the labeling of the links according to their relevance for the required learning objectives, e.g. by the use of small icons in front of links.

Labeling of links according to relevance

This directly leads to the first question: How to decide on the relevance of a link? The answer can be easy, if the creator of the webpages and the corresponding examination responsible are the same person. But in many cases the learning material is programmed by a team whose members can have different opinions on this question. As this also affects the pages' content in general, it is necessary, that the complete team agrees on a set of well formulated (e.g. Mager 1978) detailed learning objectives before the actual programming takes place. Afterwards the links can be labeled with respect to these detailed learning objectives.

In order not to confuse the students within Lilienthal it has been decided to restrict the labeling to three icons:

-***mandatory***, e.g. a link leading to a formula which the student must know by heart;

-***recommended***, e.g. a link leading to an interesting example which illustrates the effects of the formula in a certain context; or

-***nice to know***, e.g. a link leading to an abstract about how this formula had been discovered historically.

Of course it still remains the student's decision whether he follows a link and for how long he stays on the corresponding pages.

Research

Hypermedia material for roughly 80 hours of learning time has been distributed to pilot students of four European flightschools. The material had been programmed after a Delphi-process (Linstone & Turoff 1978) which lasted one year, during which several subject matter experts of all involved flightschools had discussed and finally agreed on a set of detailed learning objectives, each describing 5 minutes of learning time. On this basis, the links within the material have been labeled as described above. The number of links vary per module (9 DLO in average).

At this point in time (March 2000) evaluation of the various data (tests, questionnaires, protoquols) has just started. A first evaluation of 208 questionnaires on 11 different modules (average 45 minutes) not only proved that the big majority of students found the labeling of links useful (compare figure 1), but also that there is a strong correlation ($p < 0.01$) to the statement "the module is easy to operate". A reasonable interpretation of this correlation is that those students who made use of the additional info of the labeling icons, also felt they had a better control in general.

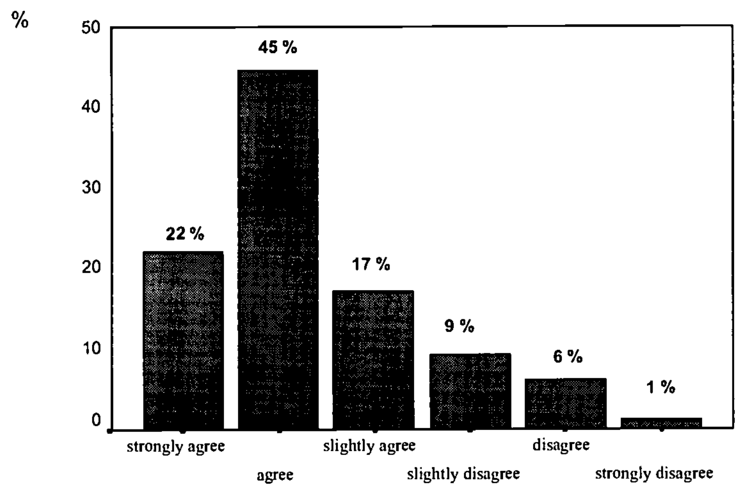


Figure 1: Evaluation of 208 student questionnaires on 11 different modules for the statement *The labeling of links is useful!*

Nevertheless further investigations are required, e.g. because in the pre-evaluation (in total 19 students) 14 out of all 17 students who marked "(strongly) agree" almost immediately added "...but still you click on every link anyway". This shows a well known behavior of hypermedia users, who only have little navigation experience. The assumption is, that the labeling will have a stronger influence on the 'click or no click'-decision in the long run.

In this context, although in our case the pilot students certainly form a rather homogenous group (typically male, age 19-23, open-minded for technically related matters, good marks in physics and mathematics), it is still expected, that students are influenced differently by this labeling. E.g.

A students still click on every link,

B students select recommended and in particular nice-to-know links according to the indicated topics,

C students avoid most recommended and all nice-to-know links.

In addition it might well be possible, that a student changes his attitude in the courses process. As has been mentioned before, in particular novices might rather show A behavior, but after a while they are expected to realize, that they need to work more efficiently and become B or C students.

But the labeling should not only influence the decision whether to click but also the navigation on the following pages. A student should be more likely to really *explore* a webpage if he knows its content belongs to the mandatory level. In contrast he might show *scanning* navigation (Canter, Rivers et al, 1985) if he knows that he needn't follow the link before at all. Since so far almost no experiences are reported in this context, these are just reasonable assumptions, which need to be investigated.

References

Joanna Dunlap (1999) *The 3 Ls of Introductory Web-based Instructional Design: Linking, Layout, and Learner Support* Roundtable EDMEDIA, oral summary

Linstone, H.A. & Turoff, M. (1975), O. *The Delphi Method* London: Addison-Wesley

Mager, R.F. (1978) *Preparing Objective for Programmed Instruction* Clarity Press

Canter, D.; Rivers, R. & Storrs, G. (1985) *Characteriizing User Navigation Through Complex Data Structures.* In: Behaviour and Information Technology 2 4 (1985) 93-102

SHORT PAPERS (Work in Progress)

When is an Interactive Learning Scenario a Matter of Interface Design?

Christian M. Adriano, Adriane M. Adriano, Ivan L. M. Ricarte
State University of Campinas, Brazil

Interaction is an important feature a learning activity must promote. Parker (1999) outlines benefits provided by interaction: "Understanding and long-term internalization can only be acquired by communication, reconstruction and reconciliation of information; interaction enables socialization, promotes motivation, and learning commitment; interactive processes foster comprehension and consensus on universal truths".

In previous research (Adriano et al.1999), we implemented a computer supported learning scenario by producing content, modeling evaluation, and choosing a proper pedagogical orientation. Our effort resulted in the first version of the CALM platform, which implements a learning scenario inspired by the Goal Based Scenario approach, provides an intelligent tutor, and hosts material for learning Java. In order to guide further effort on interaction, the following problem was posed: When is an interactive learning scenario a matter of interface design? We propose two situations in which developing interactive learning scenarios incurs in interface design. First, when concern fits on one of the items proposed by Marcus (1994): Mental and Navigation Models, Appearance, Interaction, or Metaphor. Second, when the learning scenario, implemented by the resulting interface design, must accomplish complementary definitions for the concept of "interaction".

Metaphors are fundamental concepts communicated through words, images, and sound. Mental models are data structures, functions, tasks, roles, jobs, and people in organizations of work. Navigation is the process of moving through the mental models. Interaction is all input-output sequences and means for conveying feedback. Appearance relates to visual, verbal and acoustic information.

The designed metaphors (Adriano et al. 2000) were annotation, document, and annotation-place. The design of the interaction item resulted in three annotating paradigms represented by specific annotation-places: Bridge, Inline, and Tree. The Bridge place represents the idea of annotating as adding links. The Inline place supports the paradigm of writing over the text and having the annotation content visible. The Tree place organizes annotations in a newsgroup-like fashion. The mental model comprises the annotation-place model and organization of roles. In the former, a document may contain many annotation-places and an annotation-place may contain many annotations. The organization of roles depends on each learning scenario specification. The navigation model comprises resources to manipulate metaphors. Such resources correspond to: annotation editing interfaces, a search tool, a document composition tool (annotation-places are implemented as applets within Web pages), a tool for repositioning annotation-places due to changes in the original Web page, and a tool to generate workbook-like compilation of annotations. The appearance item relates to types of annotations and annotation-places. The annotation metaphor has four visually different types: doubt, suggestion, commentary and mark.

The discussion scenario comprises theme presentation, individual annotation, group annotation, and discussion summarization. Roles are "moderator" and "commenter". The theme presentation is a notification that the Web page hosting the text for discussion is available for commenting. After notification, starts the individual annotation phase in which commenters read and make personal annotations on the text. In the next phase commenters may request the annotations of their peers and discuss opinions and acknowledgements, which involves commenting on each other annotations. When discussion is finished, due to a deadline or a common agreement, the moderator compiles annotations into a second text elaborating a summary of the discussion.

The co-authoring scenario includes goal definition, authoring, reviewing, voting, and consolidation. Roles are "co-author", "reviewer", and "author". Co-authors annotate using inline annotation-places and may define when an annotation is ready to be seen by others. Reviewers may comment on annotations made by co-authors. As a co-author decides that an annotation should become part of the underlying text, he/she requires the author to consolidate the annotation. If the author agrees, the annotation is incorporated to the text. The author can also ask for co-authors to vote whether an annotation should be consolidated. An annotation has states such as ready, removed, in consolidation, being voted, and not available.

Some interaction definitions were collected from Vigotsky, Habermas, de Certeau, and Chartier. Vigotsky (1978) deals with the cultural dimension of learning. Apprenticeship is result of interactions among historical subjects and the world. Signs and symbols are the condition for these interactions. People, instruments and signs mediate relations between a subject and physical/social environment. Signs correspond to a representation of reality and refer to remote times and spaces. Interaction is conceptualized as relations among historical individuals, signs, and instruments. Such definition is satisfied by interfaces that relate individuals as role players, signs as metaphor representations and instruments as tools of the navigation model.

Certeau (1974) states that interaction is based on a metaphor of landmark and on distinctions between place and space. In short, place is static and permanent, while space is dynamic and transient. Landmarks delimit regions (spaces or places), being also classified as dynamic or static. Static landmarks are frontiers, like rivers and fences, delimitating places. Dynamic landmarks are bridges, like doors and windows, delimitating spaces. Bridge-like landmarks represent encounters of action. Moreover, there will be so many bridges as the number of "inter-actions". Interaction is defined as a bridge separating spaces of action. Such concern inspired the design of annotation-places, whose types provide different bridging between the document space and the annotation space.

As quoted by Prestes (1997), Habermas argues that the communicative action has a kind of anchor constituting background knowledge. Such knowledge fosters interpretations for participants of an interaction. The background knowledge relates to a world of life (*Lebenswelt*), the horizon on which we move. It is pre-scientific, intuitive, not expressed and not questionable. It constitutes itself not only by cultural convictions, but also by institutional organizations and structures of personality. Habermas uses the daily communicative praxis to guarantee the symbolic reproduction of three spheres; culture, society, and personality. Culture refers to knowledge acervus, over which we formulate interpretations to understand the world. Society refers to legitimated organizations that regulate our bindings with social groups. Personality refers to competencies that enable subjects, capable of language and action, to take part in an understanding process. The following citation of Habermas clarifies these three aspects: "In respect to the functional aspect of understanding, the communicative action promotes tradition and cultural renovation. In respect to coordination aspects, the communicative action promotes social integration and creation of solidarity. In respect to socialization, the communicative action promotes formation of individual identities". Interaction is a space of conflict between a pre-comprehension of world of life and the communicative action. Therefore, when and where interaction happens, the stability of the world of life is disturbed by arguments of the communicative action. Annotation interfaces enabling discussion was a mean to accomplish such vision.

Following a historical point-of-view, Chartier (1997) provides a study of how mankind has been interacting with and by means of the written letter. Medium has changed from papyrus, to codex, to Gutenberg press, and, nowadays, to digital text. Each medium required a proper interaction paradigm suggesting that interaction be also defined by the enabling technological support. In other words, medium defines interaction. Such concept for interaction was accomplished by supporting audio and written media for annotation.

In addition to the five components proposed in Marcus (1994), we suggest a careful study of the interaction concept. The presented discussion stems from project meetings between educators and software developers. A recurring problem faced was the lack of consensus on concepts, accompanied by concerns of presupposing things that needed better understanding before implementation. Interaction conceptualization is one these concerns. We hope the ongoing research will collect further insights to the design of interactive learning scenarios as a cooperative entrepreneurship of educational and computer scientists.

References

Adriano, C.., et al (1999). Inquiring the Course Paradigm with CALM. *ICECE99*, Rio de Janeiro.

Adriano, C. , et al (2000). Changing Interaction Paradigms in Annotation Environments. *EDMedia00,* Montreal.

Certeau, M. de (1974). *L'invention de Quotidien - 1a. Arts de Faire*. Paris: Éditions Gallimard.

Chartier, R. (1997). *Le Livre en Révolutions*. Paris: Lcs Editions Textuel.

Marcus, A. (1994). Managing Metaphors for Advanced User Interfaces. *ACM WAVI*, 12-18, Bari, Italy.

Vigotsky, L, et al (1978) *Mind in Society*. Editor V. John-Steiner, Cambridge: Harvard University Press.

Parker, A.(1999). Interaction in Distance Education: The Critical Conversation. *Educ. Tech. Review*, 12, 13-17.

Prestes, N. H. (1997). The Thinking of Habermas. *In Filosofia, Sociedade e Educação*, ano 1, n. 1, (pp. 119-140), Publication of the Faculty of Education-State Univeristy of São Paulo. (in portuguese)

An Interactive System Model of an Online System for Teaching & Learning Developed as a Scoping / Costing Instrument

Anne A'Herran, Educational Development Adviser (WWW), Teaching and Learning Development, James Cook University, North Queensland 4811, Australia.
anne.aherran@jcu.edu.au

Abstract
Although there are strong reasons for purchase of an off-the-shelf system for online course delivery (including the competitive advantages of reliability, the comfort of a large client base and scalability), many universities develop a system themselves. These home-grown systems are often more responsive to specific needs. When James Cook University undertook to investigate available systems for university wide online course delivery it was important to explore costs of building a system using university resources. To this end a system model was designed as an interactive diagram reflecting each part of the system in prototype http://www.tsd.jcu.edu.au/jcudevelop/jcuproto/jcuonline The model is both an innovative example of organisational design method and a useful means of testing user pathways through the system, (use-case), which can assist costing and project management of the development of such a system.

As part of the search for the most suitable system for use at JCU we set out to determine the costs of building a system using university resources:

- there was a high level of interest in the JCU community;
- the possibility of economies of production;
- a collaborative venture of this kind with the potential for cross-institution partnerships could be of value to the university in the future.

To this end a system model was designed as an interactive diagram reflecting each part of the system, in prototype (at http://www.tsd.jcu.edu.au/jcudevelop/jcuproto/jcuonline).

The model is both an innovative example of organisational design method and a useful means of testing user pathways through the system, (use-case), which can assist costing and project management of the development of such a system.

Discussions were held with the schools of IT and Computing Science. The interactive system model was felt to be helpful in this process in that it provided, by visible and testable means, a common understanding of the scope and direction of the exercise. Costing was based in staged development from base level, adding functionality as we saw a need.

There was found to be no case for developing DIY for immediate implementation:

- the real costs of DIY infrastructure are high for a one-off development which is not amortised over other products;
- time of development has to be compressed to keep pace with user needs and technical innovation: to compress time requires commitment of personnel which increases costs;
- when a university implements its own system, support for users becomes an internal budget decision not externally (market) driven: support is therefore subject to internal budgetary pressures rather than the wider driving client base.

Validating a Theory-Based Design for Online Instruction: Aligning Tool Use and Learning Outcomes

Arshad Ahmad
McGill University
1455 DeMaisonneuve
Montreal, Quebec. H3G 1M8
arshad@mercato.concordia.ca

Abstract: This paper provides a theoretical framework for the design of a successful web-based course in Personal Finance. Using an open learning model based on constructivist principles that draw from the literature in cognition and the social sciences, this paper sketches an instructional design model and specifies online tools that mediate between course objectives and desired learning outcomes. In order to validate the model, data generated from tool use and from student performance will be analyzed using confirmatory factor analysis.

Mixed Messages with Multimedia

A growing body of research is exploring the learning effects of multimedia designed environments. Some of this research has attempted to incorporate educational concepts in the design, process and implementation of course production in technology-rich platforms. However, the results are mixed. According to *The No Significant Difference Phenomenon* (Russell, 1999) which is based on 355 research reports, summaries and papers, the conclusions mainly indicate that the learning outcomes of students using technology enriched courseware are similar to those of students who participate in conventional classroom instruction. Yet, universities are allocating substantial resources towards the development of distance education courses and programs (Brahler, Peterson et al., 1999) to increase access to learning, with the hope that the quality of education will be damaged little, if at all (Ehrmann, 1999) Questions and concerns relating to technology integration are being raised, but as yet have had little systematic impact on the policies that guide educators, administrators and practitioners (Merisotis and Phipps, 1999; Welte, 1997)). Faculty realize that there are certain benefits of technology-based distributed learning environments, but put up considerable resistance to the development of such environments (Rickard, 1999).

Mixing Cognitive and Social Science Approaches

This working paper presents a theory-based design of an undergraduate web-based course in Personal Finance with the aim of addressing some of the issues addressed above in the context of better understanding student learning. Concerns relating to technology integration in educational practice, and technology's intersection with learning theory are addressed in a design framework that aligns learning objectives, course activities and assessment methods. This alignment simultaneously considers the selection of online learning tools that mediate between design components for Personal Finance. The selection of learning tools also plays an important role in terms of how they will be meaningfully used by students, and how they will affect student performance.

Web-based instruction that is designed on accepted theoretical principles in cognitive psychology opens new doors to designers, learners and practitioners. This is simply because we know very little about best practices arising from the design of courseware that primarily uses this medium. However, in contrast, there is an abundance of theoretical studies in the cognition literature that have increased our understanding of competence in understanding a given discipline (See for example, Anderson, Corbett et al., 1995; Ausubel, 1968; Hatano, 1996; Means, 1993; VanLehn, 1996; and Winn, 1990). Similarly, studies from the literature in social sciences have proposed interactive socio-cultural contexts as a basis for understanding how learning can be constructed, scaffolded and facilitated (See for example, Bandura, 1986; Brown, Collins et al., 1989; Derry and Lesgold, 1996; Lave and Wenger, 1991; Moore, 1994; Shuell, 1993; and Richey, 1994. In his 1999 AERA Presidential Address, Alan Schoenfeld describes the split between cognitive and social science research with rcferences to studies in cognition that excel in fine-grained data analysis but suffer from tunnel vision and points to as many sociological studies that are rich in scope but are weak with respect to validity and reliability constructs. His suggestion to bridge the gap was to "build something to see if it works and then study the hell out of it".

This study seeks to validate a non-traditional design based on theoretical findings from the cognitive and social sciences literature. The world-wide-web is an obvious choice as the platform for building a design prototype because learners recognize that it is more accessible and convenient than traditional opportunities afforded in the classroom. Combining the web platform and a theoretical basis into a prototype design becomes meaningful when specific learning goals are specified with evidence to link these goals with performance outcomes that are assessed. These links are critically explored and are the focus of this study.

Challenges in the Design Process

The term technology is used broadly to refer not only to tools but also processes and is closely identified with the Greek form *techne* (art, craft, or skill), which was closely associated with *episteme* (systematic or scientific knowledge). Its educational meaning is historically derived, bound by specific psychological theories and philosophical underpinnings (Saettler, 1990). Visions of technology look very different depending on the explicit theories of learning that guide their design and implementation. According to The Cognition and Technology Group at Vanderbilt (1996), the challenge for instructional design based on significant technology integration is that learning theory, educational practice and technology interact with each other. To understand the role of technology, one must examine a simultaneous intersection with student learning and educational practice. This challenge is increased since all three areas have seen dramatic change in the past ten years. Thus, changes in theories of learning affect uses of technology, but new technologies such as the world wide web also make new kinds of interactions possible and hence affect theories of learning (Kozma, 1994; Saloman, 1993). Knowledge acquisition in constructivist environments engages learners in drawing meaning from multiple perspectives and through collaborative efforts. Engagement in real world or authentic tasks provides a context for the learner to construct meaning from his/her experiences. Thus, learning is situated in a community of learners who construct personal meaning through dialogue and socialization (See Brown, Collins et al., 1989; Jonassen, 1998; & Wilson, 1995).

Sketching the Design Components

Given these perspectives, different views of how humans learn and how designers approach instruction are incorporated under the umbrella of knowledge acquisition and knowledge construction. In addition, aspects of situated cognition, which emphasizes social and ecological interactions is also included. Parts of the design relies on an information processing view emphasizing course content that hierarchically structures the sequence of information. Using Hannafin, Land et al.'s (1999) open learning model which emphasizes diversity and choice, course material was selected to reflect a variety of print-based, multimedia and interactive web-based tools that could best enable the learner to attain the learning goals set for the course. The importance of constructive alignment between different design components is emphasised by Biggs (1999); they become inextricably linked, so that the course becomes greater than the sum of its parts. These components include a *textbook*, *short vignettes* with practionners who introduce each topic, *simulations* that forecast your net worth, or your tax bill, *interactive practice tests* including pre-tests, review exercises, short cases, etc and *communication software* that allows for threaded discussion, chats, critiquing, posting and other activities consistent with best practices in effective learning communities. Technology has been nested within a constructivist framework to raise the intellectual, social and ethical standards of learners, by empowering them to question, participate, and practice authentic issues in personal finance. Jonassen, Davidson et al. (1995) summarize this approach:"...learning is necessarily a social dialogical process in which the communities of practitioners socially negotiate the meaning of phenomena" (p.9).In addition, feedback opportunities are provided by experts (the instructor as well as practionners) to ensure accurate knowledge acquisition. Finally, communication strategies are designed to facilitate elaboration of content and solicitation of responses that

reflect what students are thinking. Here, the tools employed include interactive tests, e-mail and bulletin boards, as well as audio conferencing.
Data reflecting student use of designed tools and their performance on assigned tasks will be collected to confirm the validity of the design model. Evidence of learning using Bloom's (1956) taxonomy will reveal the general factors associated with the model. Path analysis will be used to confirm the relationship amongst the design components as they fit within the instructional design model.

References

Anderson, J. R., A. T. Corbett, et al. (1995). Cognitive tutors: Lessons learned. *The Journal of the Learning Sciences* 4(2): 167-207.

Ausubel, D. P. (1968). *Educational psychology: A cognitive view.* Toronto, Holt, Rinehart, & Winston.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ, Prentice Hall.

Biggs, J. (1999). Assessment: An integral part of the teaching system. *American Association of Higher Education Bulletin* 51(9): 10-12.

Bloom, B. (1956). *Taxonomy of educational objectives.* Handbook 1: The Cognitive Domain. New York, David McKay.

Brahler, C. J., N. S. Peterson, et al. (1999). Developing on-line learning materials for higher education: An overview of current issues. *Educational Technology & Society* 2(2): http:..ifets.gmd.de/periodical/.

Brown, J. S., A. Collins, et al. (1989). Situated cognition and the culture of learning. *Educational Researcher* 18(1): 31-41.

Derry, S. and A. Lesgold (1996). Toward a situated practice model for instructional design. *Handbook of educational psychology.* In D. C. Berliner and R. C. Calfee (Eds). New York, Prentice Hall International: 787-806.

Ehrmann, S. C. (1999). Access and /or Quality? Redefining choices in the third revolution. *Educom Review* 34(5).

Hannafin, M., S. Land, et al. (1999). Open learning environments: Foundations, methods and models. *Instructional design theories and models.* In C. M. Reigeluth (Ed). Mahwah, New Jersey, Erlbaum. II: 115-140.

Hatano, G. (1996). Cognitive development and the acquisition of expertise. *International encyclopedia of developmental and instructional psychology.* In E. De Corte and F. E. Weinert (Eds). Oxford, Pergamon: 273-276.

Jonassen, D., Ed. (1998). Designing constructivist learning environments. *Instructional theories and models.* Mahwah,NJ, Earlbaum.

Jonassen, D., M. Davidson, et al. (1995). Constructivism and computer-mediated communication in distance education. *The American Journal of Distance Education* 9(2): 7-26.

Kozma, R., B. (1994). Will media influence learning? Reframing the debate. *Educational Technology Research and Development* 42(2): 7-19.

Lave, J. and E. Wenger (1991). *Situated learning: Legitimate peripheral participation.* Cambridge, MA, Cambridge University Press.

Means, B. (1993). Cognitive task analysis as a basis for instructional design. *Cognitive science: Foundations of instruction.* In M. Rabinowitz (Ed). Hillsdale: NJ, Lawerence Erlbaum Associates: 97-118.

Merisotis, J. P. and R. A. Phipps (1999). What's the difference? *Change*(May/June): 13 - 17.

Moore, W. S. (1994). Student and faculty epistemology in the college classroom: The Perry schema of intellectual and ethical development. *Handbook of College Teaching: Theory and Applications*. In K. W. Prichard and R. M. Sawyer (Eds). Westport Connecticut, Greenwood Press: 45-67.

Richey, A. (1994). *Design 2000: Theory-based desogn models of the future*. National Convention of the Association for Educational Communications &Technology., Nashville, TN., Informational Analysis.

Russell, T. L. (1999). *The no significant difference phenomenon*. North Carolina State University, Office of Instructional Telecommunications: 119.

Saettler, P. (1990). *The evolution of American educational technology*. New York, McGraw Hill.

Saloman, G. (1993). *Distributed cognitions: Psychological and educational considerations*. New York, Cambridge University Press.

Shuell, T. J. (1993). Toward an integrated theory of teaching and learning. *Educational Psychologist* 28(4): 291-311.

The Cognition & Technology Group at Vanderbilt (1996). Looking at technology in context: A framework for understanding technology and education research. In *Handbook of educational psychology*. D. C. B. & R. C. Calfee (Eds). New York, NY, Simon & Schuster MacMillan: 807-840.

VanLehn, K. (1996). Cognitive skill acquisition. *Annual Review of Psychology* 47: 513-39.

Welte, S. L. (1997). Transforming educational practice: Addressing underlying epistemological assumptions. *The Review of Higher Education* 20(2): 199-213.

Wilson, B. G. (1995). Situated instructional design: Blurring the distinctions between theory and practice, design and implementation, curriculum and instruction, *Educational Development Research Service*.

Winn, W. (1990). Some implications of cognitive theory for instructional design. *Instructional Science* 19: 53-69.

Learning Strategies for Multi-Media Instruction

Mohamed Ally, Ph.D.
Athabasca University
1 University Drive
Athabasca, Alberta,
Canada, T9S 3A3
mohameda@athabascau.ca

Abstract: Multimedia instruction must follow instructional design principles that are based on learning theories. This session will share an effective model for designing learning materials and will describe the strategies that should be used when designing multi-media learning materials.

Pre-instructional Activities

Before teaching new materials to students, the lesson must overview the materials so that students can form a mental set for the materials and become motivated to learn the materials. The different types of pre-instructional activities include content map, advance organizer, pre-test, learning objectives, and rationale.

Prepare Learning Activities

Conventional instructional methods tend to use passive instructional strategies. It is important to use strategies that will keep students active so that they will be motivated and will process the information in greater depth. To encourage active learning, it is important to use discovery strategies so that students can find out things for themselves. Instead of teaching a large amount of information to students, we should give students the task and then guide them to find and apply the information. Multi-media and on-line instruction are excellent methods to promote active learning.

Elaborative Strategies

To make the instructional process more effective and efficient, the lesson must provide activities for students to process the content at a deep level. The deeper the information is processed, the better it is learned or remembered. As a result, the instruction should contain elaborative strategies to help facilitate deep processing. Some common elaborative strategies are asking questions during the instruction, ask students to summarize segments of the instruction, requesting students to make their own notes, and asking students to underline or highlight important information. The elaboration process facilitates efficient storage in long-term memory. This is important since the ease of retrieval will depend on the way the information is stored in long-term memory.

It is known that when new learning materials are encountered, they are attended to and transfer to short-term memory storage. After entry into short-term memory, the information must be transferred to long-term memory immediately since short-term memory has limited capacity. As a result, students should be given the opportunity to elaborate on small segments of instruction so that the materials can be transferred to long-term memory immediately.

Presentation Strategies

Most instruction is done in an expository fashion where the learning material is presented in its final form to students. The most common expository methods are rote, inductive, and deductive learning.

The rote method consists of presenting the materials to students and then asking them to recall the materials as presented. For example, the lesson may present a rule and then ask students to recall it. The deductive method occurs when students are given a rule followed by examples to explain the rule. The inductive method involves giving examples on a certain rule followed by the rule. However, to make learning more efficient and effective, discovery strategies must be used. With the introduction of new instructional technologies and multi-media, it is possible to design instruction that contains discovery strategies.

Practice Exercises

Another important component of instruction is practice with feedback. After the presentation of the materials, students should be given the opportunity to practice what they have learned so that they can get feedback on how they are performing and at the same time prepare them for the final test in the lesson. In addition, the practice test acts as a good learning strategy since test questions usually consist of general ideas which act as cues to recall specific details and skills.

Summarize the Lesson

After the lesson is presented to students, they should be given a summary so that they can get a sense of closure for the lesson and gives a general review of the lesson.

Web-Based: Instructional Effectiveness

Nella B. Anderson
Western State College of Colorado
112 Kelley Hall
Gunnison, CO 81231
nanderson@western.edu

Abstract: Training preservice education students on the Internet requires the course to be more structured than would be required to teach the same course without an electronic component (Gillette, 1996). Education students have consistently expressed the need to see technology used by their university instructors if they are to use these tools effectively in their own teaching (Larson & Clift, 1996). Due to both a lack of suitable instruments and the importance of being able to assess web-course effectiveness, the authors developed the Web-Based Survey of Instructional Effectiveness (WebSIE) to meet this need. Forty-one students enrolled in a web-based course were given the WeBSIE prior to and after the completion of the course. Pretest to posttest comparisons showed students improved in their self-reported web-based skills and attitudes in the use of the internet, integration of the internet into instruction, general computer use/attitude and using a computer for communication. Future studies need to replicate these findings and investigate the effects of the integration of technology into more and varied teacher training courses.

The effective use of technology includes rethinking traditional forms of instruction. Instructors teaching online need to maintain the perspective that we learn best "with" technology rather than "from" it (Johnson, 1996). This perspective allows instructors to engage students in active (Copley, 1992; Reeves, 1996; Yakimovicz & Murphy, 1995), authentic (Copley, 1992), challenging tasks (Copley, 1992; Reeves, 1996), and collaborative efforts (Reeves, 1996; Yakimovicz & Murphy, 1995).

A computer-specific introductory course is usually insufficient in modeling for preservice teachers the use of technology as a tool for teaching and learning (Topp et al., 1994). Education professors from various disciplines must begin to use technology as a cognitive tool to mediate and transform the training experiences of teacher education students (Larson & Clift, 1996).

Instructional Design

Training preservice education students on the Internet requires the course to be more structured than would be required to teach the same course without an electronic component (Gillette, 1996). The structure that is embedded and remains consistent throughout each unit of study. The structure of an introductory special education course taught online will be elaborated on in this section by clustering the components into categories and providing a brief description of each.

1. Instructional Design Framework
   (a) Each unit of study is divided into six instructional steps.
   (b) Each of the six steps are divided into instructional components.
   (c) Reference numbers are assigned to each of the instructional components. The reference numbers are depicted using three digits separated by decimals (e.g., 2.3.4 represents Unit 2.Step3.Activity4). The reference numbers are used when discussing activities via e-mail, newsgroup, and/or chat.
   (d) Buttons are located at the bottom of each of the six instructional step pages so that students can go to the "next step" or return to the "unit index", which provides links to all six steps.
2. Curriculum Development
   (a) The curriculum is built upon the principles of active learning, cooperative groups, peer-mediated instruction, and content experts

(i) Active learning is integrated into the course through the use of interactive forms and case studies found on the Internet.
(ii) The class is divided into cooperative groups of two based on where students live and their educational major.
(iii) Peer-mediated instruction is used through the creation of student homepages and peer expertise pages. These pages allow students to share their work and ideas with each other.
(iv) Content experts are utilized by incorporating parents of students with disabilities and personnel in special education field in local public schools into the class discussions (e.g., e-mail, chat, and newsgroup).

(b) All activities taught in the traditional course on campus are incorporated into this online course through the use of e-mail, chat, newsgroup, electronic handouts, forms, and web sites.

Teaching in this virtual classroom in comparison with teaching in the traditional classroom requires much more learning and much less teaching (Peterson & Facemyer, 1996). The dynamic learning environment available online, which is expanding at exponential rates, provides opportunities for students to become explorers and discoverers (Gates, 1996).

Education students have consistently expressed the need to see technology used by their university instructors if they are to use these tools effectively in their own teaching (Larson & Clift, 1996). All students enrolled in this online course had completed at least one required computer-specific course prior to the beginning of this online course. The development of a survey of instructional effectiveness was developed by the authors to measure the effects of learning educational content through the use of web-based technology.

Web-Based Survey of Instructional Effectiveness

Due to both a lack of suitable instruments and the importance of being able to assess web-course effectiveness, the authors developed the Web-Based Survey of Instructional Effectiveness (WebSIE) to meet this need. Expert opinion from individuals with both academic credentials (Ed.D. or Ph.D.) and web-based course experience were sought to develop an original pool of 58 items. This pool of items was subjected to factor analysis. A five-factor model was adopted retaining 30 items: Use of the Internet (8 items); Integration of the Internet into Instruction (8 items); General Computer Use/Attitude (4 items); Using a Computer for Communication (5 items); and web-based Course Effectiveness (5 items).

Using this 30 item survey authors administered 313 to preservice education students and practicing teachers. Cronbach's alpha and split-half reliabilities were calculated for the five scales. Alpha for the whole 30 item instrument was .803, and the five scales were Use = .557; Instruction = .531; Computer Use/Attitude = .415; Communication = .653; and Course Effectiveness = .419. Split-half reliabilities for the five scales were Use = .762; Instruction = .750; Computer Use/Attitude = .726; Communication = .823; and Course Effectiveness = .672.

Forty-one students enrolled in a web-based course were given the WeBSIE prior to and after the completion of the course. Single-sample Dependent T-tests were performed on all five scales. An alpha level of .05 was used for all statistical tests. Four of the five scales were significant: Use, $t_{41} = 4.873$, $p < .001$; Instruction, $t_{41} = 4.143$, $p < .001$; Computer Use/Attitude, $t_{41} = 3.797$, $p < .001$; and Communication, $t_{41} = 2.401$, $p < .02$.

Pretest to posttest comparisons showed students improved in their self-reported web-based skills and attitudes in the use of the internet, integration of the internet into instruction, general computer use/attitude and using a computer for communication. These statistically significant gains in web-based skills and attitudes were noted after one education methods course that modeled the use of the Internet in instruction. Future studies need to replicate these findings and investigate the effects of the integration of technology into more and varied teacher training courses. Additional effects of the integration of technology into teacher training programs needs be studied after these preservice teachers become practicing teachers, focusing on how often and in what ways they integrate technology into their own teaching.

References

Copley, J. (1992). The integration of teacher education and technology: A constructivist model. In D. Carey, R. Carey, D. Willis, & J. Willis (Eds.), Technology and teacher education annual (pp. 381-385). Charlottesville, VA: Association for the Advancement of Computing in Education.

Gates, B. (1996). Linked up for learning. Educational Record , 66 (4), 34-41.

Gillette, D. (1996). Using electronic tools to promote active learning. New Directions for Teaching and Learning, (67), 59-70.

Johnson, D. (1996). "We're helping them to be good teachers": Using electronic dialoguing to connect theory and practice in preservice teacher education. Journal of Computing in Childhood Education, 7 (1-2), 3-11.

Larson, A. E., & Clift, R. T. (1996). Technology education in teacher preparation: Perspectives from a year-long elementary teacher education program. Educational Foundations, 10 (4), 33-50.

Peterson, N., & Facemyer, K. (1996). The impact of the Internet on learners and schools. National Association of Secondary School Principals, NASSP bulletin, 80 (582), 53-58.

Reeves, T. C. (1996). Technology in teacher education: Electronic tutor to cognitive tool. Action in Teacher Education, XVII (4), 74-78.

Topp, N., Thompson, A., & Schmidt, D. (1994). Teacher preservice experiences and classroom computer use of recent college graduates. In J. Willis, B. Robin, & D. Willis (Eds.), Technology and teacher education annual (pp. 46-51). Charlottesville, VA: Association for the Advancement of Computing in Education.

Yakimovicz, A., & Murphy, K. (1995). Constructivism and collaboration on the internet: Case study of a graduate class experience. Computers & Education, 24 (3), 203-209.

The Interaction and Psychological Distance in Educational Situations: Experimental View

Shaker Hasan Aradi
Institute of Education, University of Tsukuba, Japan
shaker@human.tsukuba.ac.jp

Abstract: This paper reports the findings of a study conducted with an experimental undergraduate-level class. It investigated the differences between learners studying with the teacher face-to-face and learners studying at distance in terms of three dimensions; ① learners' sense of distance, ② interaction, and ③ achievement.

Introduction

One of the most important innovations resulting from the remarkable advances in communication and Internet technologies is '*face-to-face at distance education*', which is forcing us to adapt new definitions, theories and practices. Physical distance is no longer the limiting factor; *"psychological distance"* is. Drawing on Moore's work redefining "distance", "interaction" and "transactional distance" (Sewart, 1988 & Moore 1991), the concept of psychological distance (PSD) refers to how close the participants within the educational environment feel to each other in terms of emotional comfort and satisfaction.

As Holmberg (1988) observes "real learning is primarily an individual activity and attained through an internalization process;" thus, learning is the product of internal interaction between the learner's previous experiences and new information obtained from external interaction with the other components of the educational situation, including contents/media, other learners and the teacher/instructor/coach.

The present study focuses on this interaction within the educational environment, in terms of the *learners' sense of distance*" (SoD)[1], as a direct indicator of PSD. Specifically, the main objective of the experiment is to examine the relationships that exist between: a) "the learner's sense of distance", b) "interaction within the educational environment" and c) "learners' achievement".

The Study

Twenty-two (only the data from 19 participants was usable) Japanese undergraduate-student volunteers, from a women's university attended four seminars entitled "Introduction to Public Speaking" during spring, 2000. The participants were divided into two equal groups, matched for age and scores for English and Japanese language; a "*local group*" (LG), which studied with the teacher face-to-face and a "*distant group*" (DG), which studied with the same teacher at distance. An ISDN-based TV conferencing system was used to mediate communication between the two groups, so that they can study in different places at the same time. Achievement was evaluated by pre-tcsts and post-tests. The participants were asked to evaluate their "sense of distance" from others (i.e., the teacher, other learners in the same group and other learners in the other group) on a 5-point scale, with 1 indicating very close and 5 very far. The participants also recorded both how often they actually interacted with others, and how often they wanted to, as an indication of the interaction within the educational environment. The classes, as well as short interviews after each class to regarding technical aspects such as sound and picture quality, were also videotaped for further analysis and to improve the seminar contents.

[1] Sense of distance is contrasted with "real distance," as a measure of the distance learners feel to exist between themselves and other components of the educational setting, irrespective of the actual distance.

Findings

The differences between pre-test scores concerning the participant's knowledge of public speaking for the two groups were not significant (average scores were 4.5 and 5.22 for the LG and DG conditions respectively). The scores for the post-test were 16.4 for the LG and 18.66 for the DG, indicating significant improvements in knowledge concerning public speaking for both groups ($p < 0.0001$). The average scores for both groups also indicate that there were no significant differences between the two groups in terms of achievement at the end of the experiment.

In terms of learners' SoD to the teacher, the average evaluation rating for the LG condition fell from 3.166 after the first class to 1.7 after the last class. In the DG condition, this fell from 4.7 to 3.00. Although analyses (Wilcoxon Signed Ranks tests) indicated that these changes were significant ($p < 0.025$ and 0.015 for LG and DG respectively), further analyses (Mann-Whitney U test) also indicated that there were significant differences between the two groups after both the first and last classes. In other words, although the learners' sense of distance to their teacher declined significantly for both groups, those in the LG condition felt much closer to the teacher then those in the DG. Reviewing the videos for both sites, we found that although the teacher almost had the same amount of interaction with both groups during the class, he did spend more time talking and explaining to the LG both before and after the classes, and that he was able to give more individualized attention to the learners in the LG condition, which may have contributed in making them feel closer to him.

The data indicated no significant changes in the learners' sense of distance to other learners in the same groups at both sites, which might be due to the fact that the students came from the same university. Examining the learners' sense of distance to the learners in the other group, the evaluation rating fell from 4.62 after the first class to 3.00 after the last class for the DG condition (significant at 4.6% level). However, there were no significant changes in the SoD for learners in the LG condition. This might be due to the initial setting at the LG site, which did not allow learners at the DG site to see their counterparts at the LG site during the first class, which was adjusted for later classes.

The correlation between the learners' SoD to their teacher and the records of interactions was –0.287 (sig. at the .05 level). Although no significant correlation was found between the learners' SoD to their teacher and achievement, the learners' SoD was highly correlated (0.636 sign. at the .01 level) to how important the learners regarded thc contents, and how much they felt they had learnt (0.496 sign. at .1 level).

Conclusions

The results of this study suggest that it might be very difficult to acquire the same quality of interaction with physically-distant learners, and that it, therefore, takes more effort in order to reduce their SoD compared to learners studying face-to-face. Despite this, however, the more learners interact with their teachers the closer they feel to them regardless actual physical distances. Moreover, as learners feel closer to their teachers, they tend to regard the study as more important and to feel that they understand it.

References

Sewart, D. Keegan, D. and Holmerg B. (1988). (ed). *Distance education: International perspectives.*, London: Routledge

Keegan, D (1986). *The Foundation Of Distance Education*. London: Croom Helm

Moore, M.(1991). Distance education theory. *The American Journal of Distance Education, 5(3), 1-6*

Acknowledgement

This study owes its completion to the support and assistance provided by several generous people. I am indebted to Dr. Morio Yoshie and Dr. Ichiko, Shoj from Institute of Education- University of Tsukuba and Noriko Kanakubo from Tsukuba Women's University for their valuable comments, kind considerations, supportive advices and guidance and more for there continuous encouragements.

I also wish to express my sincerest gratitude to all the people and organization that helped me in completing this experiment. Especially, my friends Josh Kirby who kindly taught and prepared all the materials for the classes and Vikash Chandra who help in the experiment's setting and speared no effort to make it happen.

A Generic Pedagogical Agent Architecture That Supports Conversational Authoring

Jeremy W. Baer and Steven L. Tanimoto
Department of Computer Science and Engineering
University of Washington
Box 352350, Seattle, WA 98195-2350
jbaer@cs.washington.edu, tanimoto@cs.washington.edu

Abstract: Pedagogical agents offer great promise to improve the learning experience of students interacting with educational software systems. This paper describes work in progress on a generic pedagogical agent architecture and an authoring system to support the creation of custom agents by teachers and other domain experts using a natural, conversational metaphor.

The field of pedagogical agents is a recently emergent one which draws from previous work done in intelligent tutoring systems, autonomous agents, and educational theory (Johnson et al. 2000). Pedagogical agents have the potential to offer a wide spectrum of educational interactions with students, including opportunistic instruction, and have been shown to have positive affective as well as cognitive influences on students (Lester et al. 1997).

Several successful pedagogical agents have been designed for a variety of learning environments, ranging from skill-based training systems to more open-ended constructionist environments (Johnson et al. 2000). Currently, however, the task of building pedagogical agents is a non-trivial one which falls within the domains of researchers and professional programmers -- not those of teachers, curriculum designers, and other non-programmers. Authoring tools designed for non-programmers to create customized content for particular agents are under way, but little attention has been devoted to the question of authoring tools for creating customized agents, given a particular computer-based learning environment. It is to this question that we turn our attention in this paper. We will describe work in progress on a project which aims to allow teachers and other non-programmers to author customized pedagogical agents for interactive learning environments. We first discuss the design of a generic pedagogical agent architecture, suitable for use in constructionist learning environments. Secondly we discuss techniques we are developing to allow teachers to author agents based upon this architecture. We require that the architecture be suitable for constructionist learning environments due to their open-ended nature, which raises a greater challenge for the agent designer.

Our generic agent architecture (see figure at http://www.cs.washington.edu/homes/jbaer/pedagent/agentarch.jpg) is built around the Agent Control Module. This module is responsible for processing events received from the learning environment, updating its student and session models based on those events, initiating interactions with the student, and potentially sending commands back to the learning environment. The appearance and user interface aspects of the agent have been separated out into a distinct module. This allows for maximum flexibility in the appearance of the agent. Either the agent can appear in its own window, or the learning environment itself can implement this module, allowing the agent to appear within the main window of the environment, as do many of the existing pedagogical agents described by Johnson and Lester (Johnson et al. 2000) do.

The interaction between the agent and the learning environment consists of the agent receiving events from the environment and requesting state information from the environment or sending commands to the environment. It is up to the environment to define the set of events that will be sent to the agent, as well as the state and control commands that it wishes to expose. A distinguishing feature of this agent model is that we do not require the agent to have complete access to the state of the learning environment. While this can limit the information which the agent has to work with, it allows for interoperation with a wider variety of learning environments, all of which may represent their state in different ways.

While the Agent Control Module is the center of operations for the agent, it does not contain any built-in intelligence pertaining to any specific learning environment. Instead, it relies on the Agent Behavioral Control Description (ABCD) for this information. The ABCD is divided into four types of objects: potential student actions, agent interventions, pedagogical goals, and student concepts. Potential student actions are actions or classes of actions which the student might take within the environment, and which the agent should recognize. These actions are comprised of a series of events, each of which may contain a parameter sent from the learning environment to the agent. The sequence of events and their parameters can be generalized using regular expressions. Agent interventions may be of three distinct types - information presentation using text and images, agent-initiated dialog with the student, or agent-initiated intervention of arbitrary complexity by loading and executing an externally authored program. Pedagogical goals represent general learning objectives, for example, what the most important concepts are for a student to learn, what interaction styles to prefer, etc. Student concepts represent correct or incorrect conceptions that students may hold. Our notion of student modeling is based upon the work of Minstrell et al on educational facets (Minstrell 1992), and our student concept database is a facet base, in their terminology. The student model the agent constructs consists of a collection of student concepts; the agent infers these, and each is weighted with a confidence factor.

Since it is the Agent Behavioral Control Description (ABCD) which makes a particular agent unique, we must allow non-programmers to author it. Its rules are similar to rules in a declarative programming language. However, we do not want to require teachers to think like programmers. Our solution is to have the agent guide the author through the process in a natural, conversational manner. The agent directs the authoring process by asking a series of questions. As the author responds to these questions, the agent modifies the conversational flow and builds components of its ABCD, based on the author's input. In addition to direct question and answer, the agent utilizes generalization techniques from machine learning to allow for authoring by demonstration in some circumstances.

This authoring technique, which we call "conversational authoring", bears a resemblance to the command "wizards" which are found in a variety of applications. However, there are a number of factors that distinguish this authoring paradigm from application command wizards. One factor is that the interaction between the author and the system may be long-lived and span multiple authoring sessions. Because of this, a need exists for the agent to maintain continuity between sessions by being able to summarize the previous session and describe its current state to the author in a conversational manner. This self-description is also important for purposes of agent validation. The conversational authoring tool runs concurrently with the agent and learning environment, so the author can test the behavior of the agent at any point in the authoring process by using the environment from the perspective of a student. However, simply testing the agent may not provide enough validation that the desired ABCD structure has been created. The ability of the agent to conversationally summarize its state at any given point in the authoring process adds another tool that the author can use to validate the authoring outcome.

The work described in this paper is currently in progress. The generic agent architecture has been implemented in Java and integrated into a constructionist learning environment called PixelMath. PixelMath is a recent outgrowth of research at the University of Washington designed to teach mathematical concepts through digital image processing. Additionally, a custom agent has been built on top of the generic architecture by hard coding the ABCD in Java. We are currently in the process of implementing the conversational authoring tool, which will be tested for effectiveness by teachers familiar with the classroom use of tools like PixelMath. A complete description of this project, including current status, is available at http://www.cs.washington.edu/homes/jbaer/pedagent/index.html.

References

Johnson, W.L., Rickel, J., and Lester, J. (2000). Animated Pedagogical Agents: Face-to-Face Interaction in Interactive Learning Environments. *International Journal of Artificial Intelligence in Education*, (2000), 11, to appear.

Lester, J., Barlow, T., Converse, S., Stone, B., Kahler, S., and Bhogal, R. (1997) The Persona Effect: Affective Impact of Animated Pedagogical Agents. *Computer-Human Interaction, 1997.* Assoc. for Comput. Machinery, New York, NY. 359-366.

Minstrell, J. (1992). Facets of students knowledge and relevant instruction. *Proceedings of an international workshop - Research in physics learning: Theoretical issues and empirical studies.* The Institute for Science Education. 110-128.

Acknowledgements

The authors wish to acknowledge the contributions of Chenoah Morgan to the creation of the PixelMath learning environment and the preparation of this manuscript. Partial support for the student modeling part of this work from NSF Grant CDA-9616532 is gratefully acknowledged.

From "Learning-by-Viewing" to "Learning-by-Doing": A Video Annotation Educational Technology Tool

Ofer Bergman, Ruth Beyth-Marom, Ahuva Leopold, The Open University of Israel
Doron Hadar, Ben Gurion University, Israel
Amnon Dekel, Interdisciplinary Center, Herzliya, Israel
Synopsus@netvision.net.il

Abstract: Video films are particularly suitable as a way of experiencing the world because they provide a dynamic, although vicarious, encounter through sound and vision. However, the use of video films in their present, mostly passive, form, do not succeed in contributing enough to the learning process. SYNOPSUS was designed to cause a shift from the passive "learning-by-viewing" model to the "learning-by-doing" model while studying with educational films. By utilizing a simple user-friendly interface, the tool allows students to engage, on a computer, in active, reflective, and interactive learning with existing video films. The tool and some preliminary results of an evaluation study will be presented.

Introduction

Video films are particularly suitable as a way of experiencing the world because they provide a dynamic, although vicarious, encounter through sound and vision (Collis, 1996). Moreover, they use a number of technical devices to manipulate that experience. Salomon (1979) called these devices "supplantations", in the sense that they supplant a cognitive process.

However, the use of video films in their present, mostly passive, form, do not succeed in contributing enough to the learning process (Clark & Craig, 1992). In active learning situations students are able to reflect, construct and interact (Laurillard, 1993, Bates, 1997). In such learning environments, students are expected to comprehend the structure of the lesson, integrate its parts and construct their knowledge through experienc-based actions. Present video-film learning environments do not succeed in providing such a model.

SYNOPSUS was designed to improve the passive "learning-by-viewing" model by reinforcing a shift to "learning-by-doing" while studying with educational films.

SYNOPSUS - An Educational Tool

By utilizing a user-friendly interface, the tool allows students to engage, on a computer, in active, reflective, and interactive learning with existing video films. By allowing students to actively summarize a video film, the tool encourages them to engage in active learning. While summarizing the film, students are creating their own personal model of the movie, its structure, and its contents.

When the observer decides to summarize the film (which is seen on the left side of a computer screen), he/she begins typing the summary. Immediately, the film stops running; the written summary appears at the right side of the screen and the last video frame is attached as an icon to the beginning of the text. Pressing the Esc function resumes the film, and the summary with its icon are framed in a box. Each time the observer begins typing, the film stops running and another summary appears with its relevant icon on the right side of the screen. At the end, the student has a list of blocks in each of which there is an icon representing the place of summary in the film, and a written text which can be printed. This list of blocks can be arranged according to their order in the film, or according to the order in which they were created.

By automatically attaching relevant video icons next to a summary block, the tool provides an easy way of visually remembering and keeping track of, and returning to, important points in the film. This capability encourages students to engage in reflective thinking since relevant sections of the film can be found and seen by clicking on an associated video icon that immediately moves the film to the intended section. Reflection is also aided by allowing immediate access to relevant sections in the film via simple word searches on the textual summaries.

The tool also allows instructors to prepare interactive questions and assignments pertaining to the film watched. The questions and assignments pop up when the student reaches a pre-specified point in a the film.

SYNOPSUS can be used for distance learners and for face-to-face teaching during frontal teaching sessions. By using the presentation mode of the tool, instructors can show predefined segments of a film along with their own headers and annotations.

An Evaluation Study

The Open University of Israel (OUI) is a distance learning institution. Some of the courses offered to students are telecourses which include as learning material a textbook, 26 video films and a student guidebook. A telecourse in psychology was chosen for a study of the new tool. Out of 400 registered students, 100 volunteered to try the software. They received two CDs: one contained the software and the other contained a thirty-minute educational film. The first 60 students who were willing to participate in the study (after experimenting successfully with the software), were divided into two groups of 30 students: In group 1 students received films 1 to 6 on CDs, and in group 2 students received films 7 to 12 on CDs. Both groups received all other films on video cassettes. The two groups were similar in average age, percentage of males and number of previous course credits. This design allows for between and within comparisons regarding the experience with the software and CDs on the one hand and video films on the other hand. A third group of eight students with learning disabilities served for an exploratory investigation into the possible advantages of the software for students with such difficulties. They received the same material as group 1.

A questionnaire will be sent to all three groups at three points in time: (a) after the allocated learning period for the first six films (CDs for groups 1 and 3 and videos for group 2); (b) after the allocated learning period for films 7-12 (CDs for group 2 and videos for groups 1 and 3) and (c) after the allocated learning period for films 13-18 (videos for groups 1, 2 and 3). Group 3 subjects will be interviewed individually regarding their experience with the software and its possible help in overcoming some of their special learning difficulties. At the end of the semester students will be asked to send their summaries to the research team.

The purpose of the experiment was to test learners' attitudes towards the learning tool as well as their learning processes while using it. The design of the experiment permits absolute evaluations as well as comparisons with learners who watch the films on the TV screen without the tool. The following hypotheses will be tested:

1. SYNOPSUS facilitates the process of summarizing the film.
2. Subjects summarize more and better with SYNOPSUS than without it.
3. SYNOPSUS facilitates concentration while watching the film.
4. SYNOPSUS facilitates the process of locating a specific subject in the film.
5. Subjects go backward and forward in the film in order to access specific segments of it more often while learning with SYNOPSUS than while learning without it.
6. Subjects enjoy the film more on a television screen without SYNOPSUS than on the PC screen with SYNOPSUS.
7. Subjects feel they learn more from a film they watched on a PC screen with SYNOPSUS than from one they watched on a TV screen without it.

SYNOPSUS will be presented along with some of the experiment's results that will be available at the time of the conference.

References

Bates, T. (1997). *Open Learning and Distance Technology Education*, London, Routledge.

Clark, R.E., & Craig, T.G. (1992). *Research and theory on multi-media learning effects*. In M. Giardina (Ed.). Interactive multimedia learning environments. Human factors and technical considerations on design issues (pp. 19-30). Heidelberg: Springer.

Collis, B. (1996). *Tele-learning in Digital World: The Future of Distance Learning*, International Thomson Computer Press.

Laurillard D. (1993). *Rethinking university teaching: A framework for the effective use of educational technology*, London: Routledge.
Salomon, G. (1979). *Interaction of Media, Cognition and Learning*, San Francisco: Jossey-Bass.

Censorship or self-discipline on the Internet? Strategies for limiting access to morally undesirable Internet resources.

John Boatright, MA
University of Minnesota
1283 Goodrich Avenue
Saint Paul, MN
boat0011@tc.umn.edu

Abstract: The purposes of the Internet are many; commercial, recreational, informational, educational, communicational, relational. The Internet is a paradoxical universe of structure and anarchy: producing some good and some bad, some beautiful, and some ghastly. There are many, educationally relevant Internet resources. "by the year 2000, anyone in western civilization will be able to get the answer to any question that has an answer" according to influential *Byte* columnist, Jerry Pournelle. In the 1997 Current Population Survey by the US Census Bureau computer use was surveyed. The study showed that three quarters of the children in the USA have access to computers at home or school - significantly more at school than at home. Children most frequently used home computers for educational purposes (93.3%) and games (83%). One fifth of the children who have home computers used them to access the Internet. For adults, 18 and over, 92 million people used the computer at home or work. More than half these adults accessed the Internet from home, with 80% of them using the web to access government, business, health or educational information. Significant increases on the order of 5-15% were recorded for every category of questioning over the 5 years span between surveys. In all, one of five Americans (ages 3 and higher) used the Internet in 1997[8].

This presentation/essay concerns controlling a kid's access to "morally undesirable" information. But before we can get to that, it is important to consider the need for such control. In the schools of our nation, our children are using the Internet to reach out of the walls and experience the universe. Free ranging access to the wonders of scicnce and humanity can be had through simply searching the Internet using search programs. Any teacher or student deserves these resources and they deserve to follow the curiosities that are a contingent element of human intelligence. The question that arises involves the various interests of the purveyors of these archives. Some of these interests are illegal and even more are morally undesirable.

Introduction

The purposes of the Internet are many; commercial, recreational, informational, educational, communicational, relational. The Internet is a universe of anarchy and chaos: producing some good and some bad, some beautiful, and some ghastly. There are many, educationally relevant Internet resources. "by the year 2000, anyone in western civilization will be able to get the answer to any question that has an answer" according to influential *Byte* columnist, Jerry Pournelle. In the 1997 Current Population Survey by the US Census Bureau computer use was surveyed. The study showed that three quarters of the children in the USA have access to computers at home or school - significantly more at school than at home. Children most frequently used home computers for educational purposes (93.3%) and games (83%). One fifth of the children who have home computers used them to access the Internet. For adults, 18 and over, 92 million people used the computer at home or work. More than half these adults accessed the Internet from home, with 80% of them using the web to access government, business, health or educational information. Significant increases on the order of 5-15% were recorded for every category of questioning over the 5 years span between surveys. In all, one of five Americans (ages 3 and higher) used the Internet in 1997[8].

This essay concerns controlling a kid's access to "morally undesirable" information. But before we can get to that, it is important to consider the need for such control. In the schools of our nation, our children are using the Internet to reach out of the walls and experience the universe. Free ranging access to the wonders of science and humanity can be had through simply searching the Internet using search programs. Any teacher or student deserves these resources and they deserve to follow the curiosities that are a contingent element of human intelligence. The question that arises involves the various interests of the purveyors of these archives. Some of these interests are illegal and even more are morally undesirable.

Illegal interests are pursued and prosecuted in the United States by state and local law enforcement, the FBI, the US Marshall or the Federal Trade Commission depending on which jurisdiction the activity entails. The international nature of the Internet may bring other law enforcement agencies into the investigation and prosecution. In the US there are specific police resources devoted to cyber-crime.

On the morally undesirable side, there is no such concerted effort – in fact there seems to be a fair level of disagreement. While there is much media attention given to (thus far ineffective) efforts aimed at outlawing these undesirable Internet activities, there is a strange avoidance of discussion into exactly which information should be restricted. Consensus has arisen around some pseudo-illegal activities such as distribution of child pornography. But aside from that…almost certainly the literature simply starts off with the assumption that children need to be protected from whatever morally reprehensible activity the writer is imaging but not really describing. And, honestly, aside from acknowledging this vagueness, this writer is not much different.

The generally agreed philosophical rationale is that children from ages 5 to 18 must be protected from this information because they are not ready to contextually understand these darker fantasies and features of our culture. (In extreme cases -- I am wondering who is?) Kids are ignorant to the dangers that may be encountered through their venturing into knowledge unconditioned by experience. A loud debate rages about "how to stop access" to these dark media resources. When the next kids-killing-kids, school shooting incident occurs, our attention will be brought sharply back to the studies that widely implicate media's influence on a child's moral development. This research is not clear on the nature of the developmental harm associated with a premature familiarity of the darker side of humanity. We could wish for more specifics as to which type of media, how it specifically affects development and when in the child's development are they vulnerable to such influence.

For purposes of this essay, it will be assumed that *kids* need protection from morally undesirable elements of our culture even if adults do not. That further, the special media circumstance of Internet delivery of these morally undesirable archives directly into our schools and homes deserves our special attention. We will assume, as do many others, that an inadvertent curriculum can formulate around these dark and undesirable interests.

Since these fascinations with the darker elements exist in our culture, there is necessarily a developmental time when youth should gain controlled experiences in them. The school however is excluded from that objective – it is left to parents to control this curriculum. There are logical flaws in this plan (e.g. that parents often do not address these legitimate needs) will also be excluded from this essay.

This essay will assume that someday these "morally undesirable" graphical and information archives can be identified through public discourse and reasoning. Something beyond the "we will know them when we see them" criteria. Though there is no theory on whether it really is undesirable for children to be exposed to any of the following areas…and though there is no sharp delineation of the level at which information becomes damaging…the general content areas are well elaborated in the literature and involve concern about the following issues.

Inappropriate sexual displays.

> There is a well-publicized and very active pornographic sector accessible through the Internet[7]. These resources may involve text or graphical displays that are developmentally inappropriate for children (and frankly adults!). This area receives much attention by the naysayers of open Internet access. It is said to represent a significant but small proportion of Internet informational traffic (I have seen figures of less than 10% - I cannot seem to find the source right at this moment though) Additionally, these sites often involve unscrupulous schemes to charge the viewer -- while claiming to be free of charge. It is a common family dilemma to have a surprise encounter with the financial consequences of a child's experimenting with Internet sex sites. Again, research is disappointing here, but in my circle of friends and family, children have spent thousands of dollars in this way. Anecdotally, costs associated with these episodes are confabulated with similar costs charged by cable and phone sex experimentation.

Predatory persons

> There is a danger that children may be lured into meeting some predatory person, whose desire is to do them physical harm. While this danger is theoretically real, there is no frequency data available in the literature. It can be assumed though from reports of *adults* being lured out to meet predatory persons, that children would be also similarly vulnerable to such risks[22].

Financial Scams

There are a number of financial schemes communicated through the Internet. Pyramid schemes are popular -- so are offers "too good to be possible." Low interest, poor credit credit card offers are also frequently offered on the Internet. It can be assumed that the limited experience of kids would make them targets for these deceptive or illegal activities. Again, there is no data readily available on the incidence of children being victims. It is sufficient to say, that there are many adults that get scammed. We can be sure that if there were unlimited access to children for the scam artists and a source of credit for the children, there would be a significant level of risk to the financial well being of families and children[27].

Privacy concerns

The issue here is that children might give out information that could physically target them for predators. Another concern may be that the child, not being aware of the risks, may innocently or out of bravado arrange a connection with an unsavory character[21,22].

System integrity and security issues

There might be risks to the stability of the network due to downloading programs that originate from certain Internet sites. There is a fair amount of Internet traffic visible on lists associated with "hacking." (search keyword "crackers") The substance of these messages often reflects an interest in illegally obtained software and passwords to various nefarious sites. An easy and more popular invasion of networks involves reflecting junk e-mail ("spam") from the users domain so that it will appear to be from your computer system. I work for a women's college in the upper Midwest and we discovered that advertising for a pornographic site was using our domain as a reflector...to the extent that in one night 60,000 emails had been distributed! This, of course, was unacceptable to our network administrators. Protection from this type of hacking has been installed. Another concern is viruses and virus hoaxes. Aside from the damage an actual virus can do to networks, the volume of messages that virus hoaxes can generate is in itself, a plague.

Harassment

It is possible for a predatory person to stalk and harass a person via the Internet. Especially if used in combination with other modes of information accessible through the Internet or other information providers. Phone numbers, addresses, maps may assist the stalker to find their target repeatedly. It is more and more difficult to "disappear" if one needs to. One source listed the costs for information on the a person as $15 for social security number, to $150 for a complete background check.

Internet "addiction"

While dubious as a real disorder, some people spend inordinate, obsessive amounts of time on the Internet[3,4,11,12,13,14,15]. Sometimes this interferes with normal activities of daily living. The fear is, that introducing Internet use in schools give tacit approval for obsessive use of the Internet. There is no empirical data available in the literature, but based on anecdotal evidence (again from families and friends) teenagers are known to sacrifice duties and sometimes sleeping in order to use the Internet. Recently, the American Psychological Association gave some context to the question during a symposia on the topic. They concluded that pathological internet use was possibly an addiction, a disorder or a symptom of depression.

Abuse of credit

A problem not exclusive to the Internet, there cannot be any doubt that the Internet is a good place to spend a lot of money. Many Internet retail and service sites exist and accept credit cards. It is easy to rack up an impressive bill in a few hours of Internet shopping. Amazon.com for books, records, presents; Quill for office supplies; LandsEnd for clothing; EggHead for software; Dell for a computer; Auto.com for a car; ebay for a boat; pretty soon you've spent some bucks!

Depression

There have been articles in the psychology literature about a relationship between Internet use and depression[5,6]. The debate rages on with both side positing credible pros and cons. The crux of the issue here is the chicken/egg problem. That is did the depression precede the use of the Internet or was depression a result of Internet use? Currently the theory that seems most favored is that use of the Internet is more a symptom than a cause of depression.

Academic integrity

A virtual industry has evolved selling term papers to students. Keyword search on "term papers" revealed 100s of sites devoted to free and for sale papers. Many services offered custom services. According to "Paper-Masters" their custom written term papers are meant to be research to assist you writing your own paper. They conclude that it is not in any way unethical to use their services.

Identity

The relative anonymity provided by the Internet is a challenge to individual identity. This feature also allows people to fabricate an identity that is quite different from their own. The concern is that this fantasy identity may interfere with the identity forming process that is an important in the child[34].

Community

There are fears that rather than encouraging community and multicultural exchange the Internet actually encourages isolation.[2]

Intellectual property

Many teachers report a cut and paste form of writing where the students simply search out information on the Internet and then copy it directly into their papers without quotation. Additionally copyright infringement rules are very difficult to understand within the context of the Internet.

Social accountability

The anonymity and 2 dimensionality of the Internet does not foster authentic relationships. This issue is the converse of the safety afforded by the electronic distance of the Internet. One concern for kids is the negative role model that this demonstrates. The superficiality of complex individuals as represented on the Internet is also an impression that is unrealistic. On the Internet, as with other media, the distinction between real an imaginary is difficult to detect.[36]

Review of the literature

While it this essay is focused on educational issues in American schools, it is interesting to observe that in Europe several countries (GDR, GB and others) have also sought to control certain types of Internet communications. Great Britain actually has a complaint bureau, The Internet Watch Foundation[1], where consumers can expect to see prosecution of child pornography, and other harmful activities. The bureau expressly stays clear of controversies into items of political or social question though. Internet access is severely limited at the source - the Internet access hub, in several Middle Eastern countries (Saudi and Egypt). All accessible sites are government approved even email is scrutinized.

In the United States, a first Amendment disagreement has arisen over Internet control. The US Supreme Court has made four determinations in favor of free Internet access for anyone able to get there. Though there are plenty of details left to interpretation, the court has made sweeping statements about the freedom of the Internet. Congress continues to contemplate legislative action, intended to circumvent the Supreme Court's First Amendment rulings and control some types of Internet communications. As stated before, illegal activities are prohibited and prosecuted in multiple ways, the debate concerns pseudo-legal and legal but controversial Internet resources such as child pornography, bomb-building directions, racism, slander, misinformation.

Strategies for limiting the access of kids to morally undesirable Internet archives

Free access to all:

It would seem that this is what we have. This is a common misconception of the Internet. Certain types of information cannot (currently) be transmitted via the Internet. The interface is restricted to materials that are comprised of an audio, visual and/or digital nature. Certainly this covers a lot of ground, but in reality this is a significant limitation from the start. Not everything the human has a capacity to sense can be transmitted by the Internet.

Additionally, and of more relevance to the theme of this essay; illegal activities are prohibited on the Internet. As stated above, several governmental policing agencies monitor and in fact utilize the Internet to investigate and prosecute criminal activities[1]. Email threats are taken quite seriously – the appearance of treasury, secret service officers at a local high school last year to arrest a student for having sent a death threat to President Clinton is lesson enough to prove this point. Drug and firearm enforcement agencies also monitor the Internet for signs of criminal activity.

Direct adult supervision:

There is a tacit rejection of direct adult supervision as a control strategy in almost all the literature[30]. It is felt unrealistic that an adult mentor could monitor a kids Internet adventures, or help them gain context if they bump into something morally undesirable. The literature in this area occasionally mentions that this is an option, but that then goes no further than to state it is simply not feasible for presumably practical reasons. There is, however, agreement that this method of control would be desirable and effective. This writer is not so sure that this is the contingent difficulty with the idea. Challenges here may be more associated with the problems of communicating with our youth. Adults are really hesitant to talk about morally challenging topics – a sudden view of human sexual interaction might initiate questions – and that would lead to a difficult conversation. Teachers should bc allowed to have this kind of conversation with our youths, but the onus of responsibility is on the family where it <dismay> rarely occurs.

User Self Policing - Moral development and the Internet

It could be left to the user to restrict their own access by virtue of their own experiences[35,36]. This highly improbable suggestion centers on development of a personally held and derived dislike for morally undesirable Internet resources. It can happen, and most probably does, after the thrill is gone so to speak. The impractical part of this suggestion is not the philosophically sound grounding that exists in allowing people to morally develop, but rather the political impossibility of implementing such a plan in a country founded by the Puritans. Additionally, there is much to be said for the idea that a staged approach with contextulization would need to be implemented to coincide with the developmental capacity of each individual kid. Given the performance record of our public schools…it is utopian to imagine such a strategy could be harmlessly implemented.

Legislation:

Communication Decency Act (CDA) and Son of CDA – overturned by the US Supreme Courts. Ruled as unconstitutional by virtue of their violation of First Amendment rights[10]. Politicians continue to bring up legislation that the American Civil Liberties Union defeats in court challenges. Literally millions of dollars have been expended in the quest for legislation that can get through the first amendment tests. Often the problem is that the definitions for morally undesirable materials cannot be specifically measured, and could thus be applied too widely.

Acceptable Use Policies (AUP):

As an aide to self control, a signed statement of appropriate internet use AND the consequences of abuse of privileges is used. Samples of AUPs are available on the Internet. AUPs are used in nearly all networked computer labs. It is necessary that some person observe the Internet use in such situations. This can be done by walking around the lab or by looking at the log of Internet addresses that has been accessed on a particular computer. It would seem very possible to automate this observation of a lab by sharing the log with a central teachers workstation, but therc was no mention of this strategy in the literature. See references[31] for a link to an example provided by Rice University.

Rating Systems:

A strategy familiar to moviegoers is common of the Internet – warning the consumer of adult content. Most commercial (even free) adult sites require the user to physically confirm select their intent to utilize the morally undesirable archives. Some Internet businesses have arisen that claim to restrict the access of minors to their sites by virtue of credit card credentials. Of course, a credit card has little to do with verifying age – these sites are more interested in connecting interested parties (and their credit cards) with their cadre of pornographic vendors. The intent is to protect the inadvertent viewing of these resources, but of course, many curious 15 year olds are undeterred by these warning and click right through.

Screening Software:

It would be nice if software could be developed to filter morally undesirable Internet content, but thus far efforts have been only partially successful.[26,27,28,29,30] Current filtering software can be grouped based on the strategy used to filter. One group uses keywords, taken from a ready made list of dirty words, to eliminate access to undesirable Internet archives. Often the list can be modified by the administrator to add new words or to add in a miss spelling of the particular dirty word of concern. This is effective but suffers from the problem that sometime dirty words also have morally desirable alternative uses. For instance "breast" as a keyword will also eliminate sites concerned with breast cancer. Another approach is to keep a list of either acceptable and unacceptable sites. For instance sites ending with the ".gov" suffix are approved, Disney.com is approved, a list of sites that are not approved is provided and updated by the software company and can be modified by the administrator. Unfortunately, the undesirablc element of the Internet moves around a lot, and new morally undesirable sites are launched every day, so it is easy to imagine that something will get past the filter.

Network Filter programs:

Similar to screening software, more sophisticated filters can be installed at the network hub[30]. This is the strategy used by those Middle Eastern countries to prevent access to certain internet resources.

Intranet strategies:

One strategy taken by some schools has been to simply offer only internal versions of Internet available resources. It's a sort of smaller, internally stored version of the Internet. WebWhacker[30] whacks entire sites out of the Internet and stores them on your computer network. This strategy is fine as long as the learner only asks questions available within the limits of the stored information. An encyclopedic resource, and other informative resources are made available. Often access to the external Internet is possible for special situations, and can be more effectively monitored.

Internet watch groups:

Another way used in concert with screening software is to have a group of evaluators monitor the moral permissibility of Internet sites[30,33]. What happens is that a software company or a school enlists the help of a screening committee. Their function is to expand the list of forbidden and permitted Internet resources.

Free market pressure and industry self regulation:

Especially during the legislative debate on CDA, many Internet Service Provider companies became concerned over the trouble it might be if they could be held responsible for Internet content. America Online, the largest Internet Service provider, initiated a program of parental controls that allow various levels of access control over the Internet and AOL network resources[1,17,18]. Also, they developed a system of "moderators" to monitor kid chatrooms, as well as a responsive complaint system. In other words, they felt it was good for their business interests to allow the user to determine limits on access.

Conclusions

So what is the big picture here? First, this is a new experience to all of us, second the Internet needs to be a vital part of the learning experience for kids, Third we will not be able to bring ourselves to restrict anything but illegal activities from the Internet – and even here it's a post hoc analysis.

Clearly the best choice is to design a system where Internet use is closely monitored, but not for punitive purposes, but for contextualizing by adults who are skilled and vested in helping kids see our world, all of it at the right time. Since this is so impossible given our current factory model schools, I would recommend the strategy where much of the information needed by students is anticipated and locally stored on school friendily servers – a second network soto speak. When kids need to venture onto the Internet let them, and be there for them.

There is much research that needs to be done, but some of the important questions IMHO (in my humble opinion) have to do with cultural changes that will come as a result of this new dimension. Questions about moral development, community and diversity seem largely unstudied. Philosophical and psychological issues such as what really is inappropriate and at what developmental age are barely disturbed. Finally, I wonder what the future will hold for new ways to communicate human sensations and feeling will be.

References:

1. Psychology and the Internet: Intrapersonal, Interpersonal and Transpersonal Implications - Jayne Gackenbach (edit) Academic Press, San Diego, CA 1998.
2. "Internet paradox: A social technology that reduces social Involvement and psychological well-being?" – Kraut, Patterson, Lundmark, Kiesler, Mukophadhyay, Scherlis, *American Psychologist.* Vol 53(9), Sept. 1998, 1017-1031.
3. "The bits and bytes of computer/Internet addiction: A factor analytic approach." – Pratarelli, Browne, Johnson, *Behavior Research Methods, Instruments, and Computers.* Vol 31(2), May 1999, p305.
4. "Internet addiction: fact or fiction" – Griffiths, *Psychologist*, vol 12(5), May 1999, p240.
5. "Internet depression link?" – Rierdan, *American Psychologist*, vol 54(9), Sept 1999, p781.
6. "The Internet and relational theory." – Silverman, *American Psychologist*, vol 54(9), Sept 1999, p780.
7. "Its time to tackle cyberporn" – Carr, *New Statesman*, Feb 20, 1998, vol 127, p24.
8. "Computer use in the United States – October 1997", US Department of Commerce, US Census Bureau, Eric Newburger, Bulletin #P20-522, Sept. 1999.
9. "The trouble with censorware"- Eisenberg, *Ms. Magazine*, Sept/Oct 1998, p38.
10. "Senate committee approves filtering bill" – Flagg, *American Libraries*, April 1998, p13.
11. "Web addiction" – Gawel, *Electronic Design*, August 1999, p32
12. "So that's why they call them 'users'" – Koerner, *US News and World Report*, Mar 22, 1999, p62.
13. "Computer addiction: Is it real or virtual?" – *Harvard Mental Health Newsletter*, Jan 1999.
14. "Some scholars question research methods of expert of Internet addiction." – Young, *Chronicle of Higher Education*, May 29, 1999, pA25.
15. "Internet Addiction" – Greene, *Computerworld*, Sept 21, 1998, p78.
16. "Living the Cyberlife" – Hickman, Kaufthal, Levin, Perenson, Rupley, Willmott, *Forbes*, Dec1, 1997. p45.
17. "Video game industry makes a push at self-policing." – King, *The New York Times*, Sept 20, 1999pC1, col2.
18. "Internet industry hopes self-policing will work." – Ota, *Congressional Quarterly Weekly Report*, Dec 6, 1997 p3028.
19. "Self-interest and consumers" – Smith, *Consumers Research Magazine*, April 1996, p33.
20. "How do you police cyberspace?" – Yang, *Business Week*, Feb 5, 1996, p97
21. "Getting a handle on haters" – McKeown, *Times Educational Supplement*, May 14 1999, pE30.
22. "Threshing out the myths and facts of Internet safety." – Berson, Berson, Ralston, *Social Education*, Apr 1999, p 160.
23. "Protect your digital identity" – Kirchner, *PC Magazine*, Sept 21, 1999, p 29.
24. "Use Internet filters to erase hate from the classroom" – McCarthy, *Government Computer News*, May 24 1999, p44.
25. "*On the Internet, don't get personal*" – Attaran, IIE Solutions, May 1999, p22.
26. "Web censorware: software filters don't work." –Quittner, *Time*, July 13, 1999 p84
27. "The a to z of Internet Sleaze" – Pappas, *Home Office Computing*, Aug 1997, p70.
28. "Protecting kids and free speech" – Swaine, *MacUser*, Dec 1996, p147.
29. "How to practice safe surfing" – Baig, *Business Week*, Sept 9, 1996, p120.
30. "Exploring the Internet safely – what schools can do." – Mather, Technology and Learning, Sept 1996, p38.
31. "THE USE OF COMPUTERS, THE INTERNET AND ELECTRONIC MAIL PERMISSION FORM 1995-96" - http://www.rice.edu/armadillo/aupenglish.html
32. "Policing cyberspace" – Curtis, *Macleans*, Feb 19, 1996, p 56.
33. "Virtual vigilantes" – Lane, *Forbes*, Aug 28, 1995, p19.
34. Philosophical Perspectives on Computer Mediated Communication – Ess (edit), SUNY press, 1996
35. Cyberspace, The Human Dimension – Whittle, Freeman Press, 1996
36. Life on the Screen – Identity in the Age of the Internet – Turkle, Simon and Schuster publ, 1995.
37. Computers, Curriculum and Cultural Change – Provenzo, Brett, McCloskey, Erlbuam Assoc. Publ, 1999.

Using Speech Recognition to Support Online Learning of Second/Foreign Languages

Francis Bonkowski, IC Education, Inc., Canada
Quinn Cheung, IC Education, Inc., Canada
Liam Cheung, IC Education, Inc., Canada

This paper presents IC Education's state-of-the-art pedagogy and technology to support online language learning. IC Education has developed speech recognition over the Internet using a new client/server application that recognizes the voice of user's without having to install complicated software on a personal computer. The system entails minimal software installation by the user and provides centralization of the speech recognition engine. This innovative technology is a powerful, albeit simple tool used to teach learners proper pronunciation and new vocabulary.

A BUILDING-BLOCK METHOD FOR COURSEWARE DEVELOPMENT FOR LESS-EXPERIENCED DEVELOPERS

Eddy Boot & Yvonne Barnard
TNO-Human Factors, Soesterberg, The Netherlands
Kampweg 5, P.O. box 23, 3769 ZG Soesterberg
Email: boot@tm.tno.nl, ybarnard@tm.tno.nl

Abstract: *Although courseware has the potential to increase the efficiency and effectiveness of courses, until now the results of its application is often disappointing. In our research concerning courseware development within the Royal Netherlands Army (RNLA), we investigated some of the underlying reasons for this, and specified an approach to promote its applicability. One of the main problems is the high cost of courseware development, resulting from the long development time and the specific expertise required. We constructed a 'building-block' approach, which enables instructors with limited multi-media expertise to rapidly develop courseware for simple learning objectives, but with the use of advanced multi-media technology,. This approach consists of templates that incorporate sound didactical principles, lower the technological complexity of courseware development, and can be used within modern authoring tools. Currently we are implementing the method and are studying how to enlarge the scope of the method towards more advanced learning goals.*

The use of courseware

Recently, the interest for the use of courseware within many educational and corporate organizations is increasing in a rapid pace, as it has the potential to increase the efficiency and effectiveness of courses significantly. Organizations want to develop courseware in-house, as in most settings Commercial Of The Shelf (COTS) courseware is not specific enough and currently modern, powerful authoring tools are available. However, in many cases such attempts have been disappointing in terms of contributing to efficiency and effectiveness of (the development of) training programs. For instance, in the last few years, the Royal Netherlands Army (RNLA) has spent considerable time and effort in developing courseware for its Training Centers. This courseware mainly directed at concept learning and procedural tasks. However, the application of courseware has not yet lived up to its expectations. It has never been very cost-effective and (therefore) organizational acceptation or broad adaptation of courseware within training programs is still not accomplished.

Bottlenecks in developing courseware

TNO-HF has been asked to investigate this problem and to formulate, implement and test solutions for it. We found a number of problems concerning courseware development (Boot & Van Rooij, 1999). The development of courseware is mostly done by Subject Matter Experts (SME's) and instructors, using modern authoring tools. Despite the efforts and promises of these tools to reduce development time and the level of required expertise (e.g. Asymetrix, 1998), it still takes considerable time (and therefore costs) to produce courseware. We found that considerable programming knowledge is required for anything more that very simple courseware. Also, much time is required to familiarize with the tools and its many features and the translation of didactical models into courseware is complicated. In the RNLA, the SME's and instructors lack the didactical-, multi-medial- and programming expertise to make optimal and efficient usage of these tools. One can conclude that the development of anything more advanced than very simple courseware programs, remains costly and will be only cost-effective for large target groups.

The building-block approach

If one aims at courseware with advanced technological features (in terms of multi-media usage and interactivity), developed by people with limited programming expertise, a so-called 'building-block' approach can be a solution. This approach pre-structures the development-process by offering templates within authoring tools. Templates consist of empty courseware-structures to be filled with content. These structures incorporate sound didactical principles and advanced technological features. Once connected to each other (hence the name building-block approach) and filled with content (the learning materials), they constitute a complete courseware program. We investigated some build-in pre-structuring features of modern authoring tools that make the same claims, but they are too limited for our purposes. Therefore, our templates should be more advanced and comprehensive, in order to promote proper implementation of didactical models and lower the technological complexity. As standardization, re-usability and exchangeability of courseware(elements) is a key issue, these templates should be embedded within COTS authoring tools.

Specification and implementation of the approach

We specified a building block approach for the RNLA, with templates for four levels of courseware-structure (Boot & Van Rooij, 2000);

1. At the top level, templates provide different kinds of navigation through a number of lessons.
2. At the second level, templates provide different kinds of navigation of learning activities within lessons.
3. At the third level, templates provide interactivity within learning activities.
4. At the bottom level, templates provide the presentation of multi-media elements within learning activities.

Altogether, they contribute with standardized screen-elements to the complete user-interface of the program. The didactical functionality, embedded in the templates, is directed at relative simple learning goals; learning facts, concepts, procedures and principles. The instructional strategies that are embedded are based on theories like Gagné's Nine Events and Merrill's Component Display Theory as found in Reigeluth (1983). Technically, the templates arc build using Knowledge Objects® within the authoring tool Authorware® Version 5, and are provided with Wizards for guiding the interaction with the developers. For reasons of acceptance and commitment of the future developers, we have involved them during the specification process of the building-block approach. We found that it is important and difficult to balance well between how much templates should prescribe and which freedom remains for the developers.

Currently, we are in the implementation phase; external software developers are building the templates, after which they will be used by some developers within the RNLA. We will start a number of pilot projects to evaluate the application of the approach and the resulting courseware. Based on these results, the templates can be improved and the building block approach will be applied on a wider scale.

Future developments

One important aspect of our research is yet unresolved; how to specify a building-block approach that is also directed to more complex courseware? During specifying the described approach, we found that finding a sound theoretical basis is troublesome. It is a challenge to embed didactical models and instructional principles into software-templates that are content-empty. Our future research will be directed at embedding didactical models for advanced learning goals, using principles from learning theories like constructivism and situated cognition. Our goal is to formulate concrete guidelines for the problem-based or case-based approaches from such theories, and implement and test these within an advanced version of our current building-block approach.

References

Asymetrix (1998). *Distributed Learning, The opportunity for Training & Education*. Asymetrix.

Boot, E.W. & Van Rooij, J.C.G.M. (1999). *Structured development of courseware by templates: Analysis*. (Report TNO-TM 1999). Soesterberg, The Netherlands: TNO Human Factors.

Boot, E.W. & Van Rooij, J.C.G.M. (2000). *Structured development of courseware by templates: Specification*. (Report TNO-TM 2000). Soesterberg, The Netherlands: TNO Human Factors.

Reigeluth, C.M., (1983). *Instructional Designs and models: An overview of their current status.* Hilllsdale, NJ: Lawrence Erlbaum Associates.

Collaborative University Teaching over the Internet

Jacqueline Bourdeau, Department of Education
Université du Québec à Chicoutimi, Chicoutimi, Québec, CANADA G7H 2B1
jbourdea@uqac.uquebec.ca

Abstract: A concept has been developed to achieve various forms of collaborative teleteaching, such as sharing ideas about teaching, using learning scenarios, and engaging in joint teaching actions. Professors play a key role, since they are instrumental in integrating new technologies into teaching An environment is being developed to encapsulate an instructional design technique to facilitate sharing processes. A database technology provides distributed services over the Internet.

From Teaching to Teleteaching

University teaching has traditionally been defined as an on-campus activity where all players (1 professor and X students) are in the same place at the same time, with or without any media. In fact, all teaching has been based on these parameters. New technology (NT) brings many potential changes to these parameters, since it creates an opportunity for innovative distributed teaching modes. This potential has increased the need for instructional design, and consequently the progressive transformation of traditional teaching modes into instructional design-based teaching. Integrating NT into teaching implies changing teaching practices. Integration has taken various forms in higher education, such as: Web-based instruction, online education (www.telelearn.ca); videoconference-based teaching (Bourdeau & al., 1998); the virtual campus (www.tecfa.unige.ch), or integrative distance learning environments (www.licef.teluq.uquebec.ca). Satisfaction levels in students and faculty vary from enthusiastic to negative. Faculty is being pressured to digitize material in the form of electronic books, or add electronic communication to their classroom teaching. However, teaching continues to be based on the synchronization of professor and students in a given space. There is room for integration modes, which could be better anchored in current practices, while simultaneously fostering greater faculty involvement.

PETRUS: The Concept

Petrus is a new concept developed to integrate new technology into university teaching. The fundamental characteristic underlying the idea is to consider professors the driving force behind educational integration, since they are the agents who design teaching specifically for their own students. The integration of new technology derives its meaning (direction and semantics) from their teaching and personal interpretation. The second one is to consider new technology a catalyst rather than a tool: the spirit of the Internet is all about sharing and cooperation. A good number of professors are clearly prepared to integrate this spirit into their teaching. And lastly, the third characteristic of Petrus is to provide professors with a computerized environment where the groundwork for an instructional design technique has already been laid through scenario-building. Depending on their preferences or needs, professors can use the ScenarioBuilder in Petrus to: 1) assemble dynamic instructional scenarios, 2) gain shared access to comprehensive, validated scenarios, 3) select individual components from scenarios.

Implementation Plan and Work in Progress

Implementing sharing practices requires sharing processes and an environment designed to support these processes. Scenario-building skills can be acquired through a high-quality system where instructional principles have been built into an expert environment. Professors can access, consult, edit or assemble scenarios in the most flexible ways. They also have the option of designing their own teaching environment and learning interface for students. Teleteaching services naturally have to be anchored in current teaching practices and jointly designed with professors. The following plan was designed for a course on learning theories: 1) Collect and analyze a series of syllabi on learning theories; 2) Extract and classify items according to objectives, content, learning/evaluation activities and material; 3) Conduct a needs assessment of useful teleteaching services; 4) Choose software engineering solutions; 5) Develop and test a prototype for one course; 6) Develop and test a prototype for five courses on distributed sites; 7) Develop a full environment including rights and privileges. The plan is currently under way after a team of professors agreed to jointly design and test the scenario-builder. Steps 1 through 5 have been completed, and a Web-based prototype environment is being developed. The environment will be served by a database that dynamically feeds information into the system. First results will provide information on the quality and level of interest in collaborative teleteaching for a course on learning theories in teacher education programs.

Related Projects

To the best of our knowledge, the concept that comes closest to Petrus is ARIADNE, which stands for Alliance of Remote Instructional Authoring Distribution Networks for Europe (http://ariadne.unil.ch/). The project focuses on the development of tools and methodologies for producing, managing and re-using computer-based educational components and curricula. Collaborative approaches are encouraged, as is the share-and-reuse principle (Duval, 1999). Petrus is radically different in that professors are at the centre of all processes; they are the agents through whom everything passes, and both their personality and teaching style are incorporated into the design. Petrus is not looking to set standards, but seeks diversity instead in terms of intellectual perspectives and teaching styles. Secondly, Petrus contains a scenario-builder that incorporates teaching strategies which can also be shared. The STAR.Legacy project (http://peabody.vanderbilt.edu/ctrs/ltc/) at Vanderbilt University has some features similar to those of Petrus: the learning cycle resembles the Petrus Scenario-Builder and, and the "multiple perspectives" activity in the STAR Legacy learning cycle is characteristic of a team-teaching situation. The working hypothesis underlying the Petrus project is as follows: the successful integration of digital technologies into university teaching must go through the professor – an expert in a particular domain who is responsible for conveying information, inspiring and coaching students to help them achieve their personal, academic and career goals. Professors need to customize the learning environment for their students, and change it as needed. Professors would ultimately be engaging in team teleteaching. Videoconferencing and video servers would provide a multitude of perspectives for students, thus enabling them to acquire greater discernment and critical skills.

Sharing, Collaboration and Teleteaching

In the context of computer-supported collaborative work, sharing is seen as a sub-process of collaboration, which is itself a combination of communication and coordination. Coordination science defines coordination as managing interdependencies, and this concept can be extended to the management of interdependencies among actors (Bourdeau & Wasson, 1997). In the Petrus project, sharing processes can be identified together with their associated interdependencies. The software environment would be built around these interdependencies and provide the means to manage them. Examples of sharing processes include: sharing ideas, scenarios, teaching or coaching activities and lessons learned. Mentoring (at the novice or expert level) can also be considered a sharing process. Examples of sharing principles include: reciprocity, privileges, task distribution, resource allocation, and so on. Software to manage and support sharing processes will be designed when sharing processes are identified and validated, and means for managing interdependencies are developed. Ethical and legal issues will also be taken into account.

References

Bourdeau, J. & Wasson, B. (1997). "Orchestrating collaboration in collaborative telelearning." In B. du Boulay & R. Mizoguchi (Eds.) Proceedings of the 8th World Conference on Artificial Intelligence in Education, 565-567. Amsterdam: IOS Press.

Bourdeau J., Ouellet, M. & Gauthier, R. (1998). "Interactivity in Videoconferencing-based Telepresentations." Proceedings of Ed-Media & Ed-Telecom '98, 151-154.

Duval, E. (1999). "An Open Infrastructure for Learning - the ARIADNE Project - Share and Reuse Without Boundaries." Proceedings of ENABLE99: Enabling Network-Based Learning, 2-5 June 1999. 144-151.

Credits

The project was launched in 1998 through a subsidy by the Université du Québec FODAR Fund to a team lead by Jacqueline Bourdeau and comprised of the following professors: Samuel Amégan, Pauline Minier, Luc Morin, UQAC; Hélène Poissant, UQAM; Albert Boulet, Jacques Chevrier, UQAH; Serge Tremblay, UQAT; Jean-Yves Lescop, TELUQ; and Blaise Balmer, UQTR.

SEBASTIAN: Educational System Based on Internet Technology

José Luis Carrasco Sanz, Liliana Patricia Santacruz Valencia, Carlos García Rubio,
Peter T. Breuer, Carlos Delgado Kloos, María del Carmen Fernández Panadero

Telematic Engineering Area
Universidad Carlos III de Madrid
Avda. De la Universidad 30, 28911
Leganés – Madrid – España
sebas@it.uc3m.es

Abstract: This paper describes the work of the Carlos III University in the project SEBASTIAN (Educational System based on Internet Technology). The aim is to develop a tele-educational tool, providing to educators/trainers with a simple mechanism that makes possible the use of the network for the broadcast of educational content and enabling the creation of multilingual courses based on XML (Bray, 1998) and SMIL (Stephan, 1998) technologies.

Introduction

As soon as web technologies first became available, they were adopted for educational purposes. Hypertext technologies had already been used in learning systems, and the Internet facilitated the overcoming of distance. Higher education is now undergoing structural changes in terms of the composition of student populations, learning paradigms and curricula. As distance education becomes an integral part of higher education, student bodies are expanding to include more non-traditional students and the contents of courses are richer than before, and incorporate more interactivity.

In this new world, students participate more actively in class and collaboration becomes a more important component of the learning process. These changes have stimulated the development of new ways to represent information (for example: animations, simulation, hypertextual navigation and so on). In particular, multimedia content has been introduced via the medium of the WWW. However, there are problems associated with the variety in present day formats. Facing up to this situation, The Carlos III University of Madrid is working on a project named SEBASTIAN.

System Architecture

The system serves to integrate multimedia learning experiences into the network enabling it to be visualized according to the preferences and characteristics of the student. The courses generated are described in EML 2.0 (Educational Markup Language 2.0). This language is based on XML and includes spatial information (multimedia objects place, presentation size, etc.), temporal information (duration of multimedia objects, scenes, etc.), and information about students profiles (learning styles). The professor will eventually have one tool with three integrated functionalities for the creation of courses, see [Figure 1]. The functions are:

- **LG (Layout Generation):** Allowing the description of the spatial distribution of multimedia elements that comprise each scene of the presentation. A description language, SLML: Space Layout Markup Language (based on XML), has been designed for this purpose. This functionality will provide the creation of multimedia templates. Initially, some predefine templates will exist, but the object is that professor generated its own templates.

- **STG (Synchronous Text Generation):** The files generated are based on a new language STML: Synchronization Text Markup Language, and provide textual content in several languages. These files contain synchronization labels which synchronize the text with audio or video, as in a karaoke session.

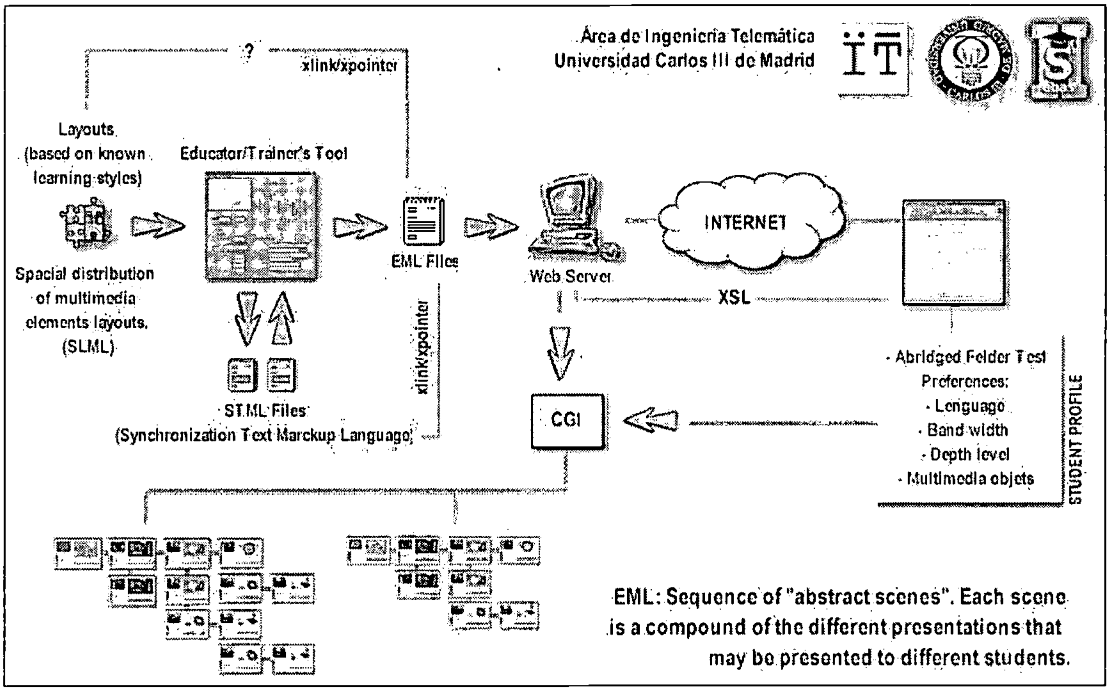


Figure 1: Contents generation, distribution and visualization process.

- **CG (Course Generator):** Integrates multimedia files and files generated by the two previous applications. The result is a presentation composed of a sequence of "abstract scenes". Each scene is a compound of the different presentations that may be presented to different students. The view presented to each student depends on their preferences and pedagogic profile. These profiles are generated automatically in accordance with the Learning Style Model (Richard Felder, 1996), the PAPI (Public and Private Information, 2000) and the LOM (learning Object Metadata 1999) specifications.

Acknowledgments

The work reported in this paper has been partially funded by the project SEBASTIAN 07T/0015/1997 of the Spanish CAM and the project INFOMEDIA CICYT TEL 1999-0207. We wish to acknowledge fruitful discussions with our colleagues in the Department of Telematics Engineering in the Carlos III University of Madrid.

References

- Bray, T. (1998). *Extensible Markup Language (XML).* W3C REC-xml-19980210
- Stephan, L (1998). *Synchronized Multimedia Integration Language 1.0 (SMIL).* W3C REC-smil-19980615
- Felder, R. (1996). *Learning Styles.* North California State University
- Hodgins, W (2000). *Learning Object Metadata.* IEEE P1484.12/D4.1
- Farance, F (1997). *Public and Private Information.* IEEE P1484.2

The Construction and Evaluation of an Internet-Based Knowledge Integration System (IKIS) For a CAI Graduate Course

Mei Chen & Tanya Scott
Department of Education
Concordia University
1455 Maisonneuve Boulevard W.
Montreal, Canada, H3G 1M8
MeiChen@vax2.concordia.ca
TScott@Education.concordia.ca

Abstract: This paper describes an on-going project that involves the construction and evaluation of an Internet-based Knowledge Integration System (IKIS) developed to support a Computer-assisted Instruction (CAI) graduate course. The IKIS integrates cognitive theories of learning and instruction, computer networking technologies, and face-to-face classroom teaching in order to (a) help students build coherent knowledge representations of a great variety of knowledge and skills that are required to design and produce instructional software prototypes and, (b) create a community of practice to aid students in making the decisions concerning the design and production. Our discussion will be focused on two important system features of the IKIS (i.e., the information architecture and communication facilities) that enable us to achieve such goals. A plan for evaluating the IKIS will also be briefly described.

In this paper, we will describe an on-going project that involves the construction and evaluation of an Internet-based Knowledge Integration System (IKIS) developed to support a Computer-assisted Instruction (CAI) graduate course in which students will develop knowledge and skills for designing and producing instructional software prototypes. Understanding of various design concepts and approaches, specification techniques, authoring tools, and development methods is emphasized within this course. Whereas the instructor of the course provides face-to-face lectures, demonstrations, discussions, and laboratory work, the complex nature of the subject can still pose a challenge for students to assimilate and integrate such knowledge. Furthermore, traditional classroom instruction remains an inadequate method in providing timely instruction to each individual student. The IKIS for (CAI) was constructed to (a) provide students with a rich, well-structured knowledge base in order to ensure their active assimilation and integration of a variety of knowledge and skills to be learned, and (b) create a community of practice to aid students in making the decisions concerning the design and production of software prototypes.

The Design of the IKIS

The IKIS integrates cognitive theories of learning and instruction, computer networking technologies, and face-to-face classroom teaching to enable students to use the well-structured knowledge base and diverse tutorial resources to build coherent knowledge representations of the subject-matter knowledge to be learned. The design of the IKIS is based on the cognitive theories of text comprehension that emphasizes the importance of structured knowledge presentations in the construction of coherent knowledge representations (Kintsch, 1988; 1998; Mayer, 1999; 1997), and on situated theory that views social interaction and collaboration as crucial factors in the development of scientific understanding (Lave & Wenger, 1991; Resnick, Levine, & Teasley, 1991). In addition, the *cognitive apprenticeship* model proposed by Collins, Brown, and Newman (1989) also informed the design of the IKIS. Five principles are articulated to guide the design of the IKIS: (a) providing a rich knowledge base to reflect expertise in the domain of instructional software design; (b) providing a well-organized and transparent knowledge structure to help students construct a coherent conceptual representation of the subject-matter knowledge, (c) employing an effective model of instruction, (d) building a community of expert practice and providing multiple perspectives towards the solutions and, (e) facilitating collaborative learning among students. The theoretical foundation and design principles of the IKIS have been described in details elsewhere (Chen, 1999; Chen, 2000). In this paper, our discussion will be focused on two important system features of the IKIS, namely the information architecture and communication facilities that reflect the principles described above. In addition, an evaluation that we will conduct in the near future will also be proposed.

The information architecture incorporated into the IKIS

The CAI graduate course is focused on the user-centered design for Computer-supported Collaborative Learning (CSCL). A series of topics were identified as important for successful design and implementation of instructional software prototypes. In order to help students construct coherent knowledge representations, the IKIS incorporates an information architecture (i.e., a hierarchical organizational scheme) to represent two "layers" of the knowledge to be learned: the first layer consists of various topics, which range from learning theories to web authoring techniques whereas the second layer is a breakdown of knowledge on each topic which includes concept, rationale, goals, methods, example, related issues, trouble shooting and tips, and reflective questions and exercises. Such a knowledge base is expected to enable the students to answer questions concerning what, why, how, to evoke reflective thinking, and ultimately, to create a rich context for students to engage in productive group discussions on the topics via computer-mediated conferencing. Furthermore, some Internet resources and lab tutorials that are relevant to specific topics are also provided to extend the knowledge base of the IKIS. Students can also access a perquisite-course website to acquire background knowledge if they wish. The information architecture of the IKIS enables the students to learn the topics in a logical manner, meanwhile this architecture is flexible enough to allow each individual to take a different navigation path based on his or her own selection. There is a navigation bar located on the top of the screen that allows students to maneuver through the course topics and breakdown by following either a pre-determined sequence or a selected path. In addition, a bottom navigation bar is available all time to enable the students to access a computer-mediated conferencing facility, newsgroup discussions, and e-mail addresses in the context of reviewing the course topics and breakdown. This bottom navigation bar also provides accesses to the resources and lab tutorials outside of the instructional content that is defined in the IKIS. An on-line help, site map, and search facility are also provided by the bottom navigation bar to enable students to navigate efficiently through the site.

The communication facilities utilized in the IKIS

There are numerous decisions that one must make in the processes of designing and producing instructional software prototypes. No matter how rich the knowledge base is and how well such knowledge base is structured, students may still have unanswered questions. The purpose of proving the accesses to a computer-mediated conferencing facility, newsgroup discussions, and e-mail addresses is to enable students to discuss such unanswered questions with their peers or experts outside of their physical environments. Three communication channels are established to support students' knowledge construction and decision-making: (a) *a channel for integrating with the peers*: the FirstClass™ software program is used to provide computer-mediated conferencing and chat facilities to facilitate the discussions among students. Each student is required to provide answers to the reflective questions that are proposed at the end of each topic. Students are also encouraged to bring up issues that they wish to clarify and respond to each other's questions. Students can also the FirstClass™ to exchange electronic files that they produced for their group work. The instructor and teaching assistant will monitor the discussion and provide directions and clarifications if needed; (b) *a channel for participating in the communities of practice*: The IKIS provides students with access to the Internet newsgroups that are most relevant to the topics discussed in the course. These newgroups are organized in a way that is sensitive to the course topics so that the students can be exposed to multiple perspectives on a given issue. Students will also have the opportunities to share their experience and expertise with people who face similar problems and understand the concerns of the practitioners in the community; (c) *a channel for* communicating with experts: In addition to the communication with the instructor of the course, students can ask questions to some design experts who will serve as the mentors during the course of the semester. These experts will help the students diagnose some "unsolvable" problems and provide suggestions via e-mail. In addition, a list of e-mail addresses of the experts in the fields relevant to CAI design will also be provided to allow students to contact these experts. The communication with these experts may provide students with insights into how experts think and practice. Thus, The communication facilities offered by the IKIS will break the boundary of time and location that is inherited in traditional teaching.

The Evaluation of the IKIS

The IKIS will be evaluated both formatively and summatively. In the formative evaluation phase, a few representative students will be asked to "walk through" the environment and provide "think aloud" protocols for making diagnosis of the system in terms of its usability and learnability. Following the necessary modifications, a summative evaluation will be conducted to determine the effectiveness of the IKIS. Two groups of students will be compared: one that use the IKIS and another that use a print-based version of the same material. An attitude questionnaire will be administered before and after the course to determine the changes in student attitudes. In addition, students' on-line discussions and course work will also be analyzed to determine the levels of expertise developed. The ultimate goal of the project presented here is to understand the ways that computer technologies can be used to enhance student learning of complex subject-matter knowledge and to develop a model of successfully integrating technology into the classroom teaching.

References

Chen, M. (1999). An internet-based knowledge integration system (IKIS) for facilitating the acquisition of complex design skills. In G. Cumming, T. Okamoto, & A. Gomez (Eds.), *Advanced Research in Computers and Communications in Education: New Human Abilities for the Networked Society*, Chiba, Japan, (Nov.,1999).

Chen, M. (2000). Building an Internet-based knowledge integration system (IKIS) to facilitate the teaching of complex design skills. Paper presented at the *Annual Meeting of the American Educational Research Association*, New Orleans, LO.

Collins, A., Brown , J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing and mathematics. In L. B. Resnick (Ed.), *Knowing, learning and instruction* (pp.453-494). Hillsdale, NJ: Lawrence Erlbaum.

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model. *Psychological Review*, *95*, 163-182.

Kintsch, W., (1998). *Comprehension: A paradigm for cognition*. Cambridge University Press, Cambridge, UK.

Lave, J., & Wenger, E. (1991). *Situated learning. Legitimate peripheral participation.* Cambridge, England: Cambridge University Press.

Mayer, R. (1989). Models for understanding. *Review of Educational Research, 59(*1), 43-64.

Mayer, R. (1997). Multimedia learning: Are we asking the right questions? *Educational Psychologist*, *32(*1), 1-19.

Resnick, L. B., Levine, J. M., & Teasley, S. D. (1991). *Perspectives on socially shared cognition.* Washington, DC: American Psychology Association.

Design decisions in the development of modular instructional content: Describing the transition from local to global learning systems

Paul Cholmsky
Concordia University, Montréal, Québec, Canada
cholmsky@videotron.ca

1. Introduction

Although the increasing sophistication of computer-based learning systems has enabled gains to be made in terms of their pedagogical effectiveness, an undesirable consequence of this sophistication has been a significant increase in development cost. The high cost of these systems has been identified as a principal barrier to their widespread deployment. Increased complexity in learning systems has also led to lengthier development cycles, which has constrained the rate of design evolution and innovation. As a result, there is a pressing need for instructional designers to focus on the efficiency of their development processes as well as the effectiveness of the outputs that are produced by them.

A possible strategy for reducing the time and cost of system development is to create a context wherein whole systems would not have to be designed largely from scratch. A key aspect of such a strategy could be the establishment of cross-organizational standards that would allow developers to reuse content components from other systems, both from within their own organization and from external sources. In essence, this would represent an attempt to leverage the productivity gains from reusability that have been achieved in software engineering into the domain of instructional content development. Over the past year, coordinated proposals have rapidly emerged from several bodies (e.g., Advanced Distributed Learning Initiative, 2000; Anderson, T., McArthur, D., Griffen, S. & Wason, T., 1999) as candidate standards for this purpose. As these proposals are vetted through their initial trials in actual learning systems, it will be important to observe how standards for content reusability affect instructional content development methodologies. Will processes primarily developed in the context of authoring content in small-scale closed systems evolve smoothly into processes for architecting large-scale distributed learning environments where the number of distinct content components may be in the hundreds or thousands? Conversely, if new processes must be developed, which ones will be required, and on what basis do we start their development?

A fundamental issue that needs to be addressed in this regard is the broad function of instructional design (ID) in the development of systems that have a substantial information technology (IT) component. Where does ID stop and IT start? Consider the development of a set of interactive practice exercises that include variable remedial feedback based on learner response patterns. A design decision could be made to use a database-driven approach wherein feedback is assembled from low-level content components that are sourced from a database. If these low-level components include subject-matter terms and their definitions, the same database might be used to drive a glossary function in the learning environment, serving the objective of content reusability. In designing such a system, we would likely not expect an IT professional to author the subject-matter definitions that lie within the database, just as we would not expect the ID professional to design the software that allows the database to communicate within a client-server environment. Appropriate allocation of responsibility for many other design issues, however, is not as clear-cut. For example, is one of these professionals primarily responsible for decomposing the feedback into suitable lower-level components, or is this a joint responsibility - and, if so, how do these professionals collaborate on this task effectively? Of specific concern are the pedagogical implications of successful technical convergence (e.g., the use of database-driven content systems, or the adoption of XML as a markup language): does this form of standardization support research on and development of pedagogical strategy, or does it sacrifice flexibility at this level to achieve the goal of technical convergence? The absence of a clear articulation of the interface between pedagogy and technology in practical terms may prove problematic.

2. Common architectural issues in the design of computer-based learning systems using modular content

To begin assessing the viability of current content development process models in the context of large-scale distributed learning environments, we can examine common categories of design decisions that occur in smaller-scale development projects and assess the possible ramifications of a significant change in scale on them:

- Modularity: What is a module, in terms of instructional content? What are the quality criteria for the definition of 'good' modules? Do these criteria change as scale increases? How do we use partitions between modules to manage risk in content development? For example, how do we partition a system in order to increase our ability to test numerous content components as they are being developed?
- Communication and information flow: What types of information get communicated between modules in a single system? Where are the architectural boundaries in an open content system? How does the information flow in a learning environment instantiate a pedagogical theory of control?
- Object- and component-based approaches to the development of instructional materials: How do we determine the right grain sizes for content development? What is the relationship between grain sizes for authoring and the units of analysis employed during front-end analysis? How can the choice of content units facilitate collaboration with software developers during design and production?
- Reusability: How is the design of a single reusable content component different from the design of an instructional product out of reusable components? What parts of a learning environment can be reused? How do we move from ad-hoc, opportunistic reuse to systematic re-use? What are the tradeoffs involved? Can there be too much reuse?
- Interoperability: At what levels is it feasible to make content interoperable? What goals are achieved by making content interoperable? What is the relationship between reusability and interoperability?
- System maintenance and evolution: How do we design system architecture so that it can survive, and indeed facilitate, bottom-up evolution of the system? What kind of evaluation data should the system collect, and how? How do we document system architecture so that it is understandable by those who will be responsible for its maintenance and evolution?
- Coordination: What happens when we move from managing individual content development projects in relative isolation to managing integrated content development programs? Which design assumptions are challenged when discrete learning products become parts of continuous learning systems?

3. The identification and categorization of design decisions

When a design domain is relatively stable, the explicit articulation of design decisions is less important, since decisions and their consequences are reasonably predictable based on past experience. Process-level issues can generally be resolved on a case-by-case basis in such circumstances. As the transition is made to developing instructional content components for use in distributed learning systems, instructional designers may face a period of domain instability where novel and complex interactions force many tradeoffs to be made unwittingly. Reassessing and evolving processes in light of these challenges will require an understanding of the new design space that instructional content developers are working within. In part, the opportunities and constraints associated with this new context will have to emerge through hard experience. A viable approach for articulating the boundaries and substance of this space in advance, however, is to identify and categorize the macro- and micro-decisions that are made in developing small-scale modular content, and examine these decisions in terms of their scalability to larger, more integrated systems. This is the subject of my current work-in-progress. By examining the development process from the perspective of decisions that are made during design, a top-down, principle-based approach to learning system architecture can be combined with a bottom-up awareness of the individual decisions designers make on actual projects. This is a key stepping-stone in the analysis of the cohesiveness and comprehensiveness of a given set of instructional development processes. The design decisions can also serve to frame, in tangible terms, the relationship between a given pedagogical strategy and its technical implementation.

4. References

Advanced Distributed Learning Initiative. (2000). Shareable Courseware Object Reference Model. Available: http://www.adlnet.org/ADL-TWG/documents.htm

Anderson, T., McArthur, D., Griffen, S. & Wason, T. (1999). IMS Meta-data Best Practice and Implementation Guide. Burlington, MA: IMS Global Learning Consortium. Available: http://www.imsproject.org/metadata

Interactive Flows in Language Learning on the Internet

Heloisa Collins
Catholic University of Sao Paulo – PUC-SP, Post-Graduate Program in Applied Linguistics - LAEL
Rua Bocaina 24/12 - 05013-030 Sao Paulo, SP, Brazil
hcollins@uol.com.br
www.hcollins.f2s.com

Abstract: Concerned with the relationship between interaction and learning, this paper aims at exploring relations between interactive flows in an EFL course offered on the Internet and language learning. The course was produced and is run by the research team of EDULANG, an ongoing research project in language learning on the Web and teacher development for the Web. In this research context, interactive flows are being used to record and analyze the rate and type of interaction in the course, identify units, tasks and course spaces that do not promote expected levels of interaction and plan and promote improvement in course structure, course content and teaching strategies.

Aims and Context

This paper derives from ongoing research in the context of EDULANG, a team project that aims at investigating multiple aspects of language learning and teaching in courses on the Internet. The paper is more specifically concerned with the relationship between interaction and learning and aims at exploring relations between interactive flows and language learning. An interactive flow is here defined as a longitudinal profile depicting amount (no. of messages or interactive turns) and direction (sender and recipient) of synchronous and/or asynchronous participation in an online course. The context of the research is an EFL course offered on the Internet (www.cogeae.uol.com/sal). The course was produced and is run by the research team of EDULANG. Aimed at adults with a basic command of English, its general social aim is to offer students the opportunity to make new acquaintances on the Internet. This general aim unfolds into specific social and language-specific, communicative functions. The course officially lasts 8 weeks but can in fact reach 12 to 13 weeks. The interactive spaces make it possible for participants to a) communicate through messages posted to a virtual Bulletin Board (BB) subdivided into three forums (Classroom, Café and Technical Support), b) display (and re-edit) their interactive production to course peers in a Production Panel, c) send progress tasks and tutorial exercises to the teacher through mail-to devices on the course pages and d) participate in online Chats. All communication is carried on in English, except for messages left in the Technical Support forum. As an essential element of learning and knowledge construction, interaction must be evaluated for type, effect and efficiency in courses on the Internet. In this research context, interactive flows are being used to record and analyse the rate and type of interaction in the course, identify units, tasks and course spaces that do not promote expected levels of interaction and plan and promote improvement in course structure, course content and teaching strategies.

Method

Data was collcctcd from indicators about sender, recipient, date and subject of 6 groups of students and their respective teachers, in 1998 and 1999, and include a) messages posted in the Bulletin Board, b) messages with ongoing tasks sent to the teacher, c) texts displayed in the Production Panel and d) participation in online chat sessions. All indicators were available within the course system.

Some Findings

Results were organized in order to reveal graphic flows of interaction involving students and peers, students and teacher, teacher and students. These flows reveal trends within each group as well as across groups. Interpreted in the light of the course context, the graphic flows below have offered support for pedagogical and managerial decisions, as well as for changes in design. Figure 1 indicates that in this course, the amount of student talk tends to be equivalent to or higher than teacher talk. This may mean that in an interactive internet course, students engage in more interaction than students in traditional face-to-face EFL courses. Figure 2 shows that different groups present different types of flows, either with a focus on teacher-student and student-teacher interaction or with a focus on communication among students. In groups where the teacher talks less, interaction among students tends to be higher. In this sense, the amount of teacher interaction with students influences the amount of students' interaction with their peers. Additionally, Figure 2 shows that groups A, B, C and D (taught in 1998) communicate a lot less in the BB than groups C and D (taught in 1999). This suggests a development of familiarity and comfort with educational contexts on the Web for both students and teachers. However, rclatively close averages of participation in the 1998 groups (11.07, 5.53, 8.45 and 11.95) and equivalent participation in the 1999 groups (28.28 and 28.38), suggest that students seem to have a *quantitative communicative quota*, that they strive to use, regardless of the interlocutors they choose to have (the teacher or a peer). Figure 3 allows an interpretation of the interactive flows in the BB in the light of course content distribution (weeks 1-3 for unit 1, weeks 4-5 for unit 2 and weeks 6-8 for unit 3). A higher state of motivation seems to be associated to specific phases of the course when participants are all getting to know each other (the beginning) or students are trying to close their participation successfully (the official end, the 8th week). Mid course activities have not been able to sustain adequate levels of interaction (notice the relative drop both in the 98 and 99 groups) and are now being thoroughly reformulated. Figures 4 and 5 offer data for interesting observations. Groups A and B seem to reinforce the *quantitative communicative quota* hypothesis, with task completion and BB message flows in a complementary relationship (lower averages in one flow type complement higher averages in the other). Groups C and D, on the other hand, present opposite results in both types of flows and suggest that teacher management has a big influence on task completion and student participation in the BB. Figure 6 reveals that among students who completed at least 50% of tasks there are more poor "chatters" (23) than good "chatters" (13). However, among the best "chatters" (more than 30 turns) were the best task completion rates. This suggests that completing tasks (a traditional activity) is still favored over other web-typical types of participation and that an intensive participation in chat sessions is usually associated to intensive task completion.

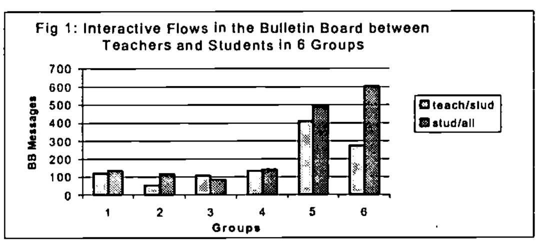


Figure 1: BB Messages between Teachers and Students

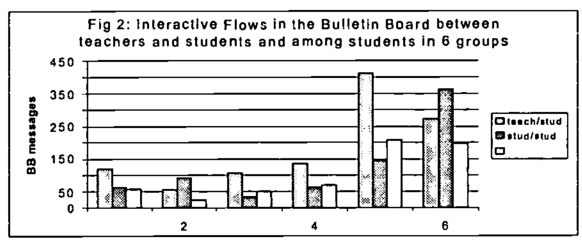


Figure 2: BB – teachers/students and student/student

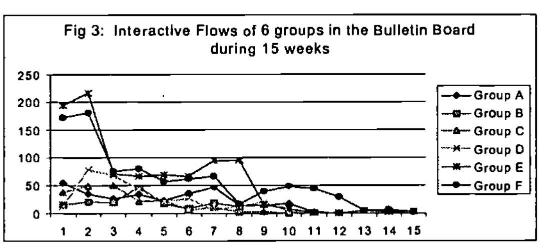


Figure 3: Flows of 6 groups in the BB during 15 weeks

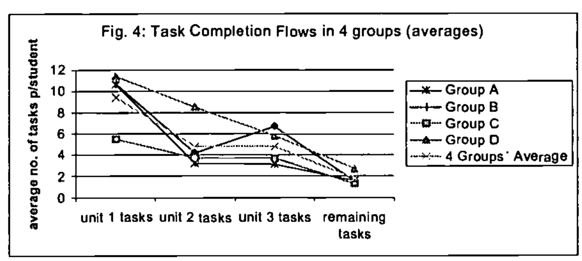
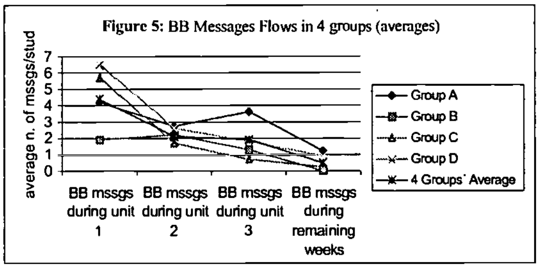
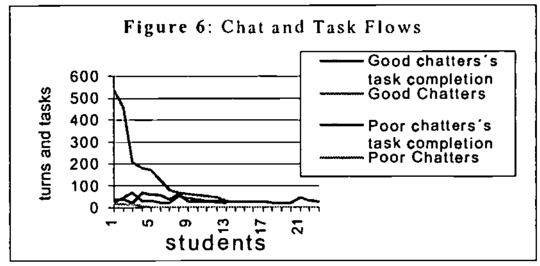


Figure 4: Task Completion Flows in 4 groups (averages)





BEST COPY AVAILABLE

The effects of collaborative, online learning on broadcast journalism students: Perception and understanding of undergraduates at linked universities worldwide.

Marion Coomey
International Centre for Learner Managed learning
Middlesex University
United Kingdom
m.coomey@mdx.ac.uk
marioncoomey@hotmail.com

Abstract: This paper describes a study that is being developed to explore online collaboration between undergraduate journalism students at universities in Australia, Canada, New Zealand, the United Kingdom and the United States. The premise of the study is that by bringing students, instructors and experts together to examine different perspectives of international news stories, learners will develop a stronger understanding of stories that get international coverage. The goal of the research is to develop a consensual and collaborative module that explores international perspectives on global news and to present this module, online ,to teams of students at the partner universities. Data will be gathered from online interviews and questionnaires given before and after the module.

Introduction

In the past decade there has been a growing amount of research in journals, books and conference papers in the area of online learning. Online learning, for the purpose of this research, refers to study that is done using computer technologies with the learner at the same location or at a distance from the instructor.

Many established universitics, such as Stanford in the United States, Deakin in Australia, University of Twente in the Netherlands, offer online classes to students who live at a distance from campus, to learners studying part-time and to professionals engaged in life long learning. These classes may have an international reach but are run and controlled entirely by individual universities. The Open University in the United Kingdom and the University of Phoenix in the United States are two examples of universities that are completely online. All students study from a distance but students are still studying at one university and working within the structure and policies of that system.

Most of the online classes described above, involve students working alone online with some support from instructors or tutors via e-mail but with little collaboration amongst students themselves. Collaborative learning, as defined for this study is: learning in an educational program created by a group of partner universities and in which students and instructors get together to examine course content issues. This sort of interactive, online learning is becoming more widely practised. Medical schools throughout Germany (Friedl, 99) share online resources to study cardiac surgery. An online training for trainers course involved learners in 22 European countries (Leino, 99). Organizations such as the United Nations are using online modules to give professionals around the world a chance to study copyright law (Durant, 99).

So far, in this researcher's literature search, most examples of online collaboration involve engineering, science, medical and business programs and most of the collaborations are developed at one university. Telg (96) noted that in the United States "few collaborative distance education efforts have taken place between American universities and universities in othcr countries".

In this researcher's area of interest, broadcast journalism, there is little documentation in the literature of any programs using online collaboration as a learning tool.

Study

It is becoming easier and easier for journalists to quickly gather information from any part of the world and disseminate it to any other part of the world but McGregor (98) asks is "the news is better reported with more understanding as a result of the new technologies". We are sending young broadcasters into a world of instant information, instant analysis and instant conclusions about global news issues. One of the questions raised by this study is: do those young journalists, and the experienced story tellers for that matter, have the enough understanding of global issues to provide clear, non-biased reports?

The premise of this study is that by linking students, instructors and broadcast experts in online discussion and by working in international teams on assignments and presentations concerning global news, the learners will develop a stronger understanding about stories that gain international media attention. The researcher is working in consensus with partner instructors in Australia, Canada, New Zealand, the United Kingdom and the United States to develop a collaborative module that will allow students to examine and discuss international perspectives on global news stories. Students will gather at the module web site that includes: structured and unstructured forums for discussion and debate, a location for students, instructors and industry professionals to interact, links to broadcast networks worldwide plus visual and written content that takes the learner through the module and its assignments step by step.

Data will be gathered using a quiz to examine students' knowledge of global news issues, before and after the module is run. Learners and instructors will respond to questionnaires online before and after the module and will participate in structured and informal taped interviews to elicit personal and anecdotal information. At least ten students from each partner university will participate in the first run of the module in April 2001.

The result of this study will be to establish an international circle bringing learners with different backgrounds and understandings of international news, into an ongoing discussion. The timing is right to examine how online collaborative learning functions within the untested area of broadcast journalism and to determine if there is a benefit for students in using this new teaching/learning method. This study aims to bring issues of online learner effectiveness to light to provoke further discussion research and practise in this area.

References

Bonk, C.J. (1999). Breakout from Learner Issues, *International Journal of Educational Telecommunication,* 5 (4), 387-410

Durant, F.T. (1999) WIPO Academy's Online Courses bring Intellectual Property to Worldwide Audiences, *Online EDUCA Berlin*, 5th International Conference on Technology Supported learning

Ewing, J.M., Dowling, J.D., Doutts, N., (1999). *Learning Using the World Wide Web: A Collaborative Learning Event, Journal* of educational Multimedia and Hypermedia, 8 (1), 3 – 22

Friedl, R. (1999 Teleteaching in Cardiac Surgery: An Innovative concept, Conference Paper, *Online EDUCA Berlin,* 5th International Conference on Technology Supported learning.

Leino, A. (1999) Virtual United: Online courses to 22 Countries by an international team, *Online EDUCA Berlin,* 5th International Conference on Technology Supported learning

McGregor, B. (1998) *Live Direct and Biased: Making television news in the Satellite Age*, Arnold, London

Oliver, R., Omari, A. (1998) Exploring Student Interaction in Collaborative world wide Web Computer-Based Learning Environments, *Journal of Educational Multimedia and Hpyermedia*, 7 (2/3), 263 - 285

Parker, R. (1996*) Mixed Signals: The Prospects for Global Television News*, 20th Century Fund, New York

Telg, R. (1996) Instructional Design Considerations for Teaching International audiences via Satellite, *International Journal of Instructional Media*, 23 (1) 209 - 223

CHANGES IN CANADIAN HIGHER EDUCATION ICT AND SUPPORT, 2000 TO 2003

Carl Cuneo, McMaster University and EvNet, Canada (cuneo@mcmaster.ca)
Brain Campbell, Mount Allison University and EvNet, Canada (bcampbell@mta.ca)
Campus Computing International (Canada)

Over the next decade, there will be an increasing digital gap between higher education institutions offering and not offering online courses. This will result from the lack of planning by offline institutions in information technology policies, networking and technical infrastructure, and access to remote electronic library resources. This is not an all or nothing situation. Some offline institutions have laid plans for a digital learning future. But compared to online institutions, they have less extensive plans. It takes several years of laying down the technical infrastructure before we see the results in suites of online courses. An institution cannot decide one year to start putting in place such an infrastructure, and then expect to see the results the following year in a dramatically increased online learning.

We mailed 8 questionnaires to 310 colleges, CGEPS, and universities in English and French Canada. 134 institutions returned at least one questionnaire from June, 1999 to April, 2000, for a response rate of 43%. The response rate was good among the 60 universities (89%), but poorer among colleges (35%) and CGEPS (25%). This is due to the inclusion of many very small colleges and CGEPS that had difficulty filling out complex questionnaires. The questionnaires were completed by 8 senior officials responsible for policy and implementation of information, communication, and learning technologies (questionnaires returned are in parentheses): VP or most senior officer responsible for information and communication technology policy (82/134 =61%); manager or director of networking and technical infrastructure (72/134 = 54%); head of computer support (84/134 = 62%); director of audio-visual services (68/134 = 51%); head librarian (68/134 = 51%); head registrar (69/134 = 52%); director of instructional development or academic or teaching technologies center (75/134 = 56%); and, president of the faculty or teachers' association (47/134 = 35%). The following comments and analyses are based on these data.

INFORMATION TECHNOLOGY POLICIES

VPs of Information Technologies at institutions offering online courses, compared to those not offering online courses, placed more emphasis over the next 3 years in: instructor training in teaching technologies; recruitment of more technical staff; cooperation with other institutions in software licensing; encouragement or requirement of student computer ownership, and provision of open access computers to students. If we expect the information technology gap to close between online and offline institutions, institutions not offering online learning should emphasize these policies at least to the same degree, if not more, than institutions offering online courses. But this is not so. Over the long term this will lead to a growing gap between online and offline institutions.

NETWORKING AND TECHNICAL INFRASTRUCTURE

We asked Managers of Networking and Technical Infrastructure how much they emphasize servers, networking, student computers, and wireless devices in their plans. The data on servers reflects the declining use of UNIX (despite its history and stability), and the rise of Linux and Microsoft NT servers. But institutions offering online courses are more likely to have all three server types in their plans than institutions not offering online courses. This may reflect the greater demand on servers among institutions that offer online learning. However, online courses are not the only demand for servers; they are used for a wide variety of administrative and educational functions. Our question did not tie the server type to a particular online learning use. The data probably reflect a more general difference in information technology configurations between online and offline institutions. Online institutions are also much more likely to expand wired and wireless networking, fast ethnernet connections, notebook and other mobile computing devices, and student computer lab capacity. The differences are so large that this kind of weak infrastructure in offline institutions will likely undermine their inability to offer future online learning.

DIGITAL LIBRARY RESOURCES

If institutions not offering online courses expect to catch up to institutions offering online courses, they should reduce their expenditures on hard copy print library resources as much as or more than institutions that are heavily into online learning. In fact, that is not the case. Offline higher education institutions plan to spend more on hard copy print library resources. A greater percentage of head librarians of institutions offering online courses plan to expand electronic library resources over the next three years in contrast to offline institutions. This reinforces the view that institutions already offering online learning are forging ahead with additional plans to develop and extend their information technology infrastructure, in this case the library infrastructure, in contrast to institutions not offering online learning. Our data also suggest that most libraries are moving quickly into the electronic age on almost any information technology question we asked. But only about one-third of head librarians plan to emphasize student e-mail access over the next three years. Libraries do not view themselves as centers for providing students with e-mail access; such services and access are available elsewhere on campus and from off-campus.

SUPPORT FOR ELECTRONIC COURSEWARE

Directors of Academic Technology and Instructional Development Centers at institutions offering online courses plan to emphasize the following between 2000 to 2003 in contrast to institutions not offering online courses: funding for teaching support and teaching technology support units; funding for free instructor workshops in academic technologies; training instructors in computer literacy and web design; funding for instructional technology projects proposed by instructors, academic programs, and departments; web course outlines; interactive multimedia web courseware with full instructor participation to teach the courses; standalone interactive web courseware with minimal instructor intervention; e-mail in courses; computer conferencing in courses; and, computer-supported collaborative learning (CSCL) in courses. However, those items receiving the greatest endorsement over the next three years among institutions offering online courses are: course outlines on the web; computer conferencing in courses; computer supported collaborative learning in courses; and, training instructors in web design. The least emphasis in plans over the next three years are in user-pay instructor workshops in academic technologies, and funding for instructor release time to work on teaching technologies.

REGISTRAR PLANS FOR SUPPORTING ONLINE LEARNING

Among head registrars at Canadian higher education institutions, there is a moderately positive association between the number of online courses offered and plans over the next three years in: student web registration; electronic delivery of student academic counseling; web course evaluations and course outlines; courses geared to job skills; distance education courses; computer conferencing, video-conferencing and e-mail in courses; computer-based training; and, linking electronic classrooms between institutions. There are no plans among registrars in institutions with many online courses to move into general paperless office procedures and web calendars over print versions (already done); student computer competencies (these skills are assumed or picked up as students take online courses); instructor online access to class lists and online submission of student grades; and, information technology in face-to-face courses . There are three areas in which registrars with low numbers of online courses plan to emphasize over the next three years, while registrars at institutions with many online courses will definitely not emphasize: part-time student enrollment; continuing education; and, instructor access to student academic records. It is often assumed that distance online learning goes hand-in-hand with continuing education and part-time studies. This may have been the world of traditional distance education. Online learning has moved out of continuing and part-time studies into full-time studies. We are probably witnessing here a transition in the academic programming of distance education as it moves from offline print correspondence to online learning.

DEVELOPMENT AND DELIVERY TOOLS OVER NEXT THREE YEARS

We asked directors of Instructional Development and Teaching Technology Centers the emphasis that their institutions will place on development and delivery software over the next three years. Institutions offering online courses indicate that they will move more strongly in the direction of the top software in the market. Over three quarters (78%) of institutions offering online courses indicated that they will move even more strongly in the adoption and implementation of courses using Web CT. Even among institutions not offering online courses, almost one-third (30%) plan to adopt WebCT. No other software comes close to WebCT in the future plans of institutions. However, there is significant growth potential in Lotus Notes, Centrinity's FirstClass, Macromedia Director and Authorware, Asymmetrix's Toolbook, and the Web Board. There does not seem to be much growth potential in Virtual-U, Question Mark, Allaire Forum, Norton Connect, and Web Course in a Box.

CONCLUSION

There is little evidence to suggest that institutions not offering online courses will soon catch up to institutions currently offering online learning. They have not prepared their technical infrastructure for offering online courses. Their main hope might be closer collaboration with neighboring institutions that have prepared their own infrastructure for a digital future in online learning.

ACKNOWLEDGEMENT:

Funding was provided by the SSHRC and support was obtained from EvNet (http://evnetcanada.org).

SUPPORTING A COMMUNITY OF PRACTICE: THE ROLE OF WORKERS AS LEARNERS

Maarten de Laat, Frank de Jong and Julian ter Huurne
University of Nijmegen and the Education and Knowledge Center (LSOP) of the Dutch Police
m.delaat@ped.kun.nl

Abstract: In this paper we focus on the use of computer supported collaborative learning (CSCL) in an organizational setting. The program we use is Web-Knowledge Forum. Although there is a lot of experience in using Knowledge Forum in a classroom setting, little is known about how to implement and work with this program in an organization other than schools. The problem investigated in this pilot study is how a community of practice uses Web-Knowledge Forum as an online learning environment to discuss work-related problems. This study focuses on role of the worker as a learner in an unstructured process of negotiation of meaning in a community of practice. In the study eight police officers participated by forming a heterogeneous group initiated by the Information Management Approach of Criminal Investigation in Police Education (ABRIO) a subdivision of the Dutch police force.

Introduction

A learning organization stimulates the ability to learn individually, in groups and to learn by the organization as a whole. The aim in this is to support continuous learning to combine and develop knowledge in the organization in order to respond flexible to changes that occur in the market (Bolhuis and Simons, 1999). There is a tendency to organize this learning as close to the workplace as possible instead of sending people to courses given outside the workplace (Van der Krogt, 1995; Nonaka & Takeuchi, 1997; Bolhuis & Simons, 1999). Revans argued for action learning. He formed learning teams to work on real organizational problems and to structure their experience in such a way that both useful solutions to these problems emerge and substantial learning occurs for participants (Vaill, 1996). So the employees are recognized as an important resource to the organization. According to Wenger (1999) people in organizations form communities of practice by helping out each other and discussing the latest developments. These communities of practice are bound by a shared practice related to a set of problems. In these communities they share and create knowledge; they learn through participation (Wenger, 1998). Membership to these communities of practice is voluntary, these communities are not bound by organizational affiliations.

In large organizations like the Dutch police force online communities have an advantage in bringing people together independent of time, space and local cultures. CSCL makes it possible for people to participate in communities of practice and work at their own pace and time. One of the programs that support this kind of collaboration is Web-Knowledge Forum. Web-Knowledge Forum is a discussion program designed to form a learning community over the Internet. It's a product of the Computer Supported Intentional Learning Environments (CSILE) family, developed at the Ontario Institute for Studies in Education (OISE) to support the collaborative construction of knowledge (Scardamalia & Bereiter, 1992). The participants operate in a shared workspace in which they read and write notes. A note is a contribution that can contain text, pictures and links to documents, html pages or other notes in the shared knowledge workspace. Working with this program stimulates the participants to talk about the subject, read relevant resource materials, pose questions, offer theories, conduct experiments, and work together to make sense of new ideas. By working together participants develop greater competence in a particular subject area, using what group members already know as an important component and co-constructing plans of action to extend that knowledge (Hewitt & Scardamalia, 1998). The creation of knowledge therefore is seen as a social product.

Originally this program was designed for use in the classroom to support the construction of knowledge in a social context. The aim in the development was to support an environment that will make it possible for schools to function as knowledge building communities (Scardamalia & Bereiter, 1992). Within knowledge building communities the focus is on knowledge construction. It's a knowledge-centered community of practice.

The problem we face is how to facilitate the creation and support of communities of practice in organizations that work in a Web based environment and make knowledge building the core of their activity. In the first place there has to be identified a 'real' and meaningful problem that exists in the organization. A problem that is owned by the participants and in which solution they are willing to put effort. Second the members of the organization who feel affiliated by this problem have to form a community in which they can participate on a voluntary and functional basis. In this paper we focus on the possibilities of Web-Knowledge

Forum to serve as a meeting place for such communities. A place where participants can work together, undertake collaborative learning activities, sharing their knowledge, aimed at deepening their expertise in the problem to be solved.

Our question is: Can groupware, e.g. Web-Knowledge Forum, support the negotiation of knowledge and understanding in communities of practice in an organization?

We focus on the role of the worker as a learner in an unstructured process of negotiation of meaning in an online community of practice.

The study

This study was conducted to gain experience with participants who were engaged in an online learning community. The community consisted of eight participants who voluntary joined in the community. They responded to a letter that was sent by the ABRIO to several police departments explaining the problem that has to be solved. The problem was about how to identify and describe general work-processes used in the field of criminal investigation. As a whole the participants formed a heterogeneous group (policy makers, criminal investigators and experts).

During a period of two months they worked together using Web-Knowledge Forum. There was much uncertainty about how to identify work-processes, therefore the participants agreed to start with an open discussion on the subject 'work-processes', instead of following a structured plan of action to tackle the problem. Web-Knowledge Forum played a central role in supporting the discussion because all the written contributions are stored as notes in a shared database available to all the participants. The discussion was divided into certain subjects called views in which the participants contributed a note or comment on a note they had read, by writing a build-on note.

Instruments

The way people participated and interacted with each other provides information about the activities of such a community. Web-Knowledge Forum is provided with an analytic toolkit (ATK) that analyses the activities of the members of the community in the database. It creates log files of all the users about how many times they have read, write or edited a note. How many notes are linked to each other and how many 'build-on's there are made.

Web-Knowledge Forum is designed to facilitate cognitive and metacognitive activities by providing opportunities to give your opinion, to give a comment, or by making suggestions or providing new information. Because of these possibilities it is important to know more about the nature of the content of the material the community has created together and what kind of activities the participant undertake. Are they trying to advance their knowledge? Veldhuis-Diermanse (1999) developed a coding scheme to gain information about the content of the written notes based on the constructivist view of learning in an educational setting. This coding scheme is still in a design stage and it is the first time this scheme is applied to an organizational community. This coding scheme consists of three main categories: 1 Cognitive activities, 2 Metacognitive activities, and 3 Affective activities.

1 Cognitive activity: Cognitive activities are used to process and acquire insight in the information being discussed. Veldhuis-Diermanse recognized three subcategories of cognitive activities: 1 debating, the accent is on arguing, presenting new ideas or thoughts about the subject; 2 using external information, the accent is on referring to information found in other sources than the database; and 3 linking or repeating internal information, the accent is on referring to information found in the shared database.

2 Metacognitive activities: Veldhuis-Diermanse (1999) describes metacognitive activities as activities undertaken to regulate each other's learning process or to regulate the goals and direction of the discussion.

3 Affective activities are used to cope with feelings occurring during the discussion among the participants (Veldhuis-Diermanse, 1999).

At the end of the pilot-study we gave the participants a questionnaire to gain information about their experiences working with Knowledge Forum.

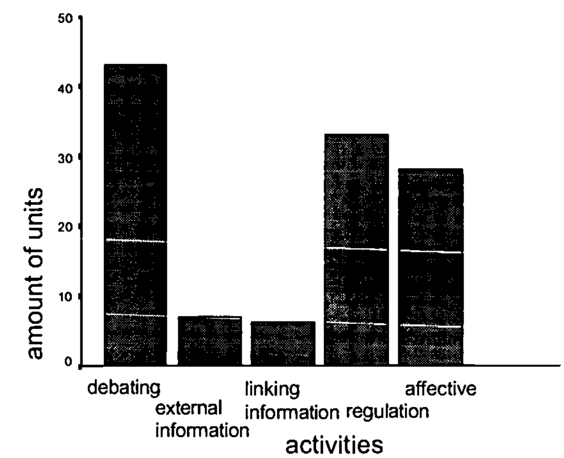
Results

The log files generated by ATK gives a description of the activities that has taken place in the database (Tab. 1). The participants contributed 98 notes in the database. That's an average of 12,25 notes per participant. 56% percent of the notes have been read. This means the amount of notes that have been opened by the participants. So this might exaggerate the actual reading that has been done. 83% percent of these notes are linked, also called build-on. The log-file only records the activities of the participants, a build-on activity therefore does not have to be content related. Table 1 shows that there are substantial differences between the participants, both in writing and reading. Notice that build-on notes are also a part of the written notes.

	Written	Build-on	Read
N	8	8	8
N	8	8	8
Mean	12,25	10,75	232,62
Mean	12,25	10,75	232,62
Std. Deviation	9,54	8,80	147,51
Std. Deviation	9,54	8,80	147,51
Minimum	1,00	1,00	113,00
Minimum	1,00	1,00	113,00
Maximum	30,00	26,00	552,00
Maximum	30,00	26,00	552,00

Table 1. Participation in the database

The content analysis of the notes reflects the following cognitive and metacognitive activities (Fig. 1).



Figurel. Activities in the database

These results indicate that the participants discuss a lot about the subject. The participants present a lot of ideas of there own and start discussing about that in the community. The participants do not bring in much new information; only seven times they referred to information that can be found outside the database (e.g. book pages). Also they did not make many content related references to the contributions of other participants in the database. Although according to the ATK 83 % of the notes are linked. This difference is explained by the fact that the coding scheme only refers to written comments to other contributions in the database. The participants show quite a lot of regulative activities, but in fact two participants are responsible for 66% of the regulative activities. There are quite a lot of affective contributions in the database. The explanation for it is that this way of working was new to them and therefore they were regularly asking for feedback and gave a lot of general reactions to the other participants. This category shows that they did not use this medium for chatting or sending 'e-mails' to each other, that are not related to the discussion. Most contributions even the affective ones were subject related.

The questionnaire provided information about the way participants worked with Web-Knowledge Forum, five out of eight were returned. 60% of the participants agreed on the question if they were collaboratively building new knowledge about 'work-processes', but they pointed out that they need to grow more into building upon the ideas of others. Also they mentioned that there was a lot of confusion about the concepts being used and that they need to clarify the goal of their study, to give more direction to the discussion. 80% of the participants indicated that they were satisfied with the opportunities, provided by the program, to discuss the subject together. The participants (80%) notified to have enough information to be able to take part in the discussion. Answers to the question, what they do if they lack certain information, are searching for relevant information, consulting colleagues at work, and trying to stimulate the other participants to explain certain issues. Results of the question about what they thought of the quality of the written notes, varies from good to reasonable. In general the quality is good but the discussion became more silent later on. "There is to little structure to guide our discussion, the notes contain valuable information but what does it bring to us?" 40% of the participants indicated that there was to less coordination during the discussion. 60% of the participants pointed out that a more structured or goal directed approach is necessary. They argue that this will help them to achieve agreement and build on to that.

Conclusion and Discussion

Summarizing the results it can be seen that the participants show a lot of activity in the database although they read much more than they contribute. Related to thc content analysis of the contributions. It seems that the activities the participants undertook are more discussion oriented than building knowledge upon already contributed or new information. However in their perception of working with groupware they appreciate the possibility of knowledge sharing. On the first glance people are willing to work in a groupware environment and share knowledge together. This is promising for the support of working in communities of practice in organizations. The analysis also shows that sharing of knowledge does not happen automatically. Although there are a lot of regulation activities, it turns out that they were mostly carried out by two participants. The questionnaire reveals that the community members desire more structure and support to direct the knowledge building activities of the community as a whole. The use of groupware in communities of practice in organizations seems promising. The participants report that this tool is useful for knowledge sharing but that the actual knowledge building activities needs to increase. They had trouble clarifying the goals and direction of the discussion. Also they discovered that there was quite a lot of confusion about the concepts used by the participants. The main concern was lack of coordination during the discussion. In an unstructured process of negotiation nobody feels direct responsibility to organize and structure the content of the problem studied. The lack of the learning ability in the sense of regulating the content and community processes seems to be crucial for people to become used to share knowledge, deepening their own and common understanding and creating further insights. To compensate this lack one can structure the negotiation of meaning by making a learning agenda. By which participant express their goals, divide certain tasks, and divide responsibilities (e.g. coordinator of the content, someone who keeps the community together or invites new participants when needed, technical assistance). One can also introduce a didactic approach of inquiry analogue to phases of the scientific enquiry process or problem solving.

References

Bolhuis, S. M., & Simons, P. R. J. (1999). *Leren en werken: opleiden en leren.* Deventer: Kluwer.

Hewitt, J., & Scardamalia, M. (1998). Design principles for distributed knowledge building processes. *Educational Psychology Review, 10*(1), 75-96.

Nonaka, I., & Takeuchi, H. (1997). *De kenniscreërende onderneming: hoe Japanse bedrijven innovatieprocessen in gang zetten.* (Tromp, Th. H. J., Trans.). Schiedam: Scriptum.

Scardamalia, M., & Bereiter, C. (1992). An architecture for collaborative knowledge building. In E. De Corte (Ed.), *Computer-based learning environments and problem solving.* (Vol. 84, pp. 41-66). Berlijn: Springer-Verlag.

Vaill, P. B. (1996). *Learning as a way of being: strategies for survival in a world of permanent white water.* San Francisco: Jossey Bass Publishers.

Van der Krogt, F. J. (1995). *Leren in Netwerken: veelzijdig organiseren van leernetwerken met het oog op humaniteit en arbeidsrelevantie*. Utrecht: Lemma.

Veldhuis-Diermanse, E. (1999). *Computer supported collaborative learning in higher education.* Paper presented at the Ico-conferentie, Utrecht.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity.* Cambridge: University Press.

Wenger, E. (1999). *Is your company ready for communities of practice?* Cambridge: Social Capital Group.

Web Accessibility Overview: What's What? Who's Who? How to?

Deanie French, Ph. D
Southwest Texas State University
601 University Drive
San Marcos Texas
elearn@Deanie.org

Abstract: Federal mandates enacted on August 7, 1998 revealed that "Effective 2 years after the date of enactment...any individual with a disability may file a complaint alleging that a Federal department or agency fails to comply with subsection (a)(1) in providing electronic and information technology. (Section 508. "Electronic and Information Technology) "The new rules will apply within a few months to all web sites operated by government agencies...By August 7, 2000, they will extend to vendors doing business with the federal government. "Possibility soon afterward they may extend to every Web site posted in the U.S." (Adam Clayton Powell III). Are ready for August 7, 2000? If not, this paper can provide ideas to help you get started.

Introduction

In PC Week Online, Vaas (2000) notes that between 95 and 99 percent of web sites are inaccessible to the visually, hearing -and/or mobility impaired. Many web developers are ignoring the accessibility issue or just do not know how to making their sites universally accessible. They are bewildered in the face of the vast information available in terms of how to make it applicable to their situation. Three areas can help focus the journey to understanding.

What's What

The law is the driving force behind the need to have universal web sites. There are already been law suits against AOL and Universities for not providing accessible web access. Equally access to information is the key reason that the focus is on web sites. Individuals cannot fully participate in today's complex society based on technology-based information if they do have access to the same information. There are several references to the law at the following web site:
http://www.swt.edu/~df12/summit/LAW.HTM

Who's Who?

This paper will mention just a few of the leaders in the field who are trying to make electronic information globally accessible. **The first is W3C.** Their mission states "The W3C's commitment to lead the Web to its full potential includes promoting a high degree of usability for people with disabilities. The Web Accessibility Initiative (WAI), in coordination with organizations around the world, is pursuing accessibility of the Web through five primary areas of work: technology, guidelines, tools, education & outreach, and research & development." (http://www.w3.org/WAI/) W3C focus is for experienced programmers and guidelines can be found at the following address:

http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/

Accessible Web Authoring Resources and Education **(AWARE)**, mission is to serve as a central resource for web authors for learning about web accessibility. The AWARE Center was launched in April 1999 as part of the HTML Writers Guild's (HWG) annual Web Accessibility Month, a special focus on the importance of designing for universal accessibility. The Center is supported by the Guild's staff and volunteers, and is designed as a resource for all web authors. Ken Barlett co-founded the HTML Writer's Guild with Martin Bayne. The HWG is the world's largest international organization of Web authors with over 130,000 members in more than 130 nations worldwide. The HGW exists to assist its members in developing and enhancing their capabilities as web authors, to compile and publicize information about standards, practices, techniques, competency, and ethics as applied to web authoring, and to contribute to the development of the web and web technical standards and guidelines.

Disability Access Information and Support **(DAIS).** Jane Jarrows, President, states, " But after we got the ramps and elevators installed, we could think about how to make the teaching that had always gone on in those classrooms fully available to all students. The parallel ends here. While we are scrambling to get the technological "ramps and elevators" in place, we are actively creating new barriers to access on a regular basis. At the risk of stretching the analogy a little too thin, if we don't be careful we will find that when those technological ramps and elevators we installed are finally in place, they only allow for a better view of the opportunities passing by us. We cannot wait to get the technology in place before we start trying to impact on the application of that technology

Microsoft. The Microsoft Senior Initiative is a program aimed at bridging the digital and generational divides and ensuring that seniors are not left behind on the information superhighway. By providing access to information technology and PC literacy training, the Microsoft Senior Initiative introduces the exciting possibilities of technology to senior citizens. The Seniors and Technology Web site (http://www.microsoft.com/seniors/) is a resource for seniors, their families and communities about the exciting possibilities that can be realized through the use of technology.

How to? For people who are just learning how to develop web pages, the easiest way is make a page using a "what you see, what you get editor," then save the web page as text and htm. The problem with this method is that that many people do not do an adequate job of keeping both pages updated. Software companies are starting to make it easier to make web pages accessible through what is called, style sheets, which control the presentation of a document. It is often easier to work in pairs or teems of two to learn this process. There are often many free workshops on the web and in your local area. Perhaps partner with someone who can pay to have a consultant.

Design is the first part of "how to." The second part is getting your page validated by a reliable source. Sites can be easily validated using on-line features which require that you paste your URL name in the box and almost immediately you will learn if you have accessibility problems. The top two sources of validation are:
Bobby Accessibility Validator
http://www.cast.org/bobby/

W3C HTML 4.0 Validator
http://validator.w3.org/

The complexity of implementation of this mandate can not be fully address with this in progress paper; however, there will a much greater discourse at the Universal Web Accessibility Symposium 2000 (at WebNet 2000) -- San Antonio, Texas, October 31, 2000.

Literature References

Section 508 of the Rehabilitation Act 29 U.S.C. § 794(d). [on-line]
http://www.access-board.gov/pubs/laws.htm#508

Vaas, L. (2000). Web Blinds Spots: The Disabled is a potentially a big market. So why is it ignored? PC On-line. [on-line]
Http://www.zdnet.com/pcweek/stories/news/0,4153,2505714,00.html

Powell III, Adam Clayton (1999.) New Law Requires Web Sites to Become 'handicapped accessible'. [online]. Available at:
Http://www.freedomforum.org/technology/1999/4/30handicapaccess.asp

Acknowledgements
I would like to thank Mette Schafer, Graduate Assistant, for all of her supporting research.

Suffering Remotely: Challenges When Teaching On-Line

Stuart Young
Department of Information Systems and Computing,
UNITEC Institute of Technology,
Auckland, New Zealand
+64 9 415 4321 ex 8656
syoung@unitec.ac.nz

Mae McSporran
Department of Information Systems and Computing,
UNITEC Institute of Technology,
Auckland, New Zealand
+64 9 415 4321 ex 8658
mmcsporran@unitec.ac.nz

Ross Dewstow
Department of Information Systems and Computing,
UNITEC Institute of Technology,
Auckland, New Zealand
+64 9 415 4321 ex 8654
rdewstow@unitec.ac.nz

Introduction

Many educators are experimenting with flexible on-line learning; consequently academics have to adapt their delivery, preparation and course administration. This study shares staff and student experiences of participating in a completely remote on-line course, compared to a flexible on-line course where students can attend classroom sessions.

The issues we encountered included ones related to hardware and software, submission of assessments, student communication with each other and the lecturers, as well as student and staff motivation over the holidays.

Existing research documents the pitfalls of teaching on-line and we used these lessons to anticipate problems as we planned our on-line course. This study documents the problems we encountered but hadn't anticipated.

THE COURSE

Internet and Web Design (IWD) is a popular first year introductory course in the Bachelor of Computing Systems degree. It is normally taught flexibly with lectures and practical classes as well as a self-paced on-line course comprised of notes, exercises, self-assessment questions and a discussion forum (1). In the 1999-2000 Summer School, the course was offered completely remotely and condensed from 14 to 11 weeks. There were no face-to-face sessions except an orientation session, the project presentations and final exam. If students had problems they were requested to post their question on a discussion forum and had no option to ask the lecturers face-to-face.

DISCUSSION

Student issues

No time for a Summer break, condensed time frame, lack of personal tutor-student contact, no option of attending classroom sessions for personal contact with other students and no opportunity to take on a vacation job. Perhaps because of the above issues, there was a higher level of drop outs than normal. Reasons for students dropping out included: getting a job, workload too heavy and no computer access at home

Staff issues

Lack of a gap between semesters to attend to the course administration for the previous course. We undertook the course as an extra to our workload, meaning no summer break to recharge and prepare for the next semester. Most of the workload consisted of administration and marking and we felt the remuneration we received did not reflect the associated workload.

Bulletin board issues

If students had problems they were requested to post their question on the discussion forum rather than e-mail the lecturers, (so that we could avoid duplication of lecturer responses and attempt to mirror classroom communication by allowing students to answer each others' questions when lecturers were not around). Despite our attempts to encourage participation, the use of the bulletin board was fairly low, with only 140 posts over the whole Summer School. Many students continued to email the lecturers rather than use the bulletin board for questions. Perhaps this was because they didn't want to look unknowledgeable in front of their peers, or because we didn't assess the students' contributions (2,3). Lecturers accessed the bulletin board every other day to check for questions to answer. The lecturer's often interrupted their vacations to make special trips to cyber-cafes, only to find that no students were seeking help.

Assignment submission issues

Students didn't email their assignments to the correct address, often sending them to our home email addresses and multiple addresses. Issues resulting from this included: lack of software at lecturer's home; lecturer's vulnerable to the risk of virus infection; and duplication of administration effort. There was a significant administrative burden for the lecturers who had to confirm receipt by email and print out the assignments. This was exacerbated by the often inappropriately large file sizes of the email attachments, (e.g. one Storyboard Word document was 3.5Mb).

Group work issues

Generally, students find it difficult to work in groups. This is exacerbated in an on-line course by having to use the printed word rather than face-to-face interaction. The condensed timescale of the course made this even more of an issue and one of our groups suffered a complete breakdown in communication. During a Semester course it is easier to identify problems with group dynamics and deal with them before they escalate.

CONCLUSIONS

The students had a generally favourable impression of on-line learning, but with reservations about the lack of personal contact and the high workload due to the collapsed course time-scale. Reasons for the course's success included: anticipating possible problems and devising strategies to deal with them; and the considerable amount of user-testing that took place in the prior flexible on-line versions of the course, when semantic problems could be cleared up easily.

However unexpected problems were: inter-group conflicts; a higher than normal drop-out rate that impacted on other group members; higher than normal administrative burden on the lecturers; and serious practical problems with the publishing of student web-sites using FTP (4).

It is important to spend time forming project groups, to let the students get to know each other's skill-set and interests thereby avoiding problems. This is perhaps even more important in a fully on-line course.

REFERENCES

1. Young, S., McSporran, M, and Dewstow, R. (1999) Who Wants to Learn On-line? Proceedings of National Advisory Committee on Computing Qualifications Conference, Dunedin
2. Hart, G., and Gilding, A. (1997) Virtual Tutorials, Virtual Lectures, Virtual Prisons? Proceedings of the Australian Society for Computers in Tertiary Education Conference, Perth
3. Klem, W.R. (1998) Eight Ways to Get Students More Engaged in Online Conferences, Technological Horizons in Education Journal. Accessed April 28, 2000 http://www.thejournal.com/magazine/vault/a1997.cfm
4. Dewstow, R., Young, S., and McSporran, M. (2000) Remote Remedies: Challenges When Teaching On-Line. Proceedings of National Advisory Committee on Computing Qualifications Conference, Wellington (in press)

Streaming Video: Pedagogy and Technology

Trevor Doerksen
University of Calgary
2500 University Dr. NW
Calgary, Alberta, Canada
doerksen@ucalgary.ca

Mike Mattson
University of Calgary
2500 University Dr. NW
Calgary, Alberta, Canada
mmattson@ucalgary.ca

Jack E. Morin
George Washington University
Washingtom, DC.
United States
morin@ucalgary.ca

Abstract: Offering video and other rich media content over the Internet is an emerging growth area and represents a new model and opportunity for education. As broadband access increases and advances are made in network caching, streaming servers, video and audio compression, and multimedia databases, delivering streaming video claims unprecedented potential for education. Universities and corporations will continue to look to technology to deliver distance education and web based courses. Determining the pedagogical applications of streaming video is an important area of research. Identifying the strengths and weaknesses from an educational point of view provides an important context to the practical matters of technical implementation. This research intends to investigate both the pedagogical implications and the technical implementation of streaming video.

Overview

Offering video and other rich media content over the Internet is an emerging growth area and represents a new model and opportunity for education. As broadband access increases and advances are made in network caching, streaming servers, video and audio compression, and multimedia databases, delivering streaming video claims unprecedented potential for education. Universities and corporations will continue to look to technology to deliver distance education and web based courses. Determining the pedagogical applications of streaming video is an important area of research. Identifying the strengths and weaknesses from an educational point of view provides an important context to the practical matters of technical implementation. This research intends to investigate both the pedagogical implications and the technical implementation of streaming video.

Often when new technologies, like video, are applied to education they are seen as having the ability to make us all learn better and faster. Some of the questions that need to be answered regarding pedagogy include:

- Does streaming video over the web offer any more promise than standard videotape, the Laser Disc, or the CD-ROM?
- Can the metadata applied to streaming video offer learning strategies and information that was previously unavailable?
- Does the distribution medium, the Internet and a computer, improve the quality or access to instruction?
- What are the ideal tools and methods to develop content and sufficient metadata that make streaming video effective in teaching and learning?

In addition to the pedagogical perspective, there is a highly technical aspect of streaming video that affects price, availability, usability, performance, and quality. The following technical components will be investigated:

- Copyright, Security, and Intellectual Property
- Multimedia Databases
- Servers
- Clients
- Compression
- Network Caching and Bandwidth Issues

Finally, partnerships with industry suppliers, distributors, faculty, and technology solutions will be investigated in an effort to provide business models that can recover the costs of implementing and delivering streaming video content for universities.

Currently, the pedagogical potential of streaming video has not been demonstrated, the technology is so new that it remains largely untested in a learning environment, and content development tools are crude or non-existent. Answering the various pedagogical and technical questions are important outcomes of this research project. Performance indicators of this research will include the application of streaming video technologies to multiple content areas - including campus and off-campus users. In addition, the partnerships developed with industry, such as Akamai or other industry partners, will be measured against the benefits to the institution.

Detailed Description

Applications for streaming video are various. They include: webcasts of special lectures; access to a rich educational video library; video and audio conferencing; the integration of video into course web pages; and the creation of video-based educational objects. The effectiveness of this technology to teaching and learning is largely untested, but none the less the demands to incorporate it into teaching and learning are starting to be met by the technology. Only recently has a distribution medium become available that allows full text searching of video, the application of metadata, interactivity, and other media in ways that make the use of video in education more flexible than ever before. Research into the tools, usability, educational effectiveness, and various solutions benefit current and future teaching and learning at our post-secondary institutions.

The focus is on three main aspects of streaming video. These are quality and performance, pedagogy, and business models. Compression algorithms, the end user software, or client, networking technologies and server solutions impact quality and performance. In order to study quality and performance, various partners around the world are providing and testing content. Other partners, that can provide performance enhancements to streaming video including, cable companies, phone companies, and broadband access providers is under investigation. Various solutions' quality and performance will be compared by individual reviewers and focus groups in several locations. Quality and performance will be tested given different conditions, including connection speed, time of day, distance from server, end-user platform, server characteristics, compression algorithm, and client. Akamai's Free Flow server technology will be tested to compare performance enhancements at a regional and international level. Campus and off-campus user tests will determine quality and performance standards for the main streaming video solutions.

Streaming video, in itself, is like any other video format from a pedagogical point of view. Video, in general, is considered linear and lacking interactivity. If putting learners in front of a video feed was effective, we would learn from home, in front of our televisions, watching a video taped lecture. Clearly, streaming video of lectures over the web does not represent any educational advantage over distributing VHS copies of lectures. However, the potential for the video and audio to contain additional information may provide an educational advantage. Using video taped scenarios that demonstrate procedures and principles can be an effective use of video. Marking up that scenario with additional information, or metadata, may demonstrate clear advantages for teaching and learning. Creating interactivity, allowing the learner to make decisions, search text, navigate non-linearly , and interact with the video may allow a learner more effective access to learning using video than previously possible. Demonstrating the possibilities is not simple. Tools that develop the metadata, and procedures that accommodate advanced content development for video are crude and difficult to use. In fact, although the need and technology exist, there no cost effective methods for creating a transcript of a video without the use of an individual typing what they hear into a computer. The expense of adding this metadata discourages its inclusion. The goals here are to demonstrate its potential and to discover processes and tools that permit the inclusion of metadata for streaming video. It is anticipated that this research will more clearly specify the need for content development software to be developed.

Associated with content development for the metadata of video are the data stores for the video and its metadata. There are several commercial database solutions currently available and establishing the criteria that matches sound pedagogy for the database is an important outcome of this study. One of the issues is extensibility of the database. Scalability, compatibility and reusability are all related to extensibility. The momentum of educational objects and IMS metadata standards for education dictate the need for the open, flexible standards and an object oriented approach. A solution where costs do not prohibit university access to necessary features, while offering security and intellectual property protection will be sought.

The third aspect of this research focuses on the costs, partnerships, infrastructure requirements, and opportunities of streaming video for institutions. In essence, a business model that can sustain the delivery of streaming video for the institution. Costs associated with video production, editing, and compression are high, adding in metadata and storing in it all in large database applications can be very high. Pricing varies widely between suppliers and solutions and an investigation into the details will lead to recommendations for implementation. Other costs associated with streaming video include servers, licensing fees, and Internet infrastructure. A detailed comparison of these costs against the performance and quality testing will lead to additional recommendations.

In addition to the cost/benefit analysis, the opportunities for collaboration with the private sector is being investigated. Opportunities exist that allow the university and its faculty to recover royalties to its intellectual property and charge for access to its servers. Streaming video over the web could prove to become the best distribution medium available for the thousands of hours of video already produced and owned by our institutions. Developing the types of partnerships and business models that could help support delivery, provide new content, build infrastructure, reach broader audiences, and maintain hardware and software is being prototyped at the University of Calgary.

Summary

The various complex issues from network, to compression, multimedia databases and usability require research, development, and testing to determine the best solutions for the institution. Guided by sound pedagogy, the framework suggested above is meant to get to some of the most important and practical issues, enabling the recommendation and adoption of solutions for the use by a post-secondary institution.

The Impact of Visualisation on Chemistry Teaching and Learning

Danica Dolnicar, Margareta Vrtacnik, Vesna Ferk
Faculty of Natural Sciences and Engineering, University of Ljubljana
Vegova 4, 1000 Ljubljana, Slovenia
danica.dolnicar@uni-lj.si, margareta.vrtacnik@guest.arnes.si, vesna.ferk@uni-lj.si

Mateja Sajovec
Simon Jenko Primary School
Ulica 31. divizije 7A, 4000 Kranj, Slovenia
mateja.sajovec@guest.arnes.si

Abstract: The availability of computers, the emergence of new visualisation and authoring tools and techniques, together with the expansion of web based learning environments and CD-based multimedia applications, offer chemistry teachers new possibilities for bridging the gap in students' knowledge and understanding of abstract and concrete chemical concepts and processes. This paper shows by example how the advantages of both the Internet and the interactive CD-ROMs can be used to improve students' learning at both macro- and microscopic level. We present results of a study of the effects of interactive multimedia teaching units on the quality of knowledge.

Introduction

The old Chinese saying, "a picture is worth a thousand words", has been proven many times by modern neuropsychological studies. Human beings can memorize 20% of what they read, and 30% of what they hear, but 40% of what they see, 55% of what they say, and 60% through active involvement; however, when all of the above sensory channels are used simultaneously, this results in the memorization of 90% of the content (Rose, 1993). According to the Gardner theory of multiple intelligences (Veenema & Gardner, 1996), we possess a number of relatively independent types of intelligences: linguistic, logical, musical, kinesthetic, spatial, inter- and intrapersonal. Each individual has the natural ability to use some of his sensory systems better than others. This shows that many different communication channels have to be used to achieve similar objectives with most of the learners. Spatial intelligence is commonly linked to visualisation and can, like all intelligences, be improved by various activities (e.g. in chemistry through use of models of chemical structures), which should be increasingly incorporated in the teaching and learning process.

In chemistry, three levels of visualisation are defined, which we explain by the example of chemical experiments. At the macro level, the real world is representable by photographs, drawings or video clips of the laboratory experiments. The 3D models of chemical structures or animations of chemical changes represent the micro level. At the symbolic level, chemical change is visualised by chemical equations or graphs. In order to achieve the learning objective, all three levels have to be correlated.

In this paper we present our work on the design, development and evaluation of interactive multimedia teaching units and web based teaching resources to be used at the primary and high school level. They can be used either for individual learning or in parallel with the traditional teaching tools in the classroom situation.

Development of multimedia chemistry teaching materials

In the design and implementation phase of the underlying CD-ROM applications of teaching materials all three different levels of visualisation in chemistry are taken into account. By using video, animations, and simulations coupled with interactive questions, games and problem-solving tasks, the users have, e.g. in the case of a chemical reaction, the possibility to observe chemical changes in reactants and products as well as energy changes, to follow them step-by-step, and then evaluate their observations. We try to simultaneously activate as many of their receptor channels as possible, and the use of nonvisual and static elements is kept to the minimum; the learning and testing

segments are tightly interlaced. Through communication - either live discussion with a teacher or via guided online discussion groups - the concepts learned are further clarified and relevant information is shared among the users.
The use of existing multimedia teaching materials in schools is supported by the intensive in-service training seminars for chemistry teachers. Teachers become prepared for active involvement in the development of teaching materials, produced by the University. To facilitate the needs of teachers and students, a specialized chemistry website named KemInfo was established. It includes a module on the visualisation of chemical structures and processes, together with tutorials for existing high quality educational multimedia CD-ROMs. It also provides the users with original interactive teaching materials, prepared either by teachers, through small-scale projects, or by the university lecturers. The teaching materials vary in size and complexity, the emphasis being on the applications using visualisation techniques (e.g. interactive maps of chemical reactions) and interactivity (collections of interactive exercises and games).

Evaluation of multimedia chemistry teaching materials

In spite of the rich assortment of educational CD-ROMs for chemistry, very little has been published regarding the impact of multimedia on the knowledge and motivation of students, let alone the cost-effectiveness of these products. In a research project, our own interactive multimedia CD-ROM, "Light and Chemical Change", was evaluated. The impact of multimedia on cognitive, motivational and motoric development of students was investigated in a qualitative study. The research involved a sample of 50 third-year secondary school students, who were divided into two proportional groups, namely the experimental and the control group. Both groups were pre-tested a week prior to the experiment through multiple-choice and open-answer written tests, so that the initial difference between the groups could be established. The experimental group then worked with the interactive CD-ROM in pairs, and they were given three hours to learn a specific content, presented by video clips, animations and simulations, accompanied by interactive questions with intelligent feedback. This group did not use any other source for knowledge consolidation. Students from the control group were also given three hours, with several course books available, starting with the teacher's explanation of the subject topic. A week after the experiment both groups took a post-test focused on understanding the concepts at the microscopic level of visualisation. The performance of both groups before and after the learning session was compared. Whereas the groups did not significantly differ at the beginning, the results of the post-test show significant difference in favor of the experimental group, which can be largely attributed to the visualisation clements included in the CD-ROM and its interactivity. In our ongoing research project, a study aimed at improving the efficiency of visual elements used in multimedia tcaching units is being conducted. We are investigating the correlation between the spatial abilities of the individual students and their ability to correctly interpret different chemical processes visualised by application of the diverse tools.

Conclusion

Active involvement of teachers in developing high quality multimedia teaching materials is the key factor for their regular use in schools. The research on the effects of such materials is needed to provide the developers with the feedback. The use of visualisation elements at all three levels is crucial in chemistry teaching, however the learning process has to be supported by discussion and testing.

References

Rose, C., & Goll, L. (1993). *The art of Learning.* Tangram, Ljubljana.

Veenema, S., & Gardner, H. (1996). Multimedia and Multiple Intelligcnces. *The American Prospect*, 29 (11-12).

Vrtacnik, M. (1999). Visualisation in Chemistry Education. *Kemija v soli*, 11(1), pp. 2-8.

Vrtacnik, M., Ferk, V., Dolnicar, D., & Sajovec, M. (1999). The Role of Visualisation in Learning Chemical Concepts and Processes. *Organizacija*, 8-9 (10-11), pp. 454-460.

Dolnicar, D., & Ferk, V. (1999). Usage of Multimedia Resources in Slovenia. *Multimedia Resources for Chemistry in Europe.* Progress Report, SOCRATES Open and Distance Learning Programme.

Student Technology Services:

A Case Study in Experiential Learning
Session #: 6070

Joe Douglas & John Grozik
University of Wisconsin, Milwaukee
Box 413, Bolton 574J
Milwaukee, WI 53223
jnd@uwm.edu
grozik@uwm.edu

Abstract:

A unique service organization, consisting exclusively of student employees, exists within the University of Wisconsin's Information and Media Technologies Division. Known as Student Technology Services (STS), this student managed organization is tasked with the operation of various computer, media and technology related campus services. STS employees work in all areas of I&MT including the Campus Computer Labs, Classroom Support, Desktop Support, Help Desk, Network Services, Peer Training, Photo Services, Printing Services, Shortcourses, Technical Resources, Video and Multimedia Production Services, TV Engineering, Distance Education Technologies, Visual Design Services, and Web Maintenance Services. More than 300 students are expected to be employed in STS by Fall 2000.

Student Technology Services (STS):

Student Technology Services (STS) is a student staffed, student managed organization responsible for delivering technology and media-related services to the campus community of the University of Wisconsin-Milwaukee. While empowered student IT workers are employed to provide a service, they are at the same time engaged in a learning experience. They are preparing themselves for their future careers through "experiential learning".

Student employees of STS come from virtually every academic major. Whereas many universities employ primarily technical majors under the mistaken belief that only they can satisfy their campus community's technology needs, STS instead looks for interpersonal skills, drive, and willingness to learn. STS has discovered that customer service and management skill sets have become as important as technical skills in the delivery of information and media-related technology services. Because most STS student employees do not have technical backgrounds, a carefully tailored training curriculum was developed and implemented. The purpose of the curriculum is to empower STS student employees by giving them the technical skills they will need to excel in their jobs as well as important professional and life skills they will need to excel in their future careers.

The STS training curriculum becomes an education when the learning is demonstrated through experience (i.e., implemented on the job) and when the experience is reflected upon (i.e., in an extensive oral and written evaluation.) Because completing the multiple levels of the curriculum, using the skill sets on the job and participating in the evaluation process are all mandatory conditions of employment, STS provides the setting for experiential learning at institutions of higher education. Many of the classes in the STS curriculum are developed and taught by STS students themselves. These STS Peer Trainers do not impose upon the institution's academic teaching mission, yet are an integral part of adding value to the learning experience of STS students. STS Peer Trainers are evaluated after each class they teach and are charged with making the necessary adjustments to their lesson plans.

In addition to the experiential learning provided by the curriculum, STS students are encouraged to transfer to other departments each year in order to learn and practice new skills. The exposure they gain in these other areas strengthens their learning experience and enables them to identify their personal and professional strengths and weaknesses. STS students are required to maintain a portfolio of their diverse work experience and training. The portfolio serves as the reflection piece to the classroom and on-the-job experience, thereby further adding value to TS' philosophy of experiential learning.

STS' focus on experiential learning has been met with welcomed enthusiasm at UW-Milwaukee. STS student employees are sought after not just for their learned technical skills, but also for the maturity and professionalism that they acquire through on-the-job experience and reflection pieces. UWM department heads specifically request STS student employees to be placed in their departments to troubleshoot and to maintain department web pages.

STS' example of experiential learning is now being introduced to the 26 other campuses within the University of Wisconsin System. Wisconsin's governor recognized the benefits of experiential learning as a means of preparing a qualified workforce in the state that can remain competitive even in the fluid environment of information technology. The Governor's Office recommended increased funding for training IT student workers throughout the entire University of Wisconsin system. His decision was based solely on the UWM STS model and its success. The biennium budget was signed into law in October, 1999 thus propagating the STS model of experiential learning throughout the state.

The STS program has generated strong interest from many academic and non-academic partners. We are exploring relationships with public school systems and with leaders in private industry to provide:

- A pre-college program to create work experience and training in technology for high school students.
- A similar work program focused on the two year technical college in Milwaukee
- Summer internships and potential scholarships for the STS student employees at UWM
- Meaningful industry relationships for students leading to employment upon graduation.

We have met with enthusiasm and willingness by all participants to work together on these new relationships. We look forward to a greatly enhanced student empowerment program when the new partnerships are in place.

Internet Connection

For additional information, please visit the STS web site at: **www.uwm.edu/IMT/STS**

The Effect of Level of Technology Training on Teachers' Attitudes Toward Using and Integrating Technology

Ronald Dugan, Jennifer Richardson, & Dianna L. Newman, Ph.D.
Evaluation Consortium/School of Education
University at Albany/SUNY
United States
rd1872@cnsvax.albany.edu

Abstract: This paper is a report of an ongoing longitudinal evaluation assessing the effect of level of technology training on teachers' attitudes and comfort toward using and integrating technology into the curriculum. Multivariate and univariate analyses were used on an initial sample of 54 K-12 public and private school teachers from a Northeast state undergoing two levels of technology training who participated as part of a Technology Literacy Challenge Grant. Initial findings support and extend previous research that shows teachers become more comfortable with using and integrating technology, and possess more positive attitudes toward technology, as the extent of training increases.

Introduction

Although over 8.5 million computers are being used for instruction in the U.S., and 85% of K-12 teachers have access to computers and other technology (Survey finds..., 1995), only half of all teachers report using computers for instruction (Hunt & Bohlin, 1995). Social learning theory (Bandura, 1977) predicts that failure of teachers to use computers will vicariously teach students not to use computers. This lack of computer use may be related to attitudes (e.g., anxiety) toward technology (Pina & Harris, 1993). Although ¼ of all people who use computers experience some degree of "computerphobia" (Rosen & Maguire, 1990), when teachers experience it, this interferes with their ability to integrate technology into the curriculum (Hunt & Bohlin, 1995). The strongest predictor of computerphobia is experience (Rosen & Weil, 1995). Limited research has shown anxiety towards computers decreases after training and practice (Cambre & Cook, 1987), yet only 29% of teachers report having more than five hours of technology training in the past year (Technology Counts '99, 1999).

The Study

The purpose of this study was to investigate the effect of level of technology training on teachers' attitudes toward, confidence using, and comfort with integrating technology. Attitudes were represented by three constructs: anxiety, avoidance, and fear of stereotyping. Confidence was measured in three areas: software, hardware, and communication tools. Comfort with integration was assessed by participants indicating one of six stages (awareness, learning the process, understanding and application, familiarity and confidence, adaptation to other contexts, and creative application to new contexts). Training occurred at two levels (Level I; 5 days training on using Power Point or Hyperstudio in the classroom: Level II; Level I training plus 3 additional days training in Web page design for curriculum use). Participants were 54 public and private school educators participating in a regional Technology Challenge Grant training program in a Northeast state. Twenty-six educators experienced Level I training while 28 educators experienced Level II training. Over 300 educators are expected to be trained at both levels by the end of this grant year. An end-of-year paper/pencil survey was administered to the first cohorts of educators experiencing both Level I and Level II training so far this school year. Ten items measured attitudes toward technology (anxiety, avoidance, and fear of stereotyping) on a six-point, Likert-type scale (1=strongly agree, 6=strongly disagree). Eighteen items measured confidence in using technology (hardware, software, communication tools) on a six-point scale (1=extremely confident, 6=not at all confident). The Stages of Adoption Scale (Knezek & Christensen, 1999) measured comfort with using and integrating technology into the curriculum.

Findings

A multivariate analysis of variance (MANOVA) was used to analyze the data. The fixed, categorical independent variable was level of technology training (Level I and Level II). The continuous, random dependent variables were confidence with using technology (software, hardware, and communication tools), and attitudes toward technology (anxiety, fear of stereotyping, and avoidance). Findings indicated no significant difference for level of training on confidence in using technology ($F=1.26$; $df=3,37$; $p>.05$). However, a significant difference was found for the effect of level of training on the construct of attitudes toward technology ($F=2.83$; $df=3,50$; $p<.05$). Examination of the univariate Fs indicated a significant portion of the construct was avoidance ($F=6.78$; $df=3,50$; $p<.05$) and anxiety ($F=6.61$; $df=3,50$; $p<.05$), accounting for 15% of the total variance (Wilkes lambda=.85). A univariate analysis of variance (ANOVA) was used to analyze the effect of the fixed, categorical independent variable (level of training) on the continuous, random dependent variable of comfort using and integrating technology (six stages: awareness, learning the process, understanding and application, familiarity and confidence, adaptation to other contexts, and creative application to new contexts). A significant difference was found for level of training ($F=5.00$, $df=1,50$, $p<.05$) on stage of comfort. Strength of association showed that nine percent of the variability in level of comfort could be accounted for by level of training. Those with more training were more comfortable with integration.

Conclusion

These findings support previous research that shows teachers who receive training in using and integrating technology into the curriculum experience less anxiety toward, and more comfort with, that technology. This study adds to existing literature by showing that additional training with more advanced technological software further decreases computer anxiety and increases comfort with integrating technology above and beyond less, and lower-level, training. If teachers are expected to integrate technology into the curriculum and model appropriate technology utilization behavior for their students, they need more training than the levels currently being received by most educators.

References

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall.

Cambre, M.A., & Cook, D.L. (1987). Measurement and remediation of computer anxiety. *Educational Technology*, 27 (12), 15-20.

Hunt, N.P., & Bohlin. R.M. (1995). Events and practices that promote positive attitudes and emotions in computing courses. *Journal of Computing in Teacher Education*, 11(3), 21-23.

Knezek, G., & Christensen, R. (1996, January). *Constructing the Teachers' Attitudes Toward Computers (TAC) Questionnaire*. Paper presented at the Annual Meeting of the Southwest Educational Research Association, New Orleans, LA.

Pina, A.A., & Harris, B.R. (1993). *Increasing teachers' confidence in using computers for education*. Paper presented at the annual conference of the Arizona Educational Research Organization, Tucson, AZ.

Rosen, L.D., & Maguire, P. (1990). Myths and realities of computerphobia: A meta-analysis. *Anxiety Research*, 3, 175-191.

Survey finds higher than expected use of technology in the nation's K-12 classrooms. (1995, September 7). *Teacher Education Reports*, 5-6.

Technology Counts '99. (1999, September). Education Week. [Available online at http://www.edweek.org/sreports/tc99.html]

LearnScope and the Development of Virtual Learning Communities

Allan Ellis
School of Social and Workplace Development
Southern Cross University, Australia
aellis@scu.edu.au

Robyn Weatherley
Training and Development Directorate
NSW Dept of Education and Training, Australia
rweatherley@cci.net.au

Abstract: The Vocational Education and Training (VET) sector in Australia is coming under increasing pressure, both nationally and internationally, to deliver courses in flexible ways that incorporate the latest in information and communications technologies such as the Internet and the World Wide Web. LearnScope is a national initiative funded by the Australian National Training Authority (ANTA). Its aim is to provide professional development support to individuals and work groups in order to develop skills and capabilities for the online environment

A preliminary study of LearnScope's Virtual Learning Community (VLC) was undertaken using a questionnaire based survey plus analysis of transcripts of forum discussions and published stories. The results highlight the complexity of the role of providing professional development for establishing online learning communities. The major areas of Technical Skills and Computer Literacy, Writing and Communication Skills, issues of Interactivity, and the development of Self-related attributes are identified as important if the VET sector is to build a critical mass of creative, capable instructors to work in the online environment.

The Changing Context of Vocational Education and Training

As the geographical boundaries of Vocational Education and Training (VET) in Australia become blurred, both nationally and internationally, the competitive edge of providers, Registered Training Organisations (RTO's), will not only be the courses and training programs they offer but the quality of instructor support and service provided to the learner. Information and communications technologies (ICT) such as the Internet and the World Wide Web has seen online interactivity emerge as a critical factor in delivering learning materials and supporting learners and instructors. A series of Australian National Training Authority (ANTA) reports (1994, 97 and 98) provide details to developments in this area.

Traditionally VET practitioners, in particular those in Technical and Further Education (TAFE) Colleges, have been provided with professional development to update their skills. In recent years this has been through work based learning using a range of processes such as mentoring, coaching, workshops, discussion groups, conferences and site visits. In the area of ICT, professional development programs have primarily focussed on technical skills development, that is, learning how to use the technology without focusing on the 'deeper' level of critically understanding the benefits and restrictions of using these tools in the learning environment.

LearnScope and its Virtual Learning Community

LearnScope is a national professional development initiative that is available to work teams and individuals within RTO's. It is focussed on the development of skills to deliver training in increasingly flexible ways using new ICT's. The LearnScope home page provides more details: http://www.learnscope.anta.gov.au/cover.html

For the individual instructors it is LearnScope's Virtual Learning Community (VLC) that provides a range of activities in several zones. These activities include:

- *About LearnScope* – an information about the national LearnScope project, guidelines and application forms and contact people within the project.
- *Key Issues* – an information area which provides clustered groupings of key issues relating to flexible delivery. This includes resources, text, access to software, people or web sites.
- *Project Gallery* – the area where LearnScope teams publish their plans, interim and final reports.
- *Expert Spruik* - an area to introduce key people who will contribute to the LearnScope VET community.

- *RantZone* – an area for people to practice their publishing skills, request information or make a statement.
- *Evaluation* – an area for the LearnScope's project evaluator to submit information about evaluation issues
- *What's New* – a frequently changing area which provides a summary of key information for all users.
- *Forums* - an area for both public and private discussions.
- *Chat Room* – an area for planned synchronous discussions.

While the VLC is primarily for the support of LearnScope project teams, anyone interested in the application of new learning technologies to achieve more flexible learning and professional development within the vocational education and training sector is welcome to register and participate.

The Survey: Methodology and Sample

Data was gathered in 1999 during two rounds of LearnScope projects and in two formats: a questionnaire, and forum discussions and published stories (Weathereley, 2000). A total of 58 questionnaires were distributed and 33 were returned giving a response rate of 57%. A total of 153 postings to 5 forums (average 14, range 10 to 21 participants per forum) as well as 336 published stories were also collected. These data was then used to:
(i) Identify the reactions, feelings and thoughts to using a virtual learning community in the context of the national VET system and to gain insight as to the level of experience of users.
(ii) Identify how VET practitioners used an asynchronous forum area set up specifically for learning.

Findings and Recommendations

It is recommended that for instructors or professional development planners who are engaging in developing online learning plans that the following areas of skills development and capabilities must be addressed:
(i) **Technical Skills and Computer Literacy**: To achieve the best possible learning environment it is necessary to go beyond the simplistic operational understanding of ICT. It is important to have the capability to make critical judgements about its appropriateness and to develop ideas about teaching and learning within the environment. The challenge for the national VET system is getting more people involved in a professional community which as Spitzer and Wedding (1995) says "...requires the active and willing participation of teachers in the process of examining, reflecting on, experimenting with, and ultimately changing the way they practice – in the context of a professional community that allows them to enrich their understanding of subject matter and to consider issues about how students learn."
(ii) **Writing Skill and Communication Style:** For online learning communities to be successful, the writing and language skill must be conducive to the audiences ability so that group interaction, sharing and participation can lead to an environment based on relationship development.
(iii) **Interactivity**
(iv) Understanding the range of interactive possibilities and promoting an environment which encourages active interaction online between people is vital. Understanding the significance of the human medium and the levels of interactivity will provide teachers with the potential to make critical judgements about student learning.
(v) **Self-related attributes**: Developing self-related attributes is significant in professional development for the online learning environment. Teachers need to identify, develop and model these attributes. Self-related attributes should also be an important aspect of learner development.
(vi) **Teaching and Learning**: Knowledge building in order to gain maximum benefits of an online community and to provide a quality learning environment, requires a range of strategies. Based on the constructivist model where learning builds on previous professional and personal experiences, the importance of linking practice with discussion, dialogue and debate in this new learning field is critical. Professional development activities need to incorporate pedagogical dimensions. These recommendations must be incorporated into instructor's professional development plans otherwise a quality online learning environment will not be achieved.

References

Australian National Training Authority (1998) *A Bridge to the Future: Australia's National Strategy for Vocational education and Training 1998-2003*, Australian National Training Authority, Brisbane.
Australian National Training Authority (1997) *About the Australian National Training Authority*, 1998, Australian National Training Authority, http://www.anta.gov.au/anta_prod/abc/default.htm
Australian National Training Authority (1994) *Towards a Skilled Australia: A national strategy for vocational education and training*, Australian National Training Authority, Brisbane.
Spitzer, W. & Wedding, K. (1995) 'LABNET: An Intentional Electronic Community for Professional Development', *Computers Education*, vol. 24, no. 3, pp. 247-255.
Weatherley, R. (2000) Online Learning: What really matters for teachers in vocational education and training, unpublished Masters dissertation, Southern Cross University, Australia.

Integrating WWW Technology into Classroom Teaching: Students' Perspectives of the Usefulness of their Course Web sites

Manal A. El-Tigi
Syracuse University
330 Huntington Hall
Syracuse, NY 13210
maeltigi@syr.edu

Abstract: The purpose of this study is to explore students' perceptions of the use of World Wide Web (WWW) technology as an instructional resource specifically customized to support teaching and learning practices on campus-based classes. While there are many efforts to design meaningful learning environments there is very little current instructional design literature on fostering and support of Web-based environments. This study examined college students' perspectives on the usefulness of specific Web site functions used for teaching and learning purposes, in an effort to optimize the use of Web-based instructional support resources.

Review of Relevant Literature

The 1999 Campus Computing Project's (CCP) national annual survey of information technology in higher education reported that many higher education institutions are providing more services via the WWW (CCP, 1999). For example, more than half (69.5%) of these institutions provide online undergraduate applications on their Web sites. More than three-fourths (77.3%) make the course catalog available online. A quarter (25%) of the institutions make library-based course reserves readings available online and almost a half (46.5%) offer one or more full college courses online via the Internet and the WWW. Similarly, the percentages of college courses using the WWW in the syllabus rose from 7% in 1995 to 28% in 1999 (CCP 1996). This number quadrupled by 1999 meaning that more than one in every four classes has a Web page. In fact, compared to e-mail and general use of Internet resources, use of Web pages has shown the highest rate of increase over the six-year period. E-mail had already been in use in 1994 rising to 54% by 1999 up from 44% in 1998, and 20% in 1995. Khan (1997) provided a definition of Web-based instruction used for the purpose of this study.

> Web-based instruction (WBI) is a hypermedia-based instructional program which utilizes the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is *fostered* and *supported* [italics added]. (p. 6)

At a university level, the *Syracuse University Faculty Syllabus Web site* available at http://syllabus.syr.edu is an example of a growing list of campus-based course Web sites. For the purposes of this study, a preliminary analysis of 175 Syracuse University Web sites was conducted during the fall 1998 semester.

Theoretical Framework

A conceptual framework was developed to ground and guide the research conducted in this study. There is evidence from research findings that certain principles exist in most successful teaching and learning practices (Chickering and Gamson, 1987, 1991). Second, there is evidence in the literature that the application of instructional design principles to the teaching and learning practices leads to more effective learning (Gagne' 1975, Gagne', Briggs, & Wager, 1992). One of the important measures of effective instruction is how students feel about the instructional process (Dick & Reiser, 1989). Based on the above premises, one can make the assumption that a well-designed instructional Web site can support and facilitate good teaching and learning practices and therefore can be perceived as a valuable instructional resource for both faculty and students.

Purpose of Study and Research Questions

The purpose of this study was to examine the opinions and perceptions of college students' use of the course Web site as an instructional resource for classroom-based teaching at a private university in the northeast of the United States. The focus of the study was on the identification of Web site functions that students' perceived as *supporting* and *enhancing* of their learning experiences by exploring students' perceptions of the usefulness of the various Web site functions. The following question was posited: How useful did students perceive their course Web sites?

Method

142 primarily undergraduate students enrolled in nine courses that employ Web sites as course resources responded to a questionnaire on their use of their respective course Web sites. Initially, all Web sites were first screened using an instrument developed by the researcher to evaluate the Web sites' instructional quality and design based on principles of instructional design. On the student Web site perception questionnaire (SWPS), functions pertaining to the Usefulness dimension were construct validated using confirmatory factor analysis. Two indexes were constructed for the *Usefulness* dimension using items that loaded (>0.60) on these two factors: GUIDE and PREPARE. The first represents practice, elicitation, and feedback functions. The second represents functions that facilitate recall of prior learning and enhance retention and transfer through communication, enrichment and remediation. All functions are derived from Gagne', Briggs, and Wagers' (1992) nine events of instruction and Chickering and Ehrmann's (1996) principles of good teaching and learning practices using technology as lever.

Results

Results showed that most functions were useful with a mean score for the PREPARE index (n=132, M=1.87, SD=0.74, scale 0-4 where 4=highly useful) and a higher one for GUIDE (n=131, M=2.20, SD=0.71, scale 0-4 where 4=highly useful).

The PREPARE index consisted of functions including: (a) the use of pictures, tables, diagrams, etc. to recall or present new information (n= 78, M=2.79, SD=1.00); (b) the additional links and information on the course Web site for further study (n= 96, M=2.43, SD=1.16); (c) the links to review/pre-requisite material to help recall (n=91, M=1.87, SD=0.74), and (d) overall usefulness of the course Web site (n=132, M=2.63, SD=1.13).

The GUIDE index consisted of functions including: (a) the opportunity to ask questions online (e-mail, listservs, hypermail, etc. (n= 112, M=2.74, SD=1.00); (b) posting graded assignments/Home Work on the Web (n=64, M=2.66, SD=1.30); (c) online practice assignments (n=47, M=2.64, SD=0.85); (d) online feedback on various assignments (n= 73, M=2.60, SD=1.00); (e) situations, case studies, formulas, problems, simulations, etc. posted on the course Web site to improve learning (n= 65, M=2.52, SD=0.99); (f) online self-assessment quizzes (n= 49, M=2.51, SD=1.23); and (g) instructions on how to navigate the Web site and download software, get an account, subscribe to a listserv (n= 100, M=2.30, SD=1.10).

Discussion

Key findings from the study are indicated below using Chickering and Ehrmann's (1996) seven principles of good teaching and learning practices for undergraduate education and Gagne', Briggs, and Wager's (1992) nine events of instruction as the framework for discussion. Findings for the PREPARE index related to assisting students to recall information and to transfer new knowledge were supported by functions representing two principles: (a) Good practice gives prompt feedback and (b) Good practice encourages contacts between students and faculty in that the most useful functions were those that enabled students to communicate with their instructors and to receive timely feedback. Electronic mail, computer conferencing, and the WWW increase opportunities for students and faculty to interact and communicate much more efficiently than before. In addition, the nature of communication becomes more thoughtful, deliberate, convenient and safe. Moreover, the negative aspects of face-to face confrontation are lessened. Findings from the GUIDE index indicated that Gagne's et. al. (1992) instructional events pertaining to presentation, practice, feedback, and elicitation of new knowledge and skills were overall most useful functions. The multimedia capabilities of the Web allow for an almost seamless integration of email capabilities, video clips, sound, images, and animation thereby allowing for multiple modes of communication through feedback and assessments. In conclusion, in terms of theoretical implications, the study supported the usability of Gagne's events of instruction in particular the ones related to presentation, practice, elicitation, and feedback, as a viable means of designing course Web sites to support teaching and learning practices. The study also provided empirical findings to support Chickering and Ehrmann's (1996) principles of good teaching and learning practices in particular the ones related to prompt feedback and student-faculty interactions. It is recommended that course Web site design could be optimized to include more instructional functions such as elicitation of responses, practice, feedback, and increased student-faculty interactions using the interactive and visual and auditory display capabilities of the medium.

References

Campus Computing Project (1999). The 1999 national survey of desktop computing in higher education. [Online]. Available: http://www.campuscomputing.net

Chickering, A. & Ehrmann, S. (1996). *Implementing the seven principles technology as lever*. [Online]. Available: http://www.itac.csupomona.edu/staff/lsgonick/chickering.html

Gagne, R., Briggs, L., & Wager, W. (1992). *Principles of instructional design*. Orlando: Florida. Harcourt brace Jovanovich Publishers.

Khan, B. (1997) *Web-based instruction*. Englewood Cliffs, NJ: Educational Technology Press.

Evaluating Motivational Aspects of a Web-based English Language Course through the Website Motivational Analysis Checklist (WebMAC)

Anise D'Orange Ferreira
Graduate Program in Applied Linguistics
Catholic University of São Paulo
Brazil
anise@pucsp.br

Abstract: This work in progress short paper is a report on subjects' evaluations of a web-based language course's motivational aspects through WebMAC, *Website Motivational Analysis Checklist*, developed by Small and Arnone (1998). The subjects were 26 adult students who participated in a basic online English course for Internet users, focused on informal asynchronous and synchronous writing and communication skills, called *Surfing and Learning*. This course is designed by teachers and researchers of the EDULANG research group. The instrument measured the level of four motivation factors which provided the results for two dimensions within an Expectancy-Value framework: *Value* and *Expectancy for Success*. The evaluation results showed a high level of *Value* dimension and *Expectancy for Success*, although factors linked to *Expectancy for Success*, such as *Organization* and *Ease of Use* showed more variation in scores than those linked to *Value*, such as *Meaning*. Although WebMAC seems to be sensitive to student motivation, other kinds of data are required to a complete course evaluation. It will continue to be used for the ongoing evaluation of *Surfing and Learning* and other courses offered by EDULANG.

Introduction

Most researchers agree that motivation is a difficult construct to work with (Weiner,1990). Wlodkowski (1999) says that beyond the general understanding of motivation as a concept that explains why people think and behave as they do, "any specific discussion of the meaning of motivation brings in a cornucopia of differing assumptions and terminology"(p.1). According to Dörnyei (1998) motivation is a "process whereby a certain amount of instigation force arises, initiates action, and persists as long as no other force comes into play to weaken it and thereby terminate action, or until the planned outcome has been reached." (p.118). He also agrees with the idea that motivation is a multifaceted factor and no theory has yet been able to represent it in its total complexity. Despite difficulties, instructional designers continue to seek motivational frameworks in order to achieve a better design in tecnology based learning environments such as the WWW (Cornell & Martin, 1997). Duchastel (1997) elects two main models. One is Keller's ARCS model, considering four factors in motivation to learn: (a)ttention, (r)elevance, (c)onfidence, and (s)atisfaction. The other one is Malone's CFC framework for instrinsically motivated inscruction, which involves three factors: (c)hallenge, (f)antasy, and (c)uriosity. ARCS guided interventions reduced the drop out rate, by half, of a Master's degree distance course intended to prepare adult students for careers in the areas of instructional design, job performance improvement, etc. (Chyung, Winiecki and Fenner,1999). Also influenced by the ARCS model, the *Website Motivational Analysis Checklist* - WebMAC (Small & Arnone, 1998, 1999) was designed to assess the motivational quality of a website. Small (1997) claims that, although the ARCS model is rooted in a number of motivational theories, its main basis is the expectancy-value framework in which motivation to behave is the sum of individual's expectancy for success in a given task plus the value attributed to success in the task. Website quality is measured within expectancy-value framework: the user is motivated to remain in the website if it has value and if the user expects to be successful in the website environment. Dörnyei (1998), surveying motivation in second and foreign language learning (L2) research shows that researchers have adopted and empirically validated some concepts originally introduced by motivational approaches in mainstream psychology, such as expectancy-value theories, goal theories and self-determination theory. Therefore, WebMAC was chosen here to evaluate motivational aspects in a L2 web based instructional design. This evaluation is part of a major research project in which the analysis of interactive flow is also considered (see Collins' paper).

Methodology

The subjects were 26 students, male and female, age 29 to 64 , who participated in a web-based language course in 1999. The course, *Surfing and Learning* (http://cogeae.uol.com.br/sal) offers a basic English for adult Internet users, focusing on informal asynchronous and synchronous writing and communication skills. It was designed by English language teachers, members of EDULANG research group, under the coordination of Heloisa Collins, in the Graduate Program in Applied Linguistics of the Catholic University of Sao Paulo (LAEL/PUCSP). WebMAC versions 3.1 and 4.0 were translated into Brazilian Portuguese and edited into a HTML format, so that the students answered the checklist anonymously at the end of the course and submitted it through a CGI implemented web form. The answers were scored according to WebMAC scoring guidelines. Both versions were used and the scores obtained from 3.1 version were adjusted to version 4.0 factors. WebMAC is composed of assertions or list items to be rated by an evaluator on a 4-point level of agreement scale. The 32 items in version 4.0 measured 4 factors: 1) Stimulating ; 2) Meaningful; 3) Organized and 4) Easy to use. The sum of first two equals the *Value* dimension level; the sum of the other two equals the *Expectation for Success* dimension level. Zero to 8 points for a factor means the site needs much improvement on this factor; 9 to 16, it needs some improvement, 17 to 24 means the site is highly motivating. Version 4.0 contains four additional unscored items: two yes/no assertions and two open questions. Most of list items are the same in both versions. However, they are not related to the same factors. In both versions, each subject provides two main scores that are plotted on a bidimensional grid: 1) Low Value to High Value and 2) Low Expectation for Success to High Expectation for Success. The score position reflects the motivational status of the site in terms of *Value* and *Expectation for Success*. (fig.1)[figures at http://www.anise.f2s.com/anise-edmedia.html]

Preliminary findings

The results (fig. 1) show the scores on the average to high-level area of *Expectation for Success* and *Value*. Only two students showed low *Expectation for Success* and only one gave low scores to *Value* dimension factors. The individuals' scores under each of the four factors (fig.2) show less variation for the *Meaning* factor than *Organized* and *Easy to Use* factors. The answers to WebMAC open questions presented in 4.0 version revealed some students' satisfactions and dissatisfactions. Despite high levels of *Value* and *Expectation for Success*, the amplitude of scores in each of the four factors suggests that the course can be improved in *Organization* and *Ease of Use* factors. The interaction in communication areas of the course was pointed out by students as a particularly strong aspect of the course design. The complaints about tools and dictionaries seem to confirm comparatively lower scores of *Organization* and *Ease of Use* factors. Future work should consider the use of WebMAC during the course. These results can be discussed in terms of guidelines for motivating language learners (Dörnyei, 1998). Although the present instrument seems to be sensitive to student motivation, other kinds of data are required to complete the course evaluation, such as the interaction flow analyses. The ongoing evaluation of *Surfing and Learning* and other courses offered by EDULANG, such as *Reading* and *Listening Comprehension* for public high school teachers, will continue to use WebMAC.

References

Chyung, Winiecki & Fenner (1999). Evaluation of effective interventions to solve the drop out problem in adult distance education. *Proceedings of ED-MEDIA 99, 11th World Conference on Educational Multimedia, Hypermedia & Telecommunications, 1999*. Association for the Advancement of Computing in Education, Charlottesville, VA, Ed-Media 1996-1999 Conferences, CD-ROM.

Cornell, Richard & Martin, Barbara L. (1997). The role of motivation in web-based instruction. In Badrul Khan Ed. *Web-based Instruction*. Englewood Cliffs, NJ: Educational Technology Publications.

Dörnyei, Zóltan (1998). Motivation in second and foreign language learning, *Language Teaching*, 31, 117-135

Duchastel, Philip (1997). A motivational framework for web-based instruction. In Badrul Khan Ed. *Web-based Instruction*. Englewood Cliffs, NJ: Educational Technology Publications

Small, Ruth (1997). Motivation in Instructional Design, *ERIC Digest*, July. [On-line] .Available: http://ericir.syr.edu/ithome/digests/RSDigest97.html.

Small, R. & Arnone, Marilyn P. (1998). *Website Motivational Analysis Checklist (3.1)*. Evaluation Instrument. Directions and Scoring Guidelines. Syracuse: SMALL Packages.

- . (1999). *Website Motivational Analysis Checklist Senior (4.0)*. Syracuse: The Motivational Mining Company.

Weiner, B. (1990). History of motivational research in education, *Journal of Educational Psychology*, 82(4), 616-622.

Wlodkowski, Raymond J. (1999). *Enhancing Adult Motivation to Learn.* San Francisco: Jossey-Bass.

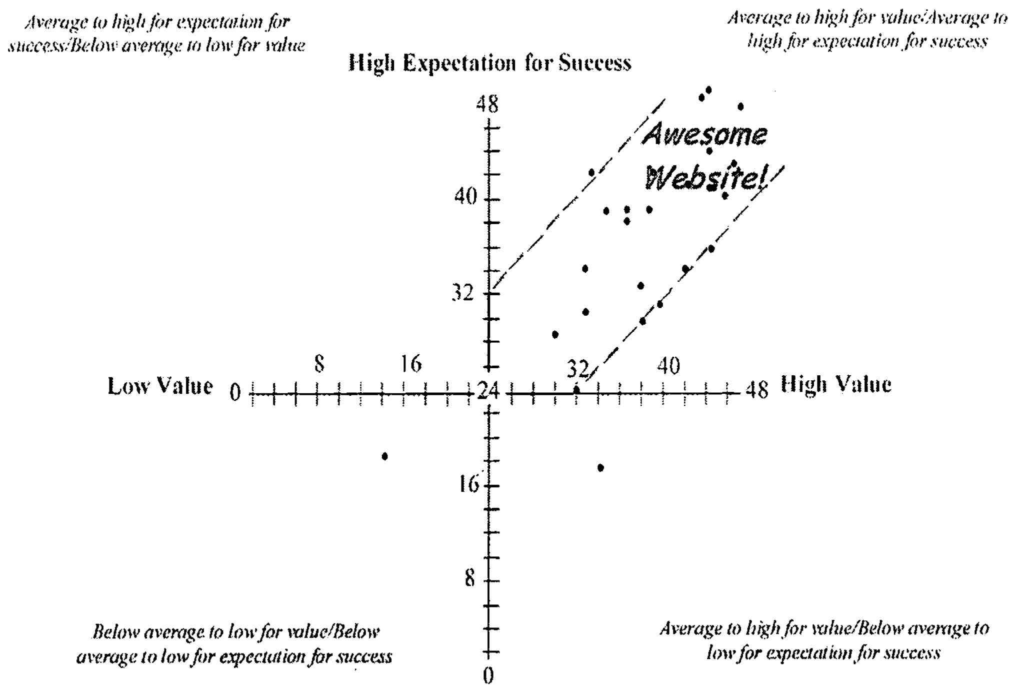


Figure 1. Plotted scores on WebMAC bidimensional grid (N=26)

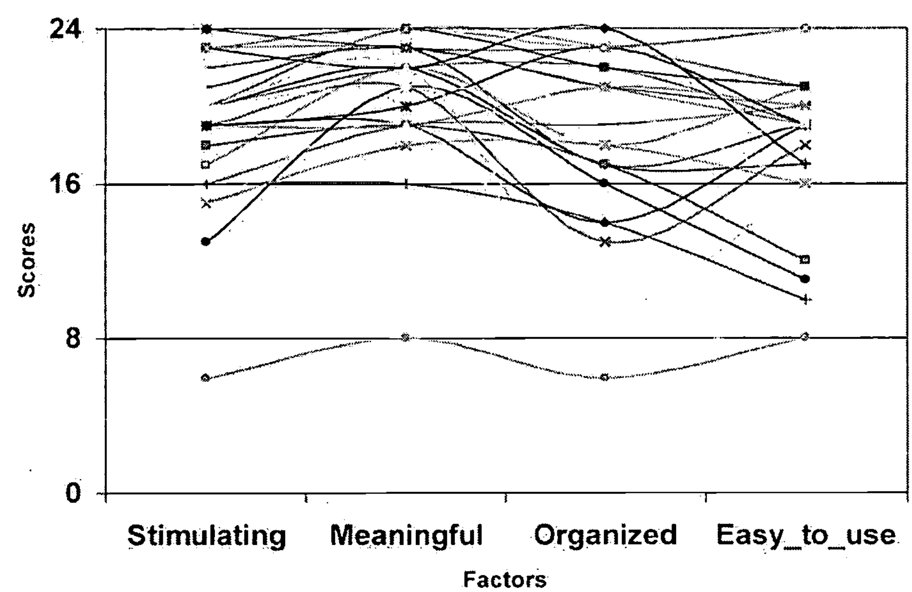


Figure 2. Individual scores related to the four WebMAC (v.4.0) motivational factors (N=26)

BEST COPY AVAILABLE

A Catalyst for Collaboration: Using Partnerships to Support Technology in Teaching

Louis Fox
University of Washington
Office of Educational Partnerships
Seattle, WA 98195-1209
lfox@u.washington.edu

Tom Lewis
University of Washington
UWired Center for Teaching, Learning & Technology
Seattle, WA 98195-3080
tomlewis@u.washington.edu

Scott Macklin
University of Washington
Program for Educational Transformation through Technology
Seattle, WA 98195-3080
smacklin@u.washington.edu

Abstract: UWired created the web-based Catalyst initiative to support innovation in teaching through technology. To scale beyond early adopters, Catalyst has developed a new strategy centered on collaborative partnerships with campus teaching practitioners—learning, technology, and teaching research centers, libraries, and departments—to disseminate innovative uses of technology in teaching through the Catalyst website.

The Problem of Supporting Innovative Teaching with Technology

In 1994, three top-level administrators at the University of Washington were charged by the Provost to "do something about technology." Collaborating with faculty, librarians, technologists, and students they quickly moved beyond a small pilot, rounding up partners and gathering resources from wherever they could to focus on bringing technology into the service of teaching and learning. Today the organization they formed—UWired—has a permanent budget, a staff of eight professionals and over 60 students, and has extended services and support to thousands of students and faculty.

As higher education institutions have scrambled to keep pace with rapid changes in information technology, many campuses have established faculty technology centers, offering workshops and training to interested educators and perhaps even supporting faculty technology projects to transform particular courses. These efforts have generally targeted "early adopter" faculty who are eager and willing to teach themselves how to use and implement new technologies. Resources are thus devoted under the assumption that early adopters will play the role of Johnny Apple-Seed, spreading innovation throughout their home departments. Indeed, UWired inaugurated its Center for Teaching, Learning and Technology (CTLT) to foster and support instructional innovation in this manner.

For the most part, however, this strategy has had a negligible impact on educational transformation through technology. Beyond the few early adopters are legions of "wary adopters" who look for easy ways to improve their teaching through technology but are unwilling to match the time commitment of the "early adopters." The classic early adopter is drawn to technology for its own sake, reveling in the "gee whiz factor" of new technologies, but "wary adopters" are pragmatic. Representing the mainstream of higher education faculty, "wary adopters" will use technology only when it can be demonstrated that doing so will add value to their teaching without significantly reducing time already allocated to teaching, research, and service activities. Needless to say, the CTLT found it quite difficult to scale up support services while also ensuring that these services meet the often different needs of "wary adopters."

Creating a Catalyst for Innovative Teaching with Technology

The need to expand support to a much wider audience—and to do so without a major infusion of new staff or relocation to a larger facility—was clear. How to do so was not. In fact, the CTLT faced four major obstacles posed by the needs of "wary adopters": (1) the absence of a coherent framework for faculty Web publishing, (2) the absence of well explained, compelling examples of enhanced teaching and learning through the Web, (3) the absence of convenient, in-person support located in departments, and (4) the absence of a clear incentive for faculty to explore the use of technology in their teaching. After an intense period of reflection and wide ranging conversations with campus stakeholders and faculty focus groups, the CTLT's leadership team developed a new framework for faculty support. The framework depended upon an instructional support Web site that would provide faculty with anytime-anywhere resources and also serve as the foundation for redesigned instructional workshops and one-on-one consulting.

The Web site, Catalyst, was launched in 1999 to provide this support while placing pedagogy and student learning at the center of the discussion about technology. Catalyst is based upon four assumptions: (1) faculty want just-in-time learning and support; (2) they prefer to learn at their own pace, in their local environment; (3) the Web is or will become the vehicle of choice for just-in-time information and learning; and (4) distributed support personnel are best suited to make the critical decisions about local infrastructure and local support. Given this, the key function for Catalyst—the value add—is in capturing, focusing and disseminating ideas, resources, and tools that allow both faculty members and local support personnel to make innovative use of new technologies in teaching and learning with a minimum of duplicative effort.

Scaling Innovation through Partnerships and Collaboration

Through Catalyst[1], UWired can easily identify promising practices from within the campus and then use them to address enterprise-wide educational needs. As an easily navigable clearinghouse for information on the use of the Web in teaching and learning, the site has met faculty needs and drawn repeat visits, creating a center of gravity for innovation in teaching with technology that far exceeds the physical reach of UWired and the CTLT. Catalyst has four basic types of content: (1) profiles of educators and programs that provide a vehicle to share ideas and experiences with technology, humanizing its use and, hopefully diffusing teaching innovation; (2) guides to instructional methods and technology tasks that provide a map to a wide range of individual documents geared towards improving learning; (3) dynamic content and frequently updated information on news and events relevant to teaching with technology; and (4) instructional tools that provide a standard mechanism for faculty to create interactive, Web-based instructional modules in any computing environment using only a Web browser.

As envisioned, departments and college support personnel who have developed materials specific to their local computing environments—for instance how-to documents on a particular Web editor or "one-off" Web-based instructional tools—have been eager to see their work repackaged and made available to a much larger audience. More, through a partnership with a university-wide initiative, the Program for Educational Transformation through Technology (PETTT), UWired now has the capacity to conduct research on the science of learning and disseminate information via Catalyst, thus promoting the thoughtful exploration, development, assessment, and dissemination of next-generation technologies and strategies for teaching and learning.

Catalyst not only extends UWired's reach, but it also improves the overall quality of faculty support, providing department support personnel with a set of resources they can draw upon, freeing them individually tailor services to their faculty. By aggressively profiling the efforts of campus educators, Catalyst makes faculty innovation visible and contributes directly to the vitality of the teaching community on campus. In its first year, the Catalyst Web site logged half a million page views; it now averages 100,000 page views per month.[2] On the UW campus, over 1000 faculty and instructors from departments ranging from Anesthesiology to Urban Horticulture have implemented Catalyst tools.

[1] See http://depts.washington.edu/catalyst/home.html
[2] See http://depts.washington.edu/catalyst/2000_report.pdf

Health Issue for Human Computer Interaction in Electronic Learning Environments

Dr. Joy Fraser
Dr Peter Holt
James Mackintosh
Athabasca University
1 University Drive
Athabasca AB
Canada
T9S 3A3
Voice: 780 6756111
FAX: 780 6756186
Email: joyf@athabascau.ca
Email: holt@athabascau.ca

Abstract: Social pressures are creating the necessity for a system of lifelong learning. Electronic distance education appears to be the optimal system for meeting the educational requirements of learners. While educational needs have shaped the development of the electronic learning environments there has been little attention paid to the physical and psychological health issues for the electronic learner. Athabasca University (AU) has used questionnaire and focus groups to examine the implications for learners using AU's electronic environments for learning.

INTRODUCTION

Distance education is often identified as a panacea for adult learners as it overcomes geographical barriers that often prevent students from attending universities to study. With the advent of the Internet as a readily accessible medium, web-based courses have become immensely popular with providers of distance education around the world. It clear by the enthusiasm with which computer-based distance delivery has been embraced that society is willing to rely on computer technology for learning.

At Athabasca University, where the mandate is distance education , students are distributed not only across Canada where the University is located, but also across North America and the rest of the world. For the past five years Athabasca University's Centre for Computing Information Systems and Mathematics (CCIS) has offered 20 undergraduate Computing Science courses over the World Wide Web (WWW). In 2001 it will be offering a Master of Computing and Information Systems over the WWW. The Center for Nursing and Health Studies (CNHS) has offered a Master of Health Studies (MHS) degree over the WWW since September, 1999 and in less than a year has over 200 graduate students enrolled in the program.

The needs and capabilities of the learners are our first considerations in the development of an electronic learning environment. In our developments we have focussed on involving the learners to optimize the environment for learning (Holt, Stauffer & Jelica, 1999). However, until recently we did not look seriously at health related issues. Marcoulides, Mayes, and Wiseman (1995) have suggested that the use of computers in the workplace can result in anxiety. Similarly, technology-based learning may result in added stress among learners. There are other potentially negative implications for students who rely on computers for learning. According to Faulkner (1998) these may include psychological factors such as alienation, inadequacy, lack of privacy, loss of responsibility and damage to self-image. Furthemore, Dix et all (1998) noted that physical problems include repetitive motion strain, postural fatigue, eye fatigue and less frequently, skin rash, reproductive disorders, and cataracts.

In order to examine health issues related to the use of computers for learning, we decided to survey graduate students in our Master of Health Studies Degree and undergraduate students in Computing Science. Questionnaire data has been collected on general computer-related habits, any health problems encountered, and their ergonomic awareness related to design of workspace, posture, usage, and exercise. This was a large exploratory study with a questionnaire of 19 items distributed to 1310 CCIS Students and 145 CNHS students). More indepth data will be gathered by focus groups which are underway--the results and will be reported more fully at EdMedia 2000. The more interesting questionnaire results analyzed to date are presented in this session.

CNHS students and CCIS students differed on a number of dimensions including graduate versus undergraduate, continuous monthly enrollment versus semester, discipline, and different WWW-based learning platforms. Since the purpose of the study is to consider ergonomic factors in the design of electronic curricula for both CCIS and CNHS students, we have not focussed on inferential statistics and differences between the groups but upon useful descriptive statistics within each group.

The return rate was low for CCIS students (150 of 1310 questionnaires). It was higher for CNHS students (41 of 145 questionnaires). The low return rate makes the results more difficult to interpret as students with health related problems may be more likely to respond giving us a biased sample. Nevertheless, computer usage was reported to be very high among respondents. Both CNHS students (80.5%) and CCIS students (85.3%) had high rates of computer use in general and relatively high use for education other than the current courses (43.9% and 72.3%). The mean time using computers was 24.2 hours per week for CNHS students and 32.2 hours for CCIS students. There was a wide range of usage but it would appear these are high-use groups at risk for computer related health problems.

CNHS students and CCIS students rated themselves respectively as somewhat or informed (75.6% and 63.4%) about ergonomic issues. However, a majority of all students did not make use of special ergonomically sound furniture and at least half of both CNHS students (53.7 %) and CCIS students (50.0%) did not take any regular breaks while working at the computer. As high usage groups these students ought to be more aware of ergonomic issues and in ideal circumstances, practice more ergonomically sound computer usage.

Both CNHS and CCIS students reported some physical problems related to computer use (26.6% and 26.8% respectively). Problems reported include carpal tunnel syndrome, eye strain, and back strain. Ironically, although both groups reported low rates of psychological problems (9.8 % and 6%), they did report considerable levels of anxiety about their use of computers. Interestingly, the most intense anxiety was associated with issues of privacy and security with 70.7% of the CNHS students and 65.1% of the CCIS students reporting slight to high levels of anxiety in this area. Other areas of anxiety included the cost of computer technology (46.3% and 57.7%); keeping current with software (46.3% and 40.3%); loss of data (43.9% and 60.8%); keeping current with technology (34.1% and 40.3%; and keeping up with the information glut on the Internet (36.6 and 47.7). High computer usage does appear to affect these students' social/family life--36.6% of the CNHS students and 34.7% had complaints from family members about their computer usage. This finding is hard to interpret in lack of comparison with students learning by other methods of education but it certainly warrants further attention.

Of the CNHS students 32.5% reported that the electronic courses aggravated old problems, 50.0% said they created new problems, and 51.3% had suggestions for course design. Of the CCIS students 12.7% reported that the electronic courses aggravated old problems, 16.7% said they created new problems, and 30.7% of CCIS had suggestions for course design. When students listed concerns most of them were related to computer use or course design rather than to health related problems explicitly (other than perhaps related to stress). This could be a function of students being so engrossed in their use of computers for learning that they are relatively unaware of health problems. We are conducting further focus groups to further investigate the factors and underlying situations that contribute to students being in undesirable physical and /or psychological danger and other ameliorative approaches they might use. On the basis of findings to date we are implementing a Java/XML based printing utility and highlighting ergonomic tips in the course materials.

DESIGNING SYNCHRONOUS INTERACTIVE LEARNING TELECONFERENCES: Digital Field Experiences at the Columbus Zoo, an Informal Science Contextual Setting

Tamara J. García-Barbosa,
Andrea K. Balas,
Dr. Barbara S. Thomson,
The Ohio State University
249 Arps Hall, 1945 N. High St.
Columbus, OH
garcia-barbosa.1@osu.edu

Abstract: The Columbus Zoo has a Distance Learning Interactive Field Experience Teleconferencing program (CZDLIFE) to provide a vehicle to enhance standards-based math and science instruction in Ohio's schools. The use of interactive technology in schools can increase the ability to use contextual settings in education which add a level of reality to classroom learning. Making connections through planned partnerships outside the traditional classroom promotes curiosity, creativity, and exploration. Learning in an informal setting helps students connect and transfer their knowledge base as they engage in new learning opportunities. Zoos can provide an excellent informal context to ground distance learning interactive field experiences.

The Project

The goal of the Columbus Zoo Distance Learning Interactive Field Experience (CZDLIFE) is to offer educational and scientific resources to enhance standards-based math and science instruction using two-way audio/video interactive technologies. The CZDLIFE provides an exciting and meaningful curriculum that incorporates a variety of activities for all students at the distant site. The instructional design of the project was grounded in contextual teaching and learning theory and situated learning environments (Brown et al. 1989, Balas, 2000). The design emphasizes the use of several pedagogical strategies blended with contextual experiences that promote real-time problem-solving interaction. These experiential activities are designed to promote knowledge creation through interaction with zoo facilitators and other learners (Thomson, B., et al. 1999). The field experience was constructed using six key areas: 1) considerations to connections to the curriculum, 2) connection to multiple content areas, 3) inclusion of non-formal educators in the design phase, 4) developmentally appropriate activities, 5) professional development activities, and 6) follow-up activities (Francis, 1999).

Research Problem and Question

The Columbus Zoo has experienced a great deal of success implementing on-site and outreach educational programs. The recent advent of the use of two-way audio/video interactive teleconferencing as a means of sharing the zoo resources has added a new and complex medium for educational content delivery. Interactive teleconferencing is a unique medium that requires different and diverse pedagogical approaches than those regularly used with on-site visitors and outreach populations. The main benefit of two-way interactive teleconferences is that the nature of the system provides a level of intimacy in communication that is not apparent in other forms of distance learning. Two-way real time video transmission of information implies a new definition of real-world context, in which the learning environment, although video-mediated, is indeed the actual environment with which the learner interacts (Jonassen et. al. 1995). Another strength of the technology lies in its synchronous nature; the teacher and learners experience parallel delivery and reception of information without a time delay.

In order to add to research based design, the main question of the study is How do you design effective standard-based two-way synchronous teleconferences from an informal education setting?

Research Design and Procedures

Background research in the development of interactive teleconferences in contextual settings such as the zoo is almost non-existent. The study involves the Columbus Zoo, in Columbus Ohio, and four distance learning sites throughout the state. The four sites were divided among three schools in New Lexington, Stark County, and Richfield, Ohio; and one community-based after-school enrichment program, which used the Cincinnati Zoo as their teleconferencing facility. Five elementary school teachers, one principal , four technology coordinators and seven classes were used for data collection. The student population ranged from second to fifth grade with a combined total of 140 students. This population is representative of Ohio's urban, suburban and rural students.

Qualitative data was gathered through surveys, interviews, observations, field notes, and researcher reflections. Surveys were collected immediately after the CZDLIFE, and interviews were conducted with the teachers and technology coordinators prior to and after the CZDLFE teleconference. The qualitative data was interpreted through the development of common themes generated from the interviews and is being synthesized into assertions about the nature of the experience.

Preliminary Results

The CZDLIFE teleconferences use a view of learning that encourages knowledge creation rather than a knowledge delivery. For most learners having tactual contextual opportunities is critical to accommodate for their learning styles (Thomson, B., et al. 1999). The CZDLIFE program has been effective in providing an opportunity to:

1. Bring to the zoo a wider student audience.
2. Help meet the needs of students who are unable to attend on-site programs.
3. Provide real time face-to-face interaction between classrooms and zoo educators.
4. Involve outside speakers who would otherwise be unavailable to regular zoo visitors.
5. Provide an opportunity to "export" unique exhibits such as the coral reef or some of the endangered animals that can not be used on regular zoo outreach programs.
6. Allow "real time" 2 way audio and video contact between students and the facilitators at the zoo.
7. Incorporate the use of experiential learning activities, live action and pre-recorded video to present interactions carried out at the zoo which are not available to the general public.

Implications

The results and conclusions of this program help provide a better understanding of design process for interactive distance learning field experiences in informal science settings. The study also serves as one of the few studies that examine the outcomes of using two-way interactive distance learning between elementary classrooms and an contextual learning setting.

References

Balas, A. (2000). Completing The Circuit: In-Service Teachers' Responses To Field Experiences In A Corporate/University Sponsored Electricity Workshop. *Paper presented at the Annual Meeting of the National Association for Research in Science Teaching,* New Orleans.

Brown, J.S., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher*, 18(1), 32-42.

Francis, R.W. (1999) Meaningful Field Trips. *Schools in the Middle*. 6(3) pp.44-46.

Jonassen, D., Davidson, M., Collins, M., Campbell, J., & Haag, B. B. (1995). Constructivism And Computer-Mediated Communication In Distance Education. *The American Journal of Distance Education*, 9(2), 7-26.

Thomson, B., Maxwell, E., Carnate, B., Frost, R. & Garcia-Barbosa, T. (1999). Creating a Culture for Success, *The Science Teacher*, 66(3) p. 23-27.

Implementing Interactive Multimedia Courses for the WWW Using Streaming and SMIL Technology

Thanasis Giouvanakis Haido Samaras Konstantinos Tarabanis
University of Macedonia
156, Egnatia Street Thessaloniki, Greece
Tel: +30-31-891589, Fax: +30-31-891544
E-mail: thgiouv@uom.gr, hsamara@uom.gr, kat@uom.gr

Abstract: This presentation reports on our current and on-going R&D efforts towards the design and development of multimedia, web-based courses suitable for use through the Internet. We discuss the process that has been adopted in designing the interface and the tools used. An important issue for the implementation of the courses is the use of streaming technology for the reliable transmission of multimedia content material over the Internet. This technology allows us to transmit multimedia data in a more efficient way and to introduce interactive elements using SMIL (Synchronized Multimedia Integration Language).

Introduction

Until now, the traditional educational system has assumed that all students learn identical materials via the same delivery mode. However, it is known that each student's intelligence profile and learning style is unique and therefore, the traditional lecture-based method of classroom instruction cannot accommodate the large number of diverse learning preferences. In this context, the Internet has emerged as a new means for meeting the needs of individual learning diversity and has introduced significant opportunities for the improvement of the educational process.

However, although significant investments have been made for the technological support of this new educational environment, similar steps have not been taken towards the creation of noteworthy educational software. Thus, although a vast amount of electronic educational material currently exists on the Internet, it is usually in the form of simple text occasionally combined with some graphics. Undoubtedly, there is a lack of genuinely qualitative educational content. This is due mainly to the fact that the current Internet infrastructure is incapable of transmitting high-quality multimedia content (a problem which can partially be addressed by the use of streaming technology). In addition, the significant expense and time required for the development of such material are serious prohibiting factors.

This paper discusses our efforts towards the design and development of interactive multimedia, web-based courses suitable for use through the Internet. The primary characteristics of the material developed are the following:

1. It is dynamic and interactive.
2. It supports the concept of collaborative learning i.e. it offers opportunities to simulate real situations of collaboration among various groups of users.
3. It can be transmitted efficiently to users.

Designing the interface

The appropriate design of the interface depends on the specific context that it is intended for. To this purpose, an effort was made to create an interface, which would be used by adult graduate and post-graduate students and would use unambiguous "metaphors" for the effective and consistent delivery of specific concepts to learners. The screen was divided into three vertical frames, the left of which always displays the contents of the course. The middle frame presents each individual course in the form of text while in the third frame, accompanying graphics, video or animation, can be viewed by the user, depending on the requirements of the specific material being worked on. It is important to emphasize that that each lesson is available in several different forms of delivery i.e. text, narration, etc.

Implementation of the educational material

On a technical level, the implementation of the courses was based on the use of:

a) Streaming technology

b) HTML, JavaScript, VBScript, XML (SMIL), ASP

Streaming technology for the efficient transmission of multimedia elements

One of the basic problems encountered during the implementation of a multimedia, web-based course is undoubtedly the limited bandwidth of the Internet. This is perhaps one of the main factors that justify the lack of extremely high-quality multimedia material. The greatest amount of educational software existing presently on the Internet is in the form of simple text, frequently enriched with some graphics. This form, however, proves to be inadequate.

Streaming technology addresses this problem in the following way:

Although, the conventional way of transmitting data through the Internet requires that the entire file (e.g. a video file) be received before it may be viewed by the user, this is not a necessity when streaming technology is the adopted method. In the latter case, the information is presented to the user (e.g. the video file begins to "play") even though the remaining information is still being received and it becomes possible to view the multimedia elements almost simultaneously with the appearance of the rest of the HTML document.

A primary advantage of this kind of technology is that it is possible to transmit very large multimedia files in an efficient and reliable way thus resulting in the preservation of the learner's concentration.

Streaming technology makes use of the RTSP (Real Time Streaming Protocol) instead of the HTTP protocol.

The product selected to deal with the difficulties associated with the network infrastructure of the Internet was the RealServer created by Real Networks. RealServer makes it possible to incorporate high-quality multimedia elements (RTSP is designed to stream clips that have time lines) within a web-based course. Whether the learner has an ISDN line or accesses the Internet through a low-bandwidth connection, s(he) may still view a course that comprises a variety of multimedia elements. There is also a possibility for the dynamic detection of different connection speeds between the client and the server so as to achieve improved transmission.

Emphasis should be given to the fact that it is possible to include additional interactive elements within the educational material (sound, video, animation) through the use of the SMIL language.

Interactivity

An additional item of concern was that the educational material should be enriched with a variety of interactive elements. To this extent, SMIL (Synchronized Multimedia Integration Language) presents notable interactive characteristics.

Based on XML, this language reacts upon the multimedia elements of the course, which are transmitted through the use of streaming technology.

The main reasons that make SMIL so important are:

a) It can integrate and co-ordinate many diverse types of multimedia information. We can capture events that are generated from the interaction between the learner and the multimedia element. This is achieved through the use of callback methods.

c) It can be considered as an "open", platform-independent technology, which is based on W3C XML.

References

A. Giouvanakis, K. Mamoukaris, H Samaras (1999). *A study of Integrated Tools for Web-based Education*, EPÅÁÅÊ, Ôelemathos, University of Macedonia.

A. Giouvanakis, H Samaras, K. Tarampanis (1999). *Developing Educational Software for use on the Internet*, 4th Panehellenic Conference on Didactics of Mathematics and Informatics, Crete.

The RealNetworks web site: www.real.com

Narrative, Context and Cognition in Interactive Media.

Lisa Gjedde
Research Centre for Educational ICT
Royal Danish University Of Educational Studies
Emdrupvej 72
2400 Copenhagen NV
Denmark
Lg@dlh.dk

Abstract: Based on case-studies of edutainment Multimedia programmes this study is exploring the affordances of the contextual elements of narrative in relation to interactive Multimedia programmes, the possible cognitive costs that lack of canonical narrative elements may have for the user and the particular possibilities they may offer in a learning environment in which meaning, experience and motivation for further exploration are key elements.

Narrative and the user`s construction of meaning

Educational or edutainment Multimedia programs are offering new environments for learning and communication (Gjedde 1999a) but often these programs are not employing the canonical narrative elements that can be found in popularization of complex information in television, magazines or in books. Instead there has been a natural interest in exploring the non-linear possibilities that the interactive media is offering. This has been done while letting go of the canonical narrative elements and schemata's that typically has a beginning including a notion of time, place and a protagonist, a development and an end (Bartlett 1932 1995; Labov 1972). Research on the relationship between narrative structure and cognitive processes like memory and comprehension has indicated that there tends to be better memory and comprehension for texts that employ a narrative structure than texts that do not use a narrative structure.(Thorndyke 1977; Mandler 1984). Narrative theories are furthermore pointing to its importance for experience, identity and communication. (Schank 1990; Schank and Abelson 1995; Schank 1997).

The structuring and communicative elements of narrative are often not used in educational or edutainment Multimedia programs, which are often encyclopaedic in structure and if using other structures as a motivating factor, tend to use games that often do not have the basic narrative elements. They are not embedding the information offered in the context and structure of a narrative, but it is instead presented in an abstract cyberspace, or in an encyclopedic structure that does not provide the same cognitive and experiential level of support for the user.

This lack of narrativity can have consequences for the ability of the user's to construct meaning from the seeming chaos gathered by experiencing information that is presented out of a context or a known and comprehensible universe.

This can be found in the edutainment/educational genre, where the user may be particularly vulnerable to the lack of cognitive support for the organization of the material, that a narrative structure may provide.(Plowman 1996; Plowman 1998)

The user may also lack the involvement, which the narrative can create through an experiential dimension, through the unfoldment of a narrative, with the possibilities for emotive and identificatory involvement and a narrative logic with an explicit causal structure. These factors may be of importance for the learner's motivation and construction of meaning, particularly the possibility for making a connection between the information they may gather through the program and their present experiences and knowledge structures. (Sarbin 1986; Schank 1990; Gjedde 1998b)

Previous research in this area, has looked at various CD-ROM's in the edutainment and educational genre (Laurillard and Taylor 1994; Plowman 1998). There are indications that a non-narrative or encyclopeadic structure tends not to support the user's construction of knowledge or perception of global coherence to the extent that the narrative that may be found in books and television typically does.

An empirical research project with an experimental design, the MENO-project (Multimedia in Education and Narrative Organisation) has experimentally employed different types of structure in an interactive educational program. (Laurillard and al. 1995) (Plowman, 1999). It was however focused on the structural manipulations and not on a narrative embedding of the material through a consistent main character that provided a focus for identification, or the point of view of a narrator.

This type of narrative embedding may be found in several successful popular science productions. An example of this is the best-selling novel by Jostein Gaarder about the History of philosophy: *Sophies World* (Gaarder 1992), which became the world's most sold book in 1995. A CD-ROM production was made on the basis of this book within the genre of edutainment, which was based on some radically different structures. In the CD-ROM version some of the canonical narrative elements have been replaced by a NLP-generator, which is capable of having a primitive dialogue with the user; and with a number of game elements.
Based on a pilot project with a case-study of some users of this CD-ROM I have identified some potential problems that will be further explored in a study that will involve other CD-ROM's of the same genre that are using narrative. The results from the pilot study are indicating that it might have implications for the user's experience when the basic narrative element are replaced by other elements, which do not support the process of narrative construction, by the user. The narrative is seen as fundamental for the user's experience of meaning and global coherence.(Bruner 1990; Schank 1990; Schank and Abelson J.1995) the narrative is furthermore of importance for the dimension of experience.(Gerrig 1993).
Without the narrative which affords an embedding context the user tends to experience the options offered in the interactivity as lacking in coherence and meaning. This must be seen in relation to the genre of edutainment and that the target group's users, are not supposed to have much previous knowledge about the particular field that the CD-ROM is presenting.
The study is being done in a naturalistic mode, with a high degree of ecologic validity, using natural users of the CD-ROM's with a mobile usability lab. This set up allows for a video-recording to be done with a video of the user as well as a documentation of the activity on the screen through a scan-converter. The study uses a qualitative methodology that involves user's narratives about their experiences with the program and their construction of meaning from it. Using both video-observation and qualitative interviews as well as a questionaire allows for a comparison between the different sets of data..
The focus of the project is to explore the user's experience through narrative and how it translates into a potential greater sense of motivation and possibly cognitive capability for construction of meaning, in relation to the non-linearity of the media.

The aims of the project:

- To provide a greater understanding for the qualitative aspects of narrative in relation to interactive Multimedia and the particular possibilities they offer in a learning environment in which meaning, experience and motivation are key elements.
- To explore the relationship between the contextual elements of a narrative . In particular these which are offered by the elements that constitute a beginning in a canonical narrative (Labov 1967.1997; Mandler 1984) - and the cognitive implications for the user in terms of experience, understanding and interest for the subject and motivation for further explorations into the subject.
- To look at possible connections between the narrative elements in the interactive program and the user's process of narrative construction and focus on the relationship between the narrative organization of the material and user's level of processing.(Laurillard et al. 1984, 1997)
- To explore gender specific preferences in the relation to narrativity (Gjedde 1998b) and multimedia.(Adam 1998).
- To inform the producers of educational multimedia about the implications for using narrative structure and other narrative elements in relation to specific groups.

References:

Adam, A. (1998). Artificial Knowing. Gender and the Thinking Machine. London, Routledge.
Bartlett, F. C. (1932 1995). Remembering. A study in experimental and social psychology. Cambridge, Cambridge University Press.
Bruner, J. (1990). Acts of Meaning. Cambridge, MA, Harvard University Press.
Gerrig, R. J. (1993). Experiencing Narrative Worlds
On the Psychological Activities of Reading. New Haven and London, Yale University Press.
Gjedde, L. (1998b). Making Sense of Science: Experience as Cognition through the use of Narrative in Popular Science. Paper presented at: IAMCR, University of Glasgow.
Gjedde, L. (1999a). Narrative, Genre and Context. Borderlines of Genre, Tampere, Finland.

Gaarder, J. (1992). Sofies verden. København, Høst&Søn.
Labov,W & Waletsky,J (1967.1997). "Narrative Analysis: Oral Versions of Personal Experience." Journal of Narrative and Life History 7(1-4): 3-39.
Labov W. (1972). The Transformation of Experience in Narrative Syntax pp.354-96. Language in the Inner City. Philadelphia.
Laurillard, D. (1984, 1997). Styles and Approaches in Problem-solving. The experience of Learning. F. Marton, D. Hounsell and N. Entwistle.
Edinburgh, Scottish Academic Press.
Laurillard, D. et al. (1995). "MENO project. ESRC Cognitive Engineering Programme, Institute of Educational Technology,
Open University." .
Laurillard, D., L. Baric, P. Chambers, G. Easting, A. Kirkwood, L. Plowman, P. Russell and J. Taylor (1994). "Interactive Media in the Classroom: Report of the Evaluation
Study." National Council for Educational Technology: Coventry.
Mandler, J. M. (1984). Stories, Scripts and Scenes: Aspects of a Schema Theory. Hillsdale, NJ, Lawrence Erlbaum Associates.
Plowman, L. (1996). "Narrative, linearity and interactivity: making sense of interactive multimedia." British Journal of Educational Technology 27(2): pp.92-105.
Plowman, L. (1998). Getting Sidetracked: cognitive overload, narrative and interactive learning environments. Vitual Learning Environments and the Role of the Teacher, Open University, Milton Keynes, UK.
Sarbin, T., Ed. (1986). Narrative Psychology - the Storied Nature of Human Conduct. New York.
Schank, R. (1997). Virtual Learning. New York.
Schank, R. C. (1990). Tell me a Story. Narrative and Intelligence. Evanston, Illinois, Northwestern University Press.
Schank, R. C. and R. P. Abelson (1995). Knowledge and Memory: The real Story. Knowledge and Memory: The real Story. J. Robert S. Wyer. Hilldale, N.J., LEA.
Thorndyke, P. (1977). "Cognitive Structures in comprension and memory of narrative discourse." Cogntive Psychology 9: 77-110.

A Multimedia Matrix Model For Designing Instructional Strategies and Learning Experiences for Students of Human Movement Studies

Halima Goss
Teaching and Learning Support Services Department
Queensland University of Technology
Brisbane, Queensland, 4001, Australia
h.goss@qut.edu.au

Graham Kerr
School of Human Movement Studies
Queensland University of Technology
Brisbane, Queensland, 4001, Australia
g.kerr@qut.edu.au

Abstract: The aim of the current project is to design, develop and implement a teaching strategies model and a multimedia template which crosses over curricular boundaries and responds to a wide variety of learning styles of students. The Conversational Framework model as proposed by Laurillard formed a starting point in examining the place of a multimedia template in Academic Learning while the design of the template has been guided by the need to establish reusable resource materials. Key characteristics of such a template were deemed to be accessibility, cohesiveness, supportiveness, flexibility and quality.

Background

According to Laurillard, the teaching - learning process is an interaction between teacher and student operating at two intermingling levels:

Level 1 - Discursive Level - the level of theory 4 stages to reach consensus:	**Level 2 - Interactive level - the level of practice** The way the student acts in the world
1. Teacher articulates the subject matter	1. Teacher sets task
2. Student joins dialogue - asks questions, practices etc	2. Student acts
3. Teacher re-expresses their point to clarify and elaborate. * Teacher uses student understanding to adapt interactive activities and elaborate theory to those appropriate to student needs	3. World responds - includes teacher, other students, experts etc. * Teacher uses student understanding to adapt interactive activities and elaborate theory to those appropriate to student needs
4. Student has another attempt at representing the theory	4. Student modifies action to improve their performance (adaptation and reflection).

The teaching model is designed to provide a framework for the teacher and student for all steps in both levels whilst the multimedia matrix plays a role in only part of the total process. A balanced mix of multimedia resources, face to face interaction, online communication and practical activity could form the components of a complete learning experience.

Teaching Plans

It is the intent of the designers that the multimedia template act as a guiding mechanism for the teacher in order to facilitate the mapping and selection process for the teaching sequence. Through thorough analysis of the learning objectives, the resource selection, interaction planning and assessment strategies are developed and a mapping of strategies is undertaken. Once all aspects of the teaching mix are determined, then the multimedia elements are produced and assembled and supporting technologies are weaved into the virtual learning environment.

A typical analysis by a teacher in planning the learning experiences may be as follows:
* Concept Map is produced showing the interconnecting curriculum and content elements
* Identification of feasible interactions that best achieve learning outcomes
* Development of plans for each interaction eg multimedia matrix, face to face discussion, practical excursion etc
* Topic in Context material is assembled and Themes and associated Activity sequence is determined and designed
* Media Resources are gathered for supporting problem solving as required by activities
* Computer tools are assembled for use by students in carrying out activities
* Delivery proceeds with monitoring and feedback loops built in to the interactions - Evaluation data is gathered and used in review of the model and matrix.

In teaching academic staff to utilise the matrix tool, the above sequence forms the basis for a workshop. This enables the intertwining of a pedagogical and a technological focus and is punctuated by a management theme ie all three focuses become a part of the teaching plan.

The Multimedia Matrix

The matrix template consists of a number of "cells" which may be populated with content or resources which are required for the student to carry out their study of a particular topic. These are as follows:
A) Topic in Context - an overview of the topic and its place in the whole curriculum. The relevance of the topic to the profession is also a key aspect.
B) Topic resources - these are not directly linked to any one theme or activity but rather are more global to the topic eg Extended readings or digressions may be placed in the resource area
C) Themes - In order to create a single environment for students that is self contained but has interconnecting parts, the template allows for the creation of several themes. A concept map highlights the links between themes.
D) Activities - these are the problems and instructions that guide students through the resources and learning experiences designed for them.
E) Tools - These include Glossaries, Concept Map generators, Text editors, Analysis tools and a launch pad for applications that are common place such as word processors and spreadsheets.
F) Media - Video, Audio, Graphics and Text elements can be used in the template - these are dropped into any matrix and become a part of the application.

Progress to date

The use of the matrix in teaching the concepts of *movement* through the specific idea of "gait" has been planned. A plan for the main phases of teaching the sequence has been established and each matrix in a sequence multimedia support applications is being developed. These include Biomechanical, Bioenergetics, Diversity and Neurologic perspectives on gait. Rather than examining gait in each of these aspects separately, the planned sequence moves from an exploratory view through each of these perpectives in order to establish core understanding and then evolution of ideas both quantitative and qualitative from a combined view. To illustrate, a typical activity may require a student to make a series of observations that will lead to understanding of both diversity and biomechanical principles and their interrelation. Use of a common visual resource in supporting such an activity ie the same video sequence, also reinforces this cross curricular notion. The template itself is in BETA phase and has been used to assemble the first of these applications.

The staff development program that is essential in establishing the model for achieving maximum effectiveness of implementation of the Conversational Framework model has begun and a network of colleagues from one faculty group who are in close proximity, has been set up. This is a key feature for staff development in an area that requires complete rethinking and restructuring of teaching and its planning. *Collegiality and support* cannot be underestimated in their power to catalyse best practice teaching. We envisage that the notion of a learning matrix both in terms of the multimedia application itself and of the curriculum structure will provide a clearer view for both students and teachers. In this way the path through the study of a discipline may be made more transparent and flexible. In supporting a student-centred approach to teaching, the initial effort has been significant, however the revolution that will follow will show energy levels that pale these efforts into insignificance.

Being Social in an Anti-Social Environment: Is Cooperative Learning Possible Using Computer-Mediated Communication?

Joseph G. Gregg
Jones International University
United States
jgregg@international.edu

Abstract: The purpose of this study is to investigate which experiences of adult learners in an online cooperative learning environment contribute to the expected evolution from an aggregate of strangers to a group capable of high performance. There is a clear need for a thorough qualitative study focusing on the development of online relationships required for successful cooperative learning groups. . The interview, observation, and journaling methods will provide information to address impression formation, social presence, group development and the conditions of ambiguity and detraining. In addition, the results of this study will help provide a palette of best practices for designers of online learning environments utilizing similar instructional strategies.

Introduction

Providing opportunities for students to take distance education courses is becoming commonplace in higher education. It should come as no surprise that this growth fosters change and with change comes resistance and criticism. Yet, perhaps it is time to listen to that criticism. Historian David Noble, professor at York University, wrote a series of articles criticizing what he characterized as the unmindful haste by higher education institutions to adopt the Internet and World Wide Web for course delivery creating nothing more than a technologically-slick updated version of the correspondence course (summarized in Noble, 1998). Nobles' primary fear is that we are creating courses devoid of any true interaction between the student and instructor.

Course developers and instructors recognize the importance of designing interactions into courses offered by distance education means. The importance and validity of these interactions is amplified in numerous studies in which students reported that their individual success was due, in large part, to a high-level of interaction, typically learner-instructor (Eastmond, 1995; Wegerif, 1998). Likewise, many learning theorists do describe the integral role that interaction plays in the level of learning attained by students (see Reeves & Reeves, 1996, for review). Most studies on communication using computer-mediated communication (CMC) or asynchronous learning networks (ALN) have examined interactions resulting from tasks requiring some type of online discussion (Eastmond, 1995; Hiltz, 1994; Wegerif, 1998) Yet, very few studies have looked at the social aspects of group processes in online environments using cooperative learning techniques.

Reports from distance learning students in collaborative or cooperative learning groups using computer-mediated communication (CMC), specifically, asynchronous learning networks (ALN), indicate that there is a crucial moment in their experience in which they cross a threshold from outsider to insider or from newcomer to old-timer (Eastmond 1994; Wegerif, 1998). Crossing this threshold is crucial for increased positive attitude leading to continuation of the course and higher achievement. Failure to cross this threshold often results in the student dropping out of the course. How does a collection of strangers move from being an aggregate of people to a group capable of high performance using computer-mediated communication (CMC), specifically asynchronous learning networks (ALN),. as the sole means of communication?

It stands to reason that understanding interpersonal communication across asynchronous learning networks is crucial to designing and implementing effective cooperative learning. Results from laboratory research led to a set of interpersonal CMC categorized as the "Cues-Filtered-Out Approach" (see Walther, 1994, for review). Essentially those theories postulated that the reduction of nonverbal cues leads to communication that is task oriented and impersonal, resulting in more equal communication among group members but the possibility of very negative interactions ('flaming'). Initially, Walther (1992) stated that the communication process observed within CMC follows that found in face-to-face groups only the time required for certain behaviors to emerge is of much longer duration. In addition, an individual's perception of anticipated future interaction with group members leads to more social relational behavior. His most recent work showed that computer-mediated communication can run the gamut from impersonal to interpersonal, and finally to what he calls hyperpersonal (Walther, 1996).

There are major discrepancies for prescriptions on how to establish and manage groups and cooperative groups, whether face-to-face or online. For example, the need for an individual to identify with the group as a prerequisite for intimacy, affection and social orientation (Bales, 1950) appears to be contrary to the identification of heterogeneous groups as the most successful for cooperative learning (Johnson, Johnson, & Holubec, 1994). Furthermore, there are conflicting theoretical approaches and even haziness in single theories about the ongoing development of thriving groups in CMC. Specifically, there are conflicting indications of how one might go about creating, facilitating, and managing online groups using cooperative learning communicating via ALN/CMC. How can these discrepancies be resolved?

Proposed Research

This study examines the key aspects to consider when using cooperative group instructional strategies for distance learning mediated by text-based Internet communication. Based on components derived from research on small group development, cooperative learning, and relational behavior, instructional strategies are recommended and a set of research questions are proposed.

Understanding the cooperative group processes when using CMC that provide for the development of successful interpersonal communication leading to close interpersonal relationships will 1) provide information for instructional designers and instructors of online courses to guide their design and 2) delivery efforts in terms of group composition, group activities, and facilitation strategies, and guide design of better interfaces and software to enhance effective communication interaction.

References

Bales, R.F. (1950). *Interaction process analysis: A method for the study of small groups*. Cambridge, MA: Addison-Wesley.

Eastmond, D.V. (1995). *Alone but together: Adult distance study through computer conferencing*. Cresskill, NJ: Hampton Press, Inc.

Hiltz, S.R. (1994). *The virtual classroom: Learning without limits via computer networks*. Norwood, NJ: Ablex Publishing Corporation.

Johnson, D.W., Johnson, R.T., & Holubex, E.J. (1994). *Cooperative learning in the classroom*. Alexandria, VA: Association for Supervision and Curriculum Development.

Walther, J.B. (1992). Interpersonal effects in computer-mediated interaction. *Communication Research*, 19(1), 52 – 90.

Walther, J.B. (1994). Anticipated ongoing interaction versus channel effects on relational communication in computer-mediated interaction. *Human Communication Research*, 40, 473-501.

Walther, J.B. (1996). Computer-mediated communication: Impersonal, interpersonal and hyperpersonal interaction. *Communication Research*, 23, 3-43.

Wegerif, R. (1998). The social dimension of asynchronous learning networks. *Journal of Asynchronous Learning Networks*, 2, 34-49.

Keep facilitating pupils and English teachers appropriately

Bo Han
Foreign Languages Department
National Teachers' College
Inner Mongolia P.R. China
hanbo49@hotmail.com

Abstract: This paper describes a research project on primary school English teaching and teacher training in Inner Mongolia P.R.China where the financial situations of the schools and pupils vary, and English teachers' levels differ greatly. The research group has developed a course, which has a set of kernel textbooks, and there are eight different combinations. This article describes why certain media are chosen and how they are used in order to make sure that teachers can be trained properly and the pupils can get the most possible benefit.

Introduction:

There is no doubt the use of technologies in learning is gathering pace around the world. The use of the multimedia as learning/teaching is changing the way the world thinks and acts. Multimedia has the potential to make teaching and learning more effective but can we use them everywhere? This article describes the research project on primary school English teaching and teacher training in Inner Mongolia and why certain media are chosen and how they are used. Future plan is mentioned and suggestions for improvement are longed for.

Analysis and schemes:

The demand for learning English is greater and greater in this fast developing world. This research project is aimed to meet the need of this demand. To plan for flexibility and adaptation right from the start is very important, if we aim to get good learning results for a long period of time (Griffiths, Heppell, Millwood, &Mladenova, 1994). The following aspects are what we considered when we tried to work out a proper plan:

There are not enough English teachers in Inner Mongolia. Some schools may have one; some other schools may have more. The teachers' English levels and teaching experience vary; Inner Mongolia is a region with different nationalities. The main languages are Mongolian and mandarin which have sharp differences. Mongolian pupils learn Mongolian and mandarin in primary school, so they can only learn English for one or two years in primary schools to make sure that they may not be overloaded; Some schools may have tape recorders, others may have overhead projectors. Video player, etc; locations: Inner Mongolia is a vast area. Primary schools scatter all over the area. To train all the teachers face to face is impossible; Some pupils cannot afford expensive textbooks and tapes. Some schools cannot afford expensive teaching aids; Although Inner Mongolia is a backward region, it is also changing rapidly. The numbers of English teachers in each school will change, the facilities in schools will change, the home appliances will change; How can we use different media for the pupils and teachers in the most appropriate way? (Collis & Deboer, 1998; Griffiths et al., 1994)

After all the above aspects besides teaching methodology being considered, certain media are used in the way as the following: Kernel textbooks and supplementary textbooks have been developed to make sure that the pupils who can only study one or two years may have basic knowledge of English before they go to middle schools and other pupils who have the opportunity to learn more in primary school may well informed. Eight teaching plans with scientifically related teaching materials have been designed to make sure that all the pupils can benefit most efficiently. The textbooks are designed black and white and special revision exercises are designed to make pupils paint the textbooks with colorful pencils by themselves. Therefore the textbooks not only attract pupils attention more and the pupils may remember more of the teaching materials but at the same time the price of the textbooks is cut down; Two sets of tapes are designed. One set is that one tape is offered each term to help the pupils to learn at home and to keep a low price for those pupils who cannot afford two tapes. The other set is that two tapes are offered each term. This is to make sure that there are enough feedbacks and interactive exercises to do, and it makes preview and review convenient. At the same time, these tapes can also be convenient for teachers to prepare their lessons. A special tape is designed only for teachers to check pupils assignment. In this way pupils do not have to buy that tape and teachers will not have trouble with the questions and answers. Transparent sheets for overhead projectors: Two sets of transparent sheets are designed. One is black and white; the other is with color to meet the need of different schools. In this way, teachers may have teaching aids even in schools with limited budgets. We made videotapes for pupils and teacher training so that teachers from remote areas can also have the opportunity to watch other teachers' teaching and understand the theories of teaching. Schools with video players can play the videotapes to their pupils and pupils with video players at home can watch the videotapes to learn better.

Learning should be immediate feedback as many educators have already recognized. However, the above media which have been used are quite limited in the aspect of interactive activities. This means that a lot of potentials from the teachers and pupils have not been cultivated. What should we do to accomplish our goal then? In order to work out our future plan, let's first see what will happen in this part of world in the near future?

The future plan:

In the near future more and more schools in Inner Mongolia will also have computers. Since Internet connection in China is still quite expensive, most of the families in Inner Mongolia will not be able to get an access very soon. But the perspective of using Internet in schools is great. A significant number of schools will have the capability to interact online. It means that teaching materials designed to be used with computers may help more and more teachers and pupils to teach and learn more effectively. The key to successful interactivity, is not simply offering educational access to preexisting networked materials. Rather, a more valuable role is to offer a collaborative environment where users can create, and share information of their own with other users. It's an opportunity that many teachers won't let slip by them. It means that we're reaching a point where teachers can't be competitive in other words, prepare today's children for the university and the modern workplace without the Web. Therefore, our future plan is divided into three steps:

1. To put the teachers books on Internet first and build a forum for teachers to share their teaching experience. In this way, teachers will be well informed and share their experience in teaching, and with the latest version of teachers' books, they can always try to teach their pupils better.
2. To put teaching materials with more interactive activities on CDs. In this way schools with computers and pupils with computers at home can use these materials to teach and learn more efficiently.
3. To establish on line courses for pupils to learn. Besides textbooks with interactive activities, a reading series can be developed. In this way, pupils with internet access not only can learn the textbooks well but can also learn by their own pace to develop their abilities in reading, listening , speaking and writing.

The above are our plan for the near future. We are eager to ask you the specialists in the conference to offer us suggestions in order to make this ideal into reality. All your advice would be greatly appreciated.

References

Collis, B., &DeBoer, W.F (1998). Rapid prototyping as a faculty-wide activity: An innovative approach to the redesign of courses and instructional methods at the University of Twente. *Educational Media International, 35* (2), 117-121.

Griffiths, D., Heppell, S., Millwood, R., & Mladenova, G. (1994). Translating software: What it means and what it costs for small cultures and large cultures. *Computers and Education*, 22(1/2), 9-17.

Course Production Applying Object Oriented Software Engineering Techniques

Ronald Hartwig, Huberta Kritzenberger, Michael Herczeg
Institute for Multimedia and Interactive Systems
University of Luebeck
Seelandstr. 1a, D-23569 Luebeck, Germany
Hartwig <hartwig, kritzenberger, herczeg>@informatik.mu-luebeck.de

Abstract: Developers of educational material like web-based training and online courses face well known aspects of classic software development processes: Reusability of course units; Supporting cooperation and resource sharing between the members of the design process, like content authors, designers, multimedia producers and quality managers and Quality management. Therefor, software engineering techniques like object-oriented analysis (OOA) based on a central database to be used in iterative design processes will also be useful for the development of educational material. This considerations are the background for our work and experiences in the project Virtual University as described in this paper.

INTRODUCTION

The Project "Virtual University of Applied Science"

This paper reports work done in the project "Virtual University of Applied Sciences" (period of duration 1998-2003, see http://vfh.de). It aims at establishing a location independent university with a curriculum for computer science of multimedia systems and for business engineering (Bachelor, Master).The authors of this paper are involved in the production of web-based courses, in the design of user-adequate learning spaces and in the support of the design process. Their focus is on usability recommendations and quality management for the course material during the development process. Other aspects like teaching strategies, learning processes or technical issues concerning the course production are supervised by other dedicated consulting groups within this project.

Adressed Problems

During the first months of course production for the virtual university several problems got obvious:

- *The lack of a appropriate context of use description.*
  Practice showed that the developers of course material had only an incomplete mental model about the needs and abilities of the intended user groups, like previous knowledge, learning style, preferences in teaching mode, motivation and other information that would be important to adapt the teaching strategies and delivery of hypermedia structure and content accordingly (Kritzenberger 2000). The mental models about this user group and the assigned attributes even differed during development phases.
- *No stable base for the quality management*
  Quality management (e.g. of learning processes, functional correctness, usability) suffers from a lack of basic information about design and implementation requirements.
- ***Consistency of content information and re-use of contents***
  Another problem is that the content or the structure of the course units may get inconsistent during workflow. While the content author has her or his version (e.g. a linear MS-Word-Document), the hypermedia producer has to transfer content and structure to web formats (HTML and sometimes JAVA Add-Ons). Changes in the linear version have to be manually transferred to the hypermedia version. This is a source of errors and often prevents maintainance, because of the extra effort it will take. Keeping such a training unit up to date often requires to start all over again (e.g. with updating the Word-Document) and repeat former development steps.

DESCRIPTION

The main idea is to overcome the problems mentioned above by introducing a central information base which is used by all participants during the design process: content author, designer, producer and quality manager (see figure 1). Using a simple relational database combined with a powerful web frontend seems to be adequate. This database should include all the context information as well as the content of the teaching units. In a first step these informations are only presented to the involved persons but no contents are automatically generated.

For database organization object oriented techniques are used. Classes of information like "user attributes", "organisational requirements", "content", etc. are identified and then may be freely combined into "views". These views are role dependent, for example the content author may concentrate on the analysis data and the contents. Whereas the producer, who has to implement the learning unit, may need additional design rationales added by the designer. A quality manager can base his evaluation of the system on the requirements identified and documented during the analysis phase.

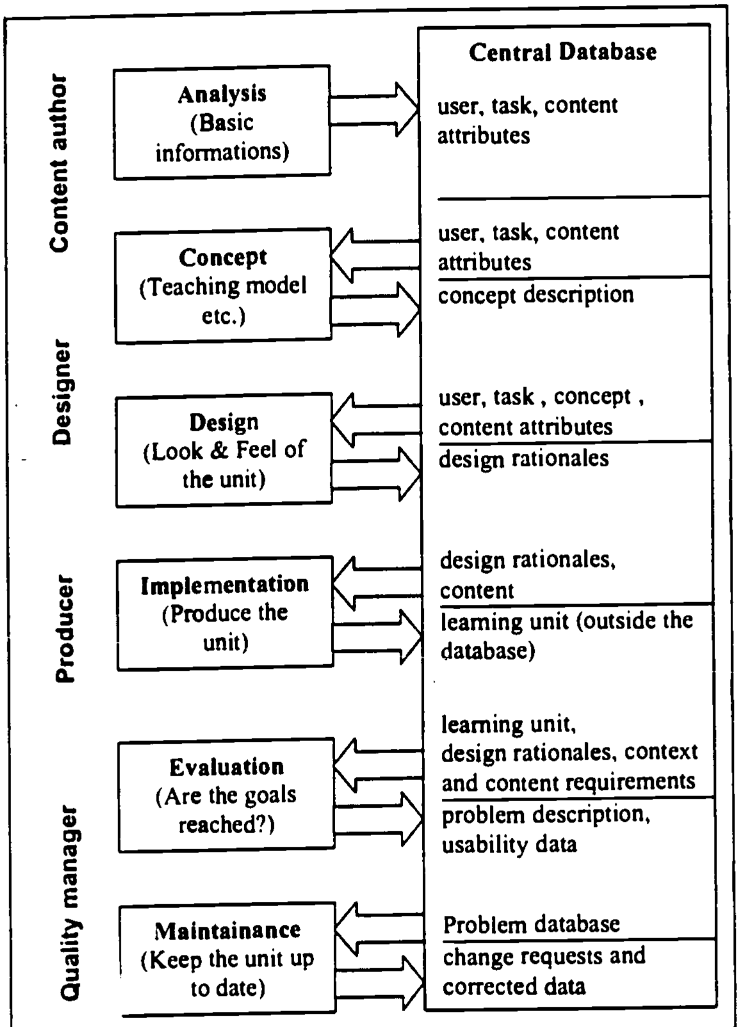


Figure 1: An iterative development process for educational systems (eg. web based training units). Please note that all these steps are to be handled iterativly, that means the whole flow must be done several times.

As the size and the number of the learning units is difficult to handle, techniques of the OOA are used: abstraction, inheritence and generalization. If for instance many different user groups are to be considered, they may be ordered hierarchically: "All users" → "users of the teaching unit" → "A special group within these user group". Attributes of the most general object ("All users") are inherited by all following objects and then, e.g. the designer's view includes all attributes, from the general to the specific ones. OOA techniques, like underspecification and refinement make the handling of large object sets easier and allow all participants to start with rather raw data and to refine them during the lifecycle of the developed system using OOA techniques based on a database has several advantages. The database supports the complete lifecycle of the course unit and makes all information and design rationales available again for maintaining or updating the course. As the contents are HTML-based they can be included into the courses with less manual effort. Furthermore, the connection of each unit to the position and role in the database is kept. nection to the database. Additionally for each production phase there is appropriate additional information available, like design rationales and the related context informations. Updating a content in the database automatically updates the course and avoids inconsistencies.

Current and future work

Currently two major tasks are to be solved: First the different object classes (content and context objects) and views needed for the educational systems must be identified, validated and implemented. Second the database tool has to be implemented and tested.

As the described method is similar to a special OOA technique currently under development in our institute as well (project "TAToo") see (Herczeg 1999), we reuse implementation resources from that project. Actually the database frontend and the needed JAVA/JDBC/JSP-Interface will be the same in both projects.

REFERENCES

- Herczeg, M (1999): A Task Analysis Framework for Management Systems and Decision Support Systems. *AoM/IaoM. 17th International Conference on Computer Science.* San Diego, California, August 6-8, 1999 . pp 29-34
- Kritzenberger, H. (2000): Completing Desing Concepts for Lifelong Learning. This volume (to appear)

A Framework for Evaluating the Usability of Political Web Sites: Towards Improving Cyberdemocracy

Shahizan Hassan
Department of Management Science
University of Strathclyde, Scotland, U. Kingdom
shahizan@mansci.strath.ac.uk

Feng Li, PhD
Director of Postgraduate Research, Department of Management Science
University of Strathclyde, Scotland, U. Kingdom
feng@mansci.strath.ac.uk

Abstract: In an Internet environment, users' expectations are diverse due to its on-line characteristics. Internet can be assessed by any user of any age, group, race, nationality, and gender all over the world at any time and at any place. Considering these, web site designers must adhere to certain design standards and properly evaluate their sites to ensure its usability and effectiveness. Despite abundance of studies on web usability, very few of them focus on the political web sites. Using political web sites in Malaysia as an empirical base, this research intends to identify factors affecting the use of political web sites; and then based on the analysis, develop a framework for evaluating the usability of political web sites. The main purpose is to contribute towards the improvement of cyberdemocracy in the information age.

Introduction

The central focus of the debate on the success of a democratic political system is people participation in election, political discussion, and the process of governance. In order to participate, people should possess sound knowledge about political and social issues affecting them. Traditionally, people are mostly dependent on mass media mainly newspapers, magazines, television and radio as sources of political information. Indeed, mass media has been very influential in shaping public opinion about political and social issues in any democratic country. Today, the advent of the Internet has revitalized the whole concept of communication media. Ideally, it does not only provide an alternative source of political information, but it can also be used as an effective political communication medium between and among citizens, public leaders and political parties. This development certainly provides opportunities for the enhancement of democracy whose main emphasis is on citizens' freedom to actively participate in politics by debating and exchanging views on key social and political issues.

Cyberdemocracy and Current Practice

There is little agreement on the exact definition of cyberdemocracy because of its uncommon usage. Clift (1997) states that cyberdemocracy is about the use of online communication tools for many-to-many civic discussions among citizens and public leaders. It is based on the belief that opens communication and participation is the foundation of democracy. According to Alexander and Grabbs (1998), cyberdemocracy refers to the optimized use of internet-based communication technologies by government agencies, interest groups and non-profit organizations to promote public participation in the process of governance. In general, cyberdemocracy is defined as the use of the Internet technology such as World Wide Web (WWW), File Transfer Protocols (FTP), electronic mail (email), conference facilities and net chatting for dissemination of information and exchange of ideas between and among government, political parties and public leaders with the general public. There are a number of examples of efforts carried out by government, political parties and voluntary bodies to establish cyberdemocracy. Minnesota e-democracy project (http://www.e-democracy.org), established in 1994 by a group of volunteers, held the first online debate via email among candidates for governor and United States Senate and launched the MN-POLITICS email discussion forum. Another example is United Kingdom Citizen Online Democracy (http://www.democracy.org.uk), a non-partisan effort, that began work before the 1997 national election. It hosted a number of topical events on such topics as European monetary union efforts and online delivery of government services, and it held an all-party debate during the election.

Web Usability and Research Focus

Usability is basically a very broad concept in system design and difficult to define. In this research, usability refers to how easy, effective and useful it is for a person who uses a political web site to achieve their goals. According to Nielsen and Mack (1994), and Shneiderman (1998), there are 5 main aspects of usability: ease of use, efficiency, satisfaction, rate of users' error and retention over time. The primary focus of this research will be on the usability issues of web sites used as political communication medium. These issues are grouped into seven main factors: Screen design, Content, Accessibility, Navigation, Media Use, Interactivity, Consistency -- abbreviated by the researcher as SCANMIC. These are the generic factors of web usability based on an analysis of current web design guidelines and literature.

Research Question

In an Internet environment, users' expectations are diverse due to its on-line characteristics. Internet can be assessed by any user of any age, group, race, nationality, and gender all over the world at any time and at any place. Considering these, web site designers must adhere to certain design standards and properly evaluate their sites to ensure its usability and effectiveness. Despite abundance of studies on web usability, very few of them focuses on the political web sites. Yet, usability has become one of the most important aspects that determine the success of web sites regardless of their category. With this in mind, this research will address three major questions;

a) What are factors that affect the usability of political web sites?
b) How to evaluate the usability of political parties' web sites?
c) What is the level of the usability of web sites in current cyberdemocracy efforts in Malaysia?

Conclusion

The above research questions will be used to achieve the following objectives:

a) To identify factors that affect the usability of political parties' web sites.
b) To design a framework for evaluating the usability of political web sites. The framework is designed for both technical and non-technical people who are involved in political web site development.
c) To test the applicability of proposed framework.
d) To propose a guideline for developing a usable political web site.

Reference

Alexander, J.H. & Grubbs, J.W. (1998). Wired Government: Information Technology, External Public Organizations, and Cyberdemocracy. *Public Administration Interactive Journal* [Online], Vol. 3(1). Available : http://pamij.com/alex.html [access:1999, May 12]

Clift, S.L. (1997). Putting Pen to Paper [Online]. Available: http://e-democracy.org/intl/library/essay.html. [access:1999, April 25]

Nielsen, J. & Mack, R.L. (1994). *Usability Inspection Methods*, Canada : John Wiley & Sons Inc.

Shneiderman, B. (1998). *Designing the user interface: Strategies for effective Human-Computer Interaction*, 3rd Edition, USA : Addison Wesley Longman Inc..

Biggs' Constructive Alignment: Evaluation of a Pedagogical Model Applied to a Web Course

John Hoddinott
University of Alberta
Biological Sciences
Edmonton, Alberta, Canada, T6G 2E9
john.hoddinott@ualberta.ca

Abstract: Biggs' (1996) proposed a pedagogical model where "performances of understanding" specified in course objectives are used to systematically align teaching methods and assessment practices. The model was applied in a plant physiological ecology course delivered at a distance over the web. Students and instructor thought the course format helped learning and that the assessment model, the SOLO Taxonomy, was good. Everyone also concluded that the course workload was too great in spite of ample feedback to discourage such excess. The course may be viewed at: http://www.biology.ualberta.ca/courses.hp/bot431.hp/bot431hp.html

Evidence based good teaching practice seeks to enhance "deep learning" by emphasizing active learning strategies, high expectations, time on task, prompt feedback, respect for diverse ways of learning and student-student and instructor-student interaction. Deep learning is supported by a constructivist pedagogy that argues that it is the learner's activities that aid their construction of meaning to bring about learning.

Biggs (1996) has articulated a "Constructive Alignment" model that is the marriage of two ideas: constructivism as a framework with the learner's activities as central in creating meaning and the instructional designers emphasis on the relationship between the learning objectives and the targets for assessing student performance. In his model, the "performances of understanding" nominated in the objectives are used by the instructional designer to systematically align the teaching methods and the assessment activities.

Biggs and Collis (1982) previously developed a 'Structure of Observed Learning Outcomes (SOLO) Taxonomy' that analyzes the cognitive level of students' written work. It identifies five categories:

1) prestructural - no understanding of the topic,
2) unistructural - nominal understanding of one, or a few, points,
3) multistructural - several aspects understood but used separately,
4) relational - components integrated into coherent wholes,
5) extended abstract - the integrated whole is reconceptualized at a higher level of abstraction.

The taxonomy provides a scheme that served as a basis for giving feedback to students on their written work.

The Constructive Alignment model was applied in a distance delivered web based course for senior undergraduate and graduate students. For each week of the course, the course web site gave details of the learning objectives, required reading, optional supplemental reading and web hyperlinks to resource sites. The web site also provided an extensive background on the pedagogical principles behind the course, the nature of the SOLO Taxonomy, sample responses to a problem and their assessment according to the Taxonomy, and advice on preparing portfolios of evidence that the learning objectives had been achieved.

Students were invited to assemble their own portfolios of evidence that they had achieved the learning objectives. Portfolios were submitted by e-mail and assessment feedback was provided in the terminology of the SOLO Taxonomy. Students had access to a password protected conferencing system that allowed them to interact with each other, the teaching assistant and the instructor in a virtual, asynchronous group environment. An on-line chat room was also available through the conference system. Private communication between participants was available through e-mail.

The course opened with a telephone conference to allow the students to meet each other and interact with the teaching assistant and instructor. The students and the teaching assistant then moved to a computer lab where all students had the opportunity to demonstrate that they were familiar with the computer and software skills required to complete the course work.

Student assessment in the course was based on the submission of three portfolios of evidence of meeting the learning objectives through the term. Take home mid-term and final exams were also given. These exams were integrative of the material in the portfolios and gave the students considerable discretion in selecting the context in which the questions were answered. Exam feedback was again based on the SOLO Taxonomy. As the eight students in the course had no previous experience of distance education or portfolio assessment, they were invited to maintain a reflective journal that was read three times during the course by the instructor. Marks for keeping the journal were given on a credit/no-credit basis.

At the end of the course students were asked to evaluate the course and their learning experience. Evaluations were submitted to the TA who cut and pasted the anonymous student comments into an e-mail message to the instructor.

The evaluations showed that the students thought the course format helped learning, they developed independent learning, time management and communication technology skills, that the web materials on the SOLO Taxonomy were good, that the web material on the course philosophy was good but only in retrospect and that the learning journal material was very helpful.

In the future the students thought that workload in the course should be reduced, feedback increased, course notes provided, more texts should be placed on reserve, a lab should be included and a TA with a background in physiology would be preferable.

Students thought that future offerings of the course should retain the chat room, group camaraderie, learning objectives, the SOLO Taxonomy, and the instructor's understanding.

The instructor's evaluation concluded there should be a reduced workload, more frequent feedback, greater use of an on-line seminar facility and continued use of the SOLO Taxonomy and learning journals.

Workload was an issue for everyone. Despite the feedback given on their portfolios, the volume of evidence provided on each of the three submission dates increased steadily. Students were spending more time assembling evidence and the instructor was spending more time assessing it. Conversations in the chat room emphasized the concern that everyone shared and a phone conference was organized to discuss the problem in real time. Despite encouragement by the instructor to pay attention to the quality of the portfolio contents rather than the quantity, the problem persisted.

Providing more regular feedback would have spaced out the assessment workload for the instructor but it is not clear that it would have helped reduce the pressure the students placed on themselves to submit a large mass of evidence of their learning. The conferencing tool (WebTeach) had a seminar facility where students could have posted questions for their peers relating to the learning objectives. Responses to questions posted by their peers were not readable until participants had submitted their own answer. This facility remained unused although it might have been a vehicle to model the depth of material that was reasonable in a portfolio. It is also possible that students would see use of the seminar facility as even more work.

Everyone involved in the course was satisfied with the SOLO Taxonomy as a framework for assessment. It allowed the students to align their portfolios to the learning objectives and the assessment criteria. Students found preparing a learning journal to be useful. Evidence of concern over workload was recorded in the journals along with recognition of the feedback they were getting on what was anticipated. However, recognition of the issue and a discussion of solutions did not solve the problem.

The learning objectives were well received by the students. However, some continued to think that course notes would have helped. It seems that even these senior students were uncomfortable in assuming a large degree of control over their own learning. It is worth noting that some students commented that the material on the pedagogy behind the course was only useful "in retrospect". If these various opinions were expressed by the same set of individuals, it might suggest that more quickly coming to terms with the pedagogical background might have compensated for the lack of the course notes.

In conclusion, Biggs' pedagogical model of Constructive Alignment is suitable for application in a web environment.

References

Biggs, J., & Collis, K.F. (1982). *Evaluating the quality of learning: the SOLO taxonomy*. New York: Academic Press.

Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher Education* 32, 347-364

A Multimedia Resources Bank for Teaching and Learning

Vincent Hung, Jacky Pow
Centre for Learning, Teaching and Supervision
Hong Kong Institute of Education, Hong Kong
vhung@ied.edu.hk , jpow@ied.edu.hk

Winnie So
Department of Science
Hong Kong Institute of Education, Hong Kong
wiso@ied.edu.hk

Abstract: This paper introduces an attempt to make use of Information Technology to facilitate teaching and learning in a teacher education institute. A multimedia video bank was being developed to provide with teacher educators and student teachers necessary video clips that could be made use to produce computer- assisted instruction programs that fit the local context. All the videos are intentionally to do without any narration or background music to allow flexibility for the subject teachers to present their materials and to better communicate with the students.

Background

In the First Policy Address of the Chief Executive of the Hong Kong Special Administrative Region (HKSAR) Government, a firm devotion of the Government to develop information technology (IT) in education was first revealed. However the education community in HK is still striving to seek the direction of IT in education that matches the local context, a unique culture of the East and the West. Most of them, especially the primary school teachers are puzzled simply because they do not know how to start with teaching with IT.

Objective

With the aim to facilitate teaching and learning with IT that fits the local context, this project attempts to build up a multimedia resources bank (MMRB) for teacher educators and student teachers in the Hong Kong Institute of Education (a publicly-funded teacher education institute) to develop their own computer-assisted instruction (CAI) programs or to use as part of the teaching materials. It works towards a direction to encourage and promote innovative teaching approaches with an effective use of IT in classrooms.

Multimedia Resources Bank in General Studies

Despite of the resources put in acquiring computer hardware and software, there is hardly any quality interactive CAI program in "General Studies" being developed because there are difficulties facing by the primary school teachers:
[1] The heavy workload does not allow them to have location shooting and video editing that are both needed in developing the CAI programs in "General Studies".
[2] It is not worthwhile for the primary school teachers to heavily involve in video production, as it is not their profession in this aspect.
However, there are enthusiastic primary school teachers who are willing to produce their own multimedia teaching materials provided that there is enough support (Pow, So and Hung, 2000). With this in mind, we therefore tried to build a MMRB in "General Studies" for the primary schools teachers and let them to make use of the resources to tailor make their own CAI programs to facilitate teaching and learning. With the cooperation between a lecturer from Department of Science and education technology professionals from the Centre for Learning, Teaching and Supervision in Hong Kong Institute of Education, the team has produced about a hundred video clips according to the syllabus of the "General Studies" to be put on the MMRB. We chose "General Studies" as the starting point for MMRB as it is a new subject that integrates science, social study and health education in primary school curriculum, and hence at hand resources are still lacking.

The content of the video clips covers a broad area of topics from Hong Kong community services, transportation, housing, etc. to scientific experiments such as the property of magnet, heating, etc. The videos are classified, edited into a reasonable length and stored onto a video server for easy retrieval and viewing. All the videos are intentionally to do without any narration or background music since we would like to allow flexibility for the subject teachers to present their materials and to better communicate with the students. Although it is the Institute that owns the copyrights, staff and students can use it freely in their own works or teaching. Staff and students can instantly view the video clips of their choice at any computer that is linked up with the Institute's Intranet or download these media clips for their own use later on. This MMRB is expected to be able to save up valuable time and resources for those who want to try out teaching with IT but do not have enough time and resources to produce the media on their own. It is hoped that this could contribute partly to promote innovative use of IT in teaching and learning, not just within our Institute but also to the education community at large.

Reference:

Pow, J., So, W. & Hung, V. (2000). Challenges to the Implementation of IT in Education: A Case Study in Hong Kong. *Proceedings of SITE 2000*. Vol. 3. pp. 1927-1931.

The Effects of PBL Authenticity on Learning and Motivation

Myunghee Kang
Educational Technology Department
Ewha Womans University
Seoul, Korea
Mhkang@mm.ewha.ac.kr

Nari Kim
Educational Technology Department
Ewha Womans University
Seoul, Korea

Abstract: The purpose of this study is to examine the effects of learner's PBL authenticity perception on achievement and motivation. There are two major research questions. First, is there a difference on learner's achievement between high and low perception level of authenticity? Second, is there a difference on learner's motivation between high and low perception level of authenticity? The results show the following: (1) There is a significant difference in the learner's achievement between low and high level of authenticity perception ($t=-3.42$, $p<.05$) (2) There is a significant difference in learner's motivation ($t=-3.34$, $p<.05$).

Introduction

In recent years, with the advent of the Information Society, the focus of educational paradigm has been shifting from "teaching" to "learning". This signifies a move to a learner-centered education where the student becomes an active participant in the learning process. Korea's educational reform committee has established a goal to build a learner-centered educational environment to prepare Korea's students to be competitive in 21st century.

"Web's Cool" program has been planned since 1998 to support the learner-centered education system in Korea. Subject areas such as language arts, math, science and ESL(English as a Second Language) for middle school students have been developed on the Web. Since the Web was considered to be an effective medium for learner-centered approach by applying the constructivistic principles, PBL(Problem Based Learning) strategy were applied to provide students opportunities to participate in the learning process actively.

While the Web's Cool has been developed, we wanted to investigate the fact that whether the problem we were using as an authentic task has any effect on learner's motivation and achievement. In order to measure the authenticity of the task, the expert's as well as student's perception level of the authenticity toward the task has been scored by using a 5 point scale. Two tasks were selected as high and low authenticity level of perception by both 10 experts and 10 students to investigate the effects.

The purpose of this study is to examine the effects of the authenticity perception on learner's motivation and achievement. There are two major research problems. First, is there a difference on learner's motivation between high and low perception level of authenticity? Second, is there a difference on learner's achievement between high and low perception level of authenticity?

Research Method

Subjects

Subjects for this study are 51 students of the middle school students. Two learning tasks perceived low and high authenticity are selected.

Results

The results are as follows:

(1) There is a significant difference in the learner's achievement in general between low and high level of authenticity perception ($t=-3.42$, $p< .05$). A significant difference was found in the learner's authentic achievement between low and high level of authenticity perception ($t=-4.54$, $p< .05$). However, no significant difference was found in the learner's logical achievement between low and high level of authenticity perception ($t=-1.75$, $p< .05$).

Achievement	Authenticity perception level	Mean	SD	t	p
Authentic Achievement	High	1.58	.77	-4.54*	.00
	Low	1.05	.88		
Logical Achievement	High	1.69	1.01	-1.75	.09
	Low	1.34	1.03		
Total Achievement	High	3.27	1.56	-3.42*	.00
	Low	2.42	1.99		

(* : $p < .05$)

(2) There is a significant difference in learner's motivation of a total ($t=-3.34$, $p<.05$), attention($t=-3.16$, $p<.05$), relevance($t=-2.55$, $p<.05$), confidence($t=-2.85$, $p<.05$) and satisfaction($t=-2.34$, $p<.05$) between low and high level of authenticity perception.

Motivation	Authenticity perception level	Mean	SD	t	p
Attention	High	3.68	.57	-3.16*	.003
	Low	3.44	.52		
Relevance	High	3.64	.50	-2.55*	.014
	Low	3.47	.53		
Confidence	High	3.47	.42	-2.85*	.006
	Low	3.29	.41		
Satisfaction	High	3.40	.46	-2.34*	.023
	Low	3.25	.45		
Total	High	3.45	.42	-3.34*	.001
	Low	3.27	.40		

(* : $p < .05$)

Conclusions

Based on the results of the study, following suggestions were made: (1) Measuring scale of authenticity of the learning task has to be further validated through many different situations and various subjects (2) Authentic assessment of the authentic learning environment has to be studied further.

References

Kang, M.(1994). Courseware Design Strategies Based on Anchored Instruction. *Information Technology*, 12(6), 62-72.

________ (1994). The Effects of ARCS model on Instructional Softwares. *Educational Technology Research*, 10(1), 135-156.

Bransford, J., Sherwood, R., & Hasselbring, T. S. (1988). The video revolution and its effects on development. In G. Forman & P. B. Pufall, *Constructivism in the computer age*(pp.173□202). Hillsdale, NJ: Lawrence Erlbaum Associates.

Teaching WAP Technology as a Part of a Multimedia Course

Harri Keiho, Jari Lahti, Jari Multisilta
Tampere University of Technology, Information Technology, Pori
P.O. Box 300, FIN-28101
Pohjoisranta 11
FIN-28101 Pori,
{harri.keiho;jari.lahti,jari.multisilta}@pori.tut.fi

Abstract: Wireless Application Protocol (WAP) provides a universal open standard for bringing Internet and Intranet content and advanced Value Added Services to mobile phones, PDA's and other wireless devices [1]. The production of WAP applications and content requires new software professionals on the area. In this paper we describe our experiences from the multimedia course where students developed WAP applications as their project work[5].

Background

WAP is an industry standard whose purpose is to achieve universal mobile access to Internet based information services. The application is independent of the underlying digital wireless network technology [1]. WAP applications are developed with Wireless Markup Language (WML) and WML Script. [2]. WML applications can be developed with special toolkits, for example Nokia WAP Development Toolkit , Ericsson WAP development kit or UP.PHONE development environment . These toolkits include smart editors and debuggers, phone simulators and help system. However, its is possible to develop your WML applications using only a simple ASCII editor. The students developed simple WAP applications in the laboratory work and implemented a larger project work in the end of the course.

Wireless Markup Language Specification and WML Script

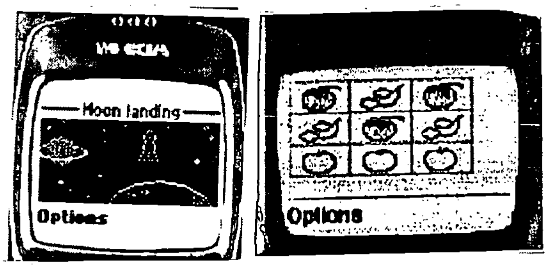
The Wireless Markup Language specification describes the markup language, WML, including the document semantics, Document Type Definition (DTD), and encoding extensions. WML is a markup language based on Extended Markup Language (XML) and is intended for use in specifying content and user interfaces for narrowband devices, including cellular phones and pagers. All information in WML is organized into a collection of cards and decks [3]. WML Script is a scripting language that makes it possible to implement dynamical elements in the WML application.

Student's WAP projects

The students were required to design and implement a real WAP software and document the code in the end of the course. The topic of the project was free and many of the students chose to implement a game in WAP phone. In this chapter we will present three WAP games, namely Moonlanding game, Lucky Wheel, and Jackpot. The idea of the Moonlanding game is to land to the surface of the moon by controlling the fuel consumption of the rocket (Fig. 3). In the Lucky Wheel game your mission is to find out a secret word or words by guessing the missing characters. Jackpot is the WAP implementation of the old casino game (Fig. 3). Some of these applications are being developed furthermore and will be published in the commercial WAP service by the national mobile phone operator.

The first step in the project was the learning of the WAP development environment. The Nokia Wap software toolkit was used in the projects. In general, programming in WML and WMLS is similar than programming in almost any other environment. It is possible to use the toolkit as a stand-alone environment or with Nokia WAP gateway in order to simulate real wireless connections [6]. In our case, it was not required for the students to test their software in real phones. During the development of their software the students find out several problems. One of the most significant problem was the differences between the real phone and the simulated phone. Of course the toolkit itself was beta-level software and was not very reliable. In addition the real WAP phone does not fullfill the WAP specification [4]. For example, the Nokia 7110 WAP phone does not support table feature in the WML content and the WAP applications can use only a little memory - the memory size in the phone is appx. 2 KB.

Figure 3. The moonlanding game and the Jackpot.



Positive aspects in the project were that the project was very motivating, the simulator makes it possible to develop software without the real phone, it was easy to learn to program with WML and WMLS because they are similar than HTML and JavaScript and students used actively WAP discussion groups in internet.

Conclusions

Increasing global competition, digitalization of content the general use of HTML and WML languages and the adoption of mobile broadband data transfer will require software specialists with new skills. In the future content producers, telecommunication companies, IT companies and media companies need workers with good knowledge technological convergence and good ability to use the new content producing technologies like WAP. This is a demand for the educational institutes and universities. We should provide up-to-date technological education and be prepared to modify our curriculum to follow the latest technological innovations. In this paper we have discussed about WAP as a new technology to implement wireless content services. The students at Tampere University of Technology studied the WAP technology and implemented simple WAP applications as their project work. The applications were developed using freely downloadable Nokia WAP development toolkit. The most significant problem was the differencies between the real WAP phone and the simulated WAP phone. From our point of view the projects succeeded well: some of these applications are being developed furthermore and will be published in the commercial WAP service by the national mobile phone operator.

References

1. Wireless Application Protocol Forum Ltd. *WAP Architecture*, http://www.wapforum.org/what/technical/SPEC-WAPArch-19980430.pdf, version 30.4. 1998 (26.1.2000)

2. Wireless Application Protocol Forum Ltd (1999). *Official Wireless Application Protocol* The Complete Standard with Searchable CD-ROM Published by John Wiley & Sons, Inc.

3. Pekka Niskanen *WAP Ohelmoijan Käsikirja*, IT Press 1999 (finnish)

4. Wap Forum (2000) http://www.wapforum.org/ (24.1. 2000)

5. Keiho H., Koivisto H., Jaakkola H., *A new business strategy for teleoperators. Opportunity for modern broadband access technologies.* Proceedings of the IEMC '98, Puerto Rico. IEEE. pp. 399-402.

6. *Getting Started Guide: Nokia Wap Server 1.0* November 1999. Nokia Mobile Phones

Enhancing Total Patient Management Skills in Dentistry with Interactive Multimedia Simulation

Mike Keppell
Biomedical Multimedia Unit, Faculty of Medicine, Dentistry & Health Sciences
The University of Melbourne, Australia
e-mail: m.keppell@medicine.unimelb.edu.au
Karen Kan & Louise Brearley Messer
School of Dental Science, The Faculty of Medicine, Dentistry & Health Sciences
University of Melbourne, Australia
e-mail: k.kan@dent.unimelb.edu.au, l.messer@dent.unimelb.edu.au

This paper examines a project which aims to improve dental clinical management through case management of medically compromised dental patients. During the past few years, it has become increasingly difficult to access suitable patients, especially child patients, for dental students and consequently for them to become sufficiently experienced in treating patients with medical conditions. Multimedia simulation provides a means to fill this gap and allows interactive learning in a non-threatening environment. This paper examines the design, development, project management and evaluation of the first module – congenital heart disease.

Teaching dental students to treat patients safely and efficiently presents many challenges. The declining availability of suitable patients attending the teaching clinics of the Royal Dental Hospital of Melbourne prevents students from developing a range of experiences in total patient management. A disadvantage of traditional preclinical laboratory teaching is that students are not able to integrate theoretical and practical skills. Consequently there are concerns that dental students are not competent in combining preventive and restorative management philosophies while integrating diagnosis and treatment planning (Suvinen, Messer, Franco, 1998). Multimedia case simulations were considered to be a viable alternative as they replicate the dental clinic without requiring 'live' patients. These modules provide an opportunity to develop and consolidate the concept of integrated patient care.

During 1999 the first module, congenital heart disease (CHD) was designed and completed. During 2000 further funding will allow three other modules to be developed: diabetes, Down syndrome and cleft lip and palate. These medical conditions were chosen as they are the most likely medical conditions to be encountered and are least understood by a dentist in general practice treating children. Each condition will follow the existing template developed for the CHD module except for the diabetes module which will use a 3-D Dental surgery to enhance interactivity. The CHD module contains a description and review of the medical condition, considerations of medical management and dental management. The student is then presented with a case scenario of a child with CHD. The student constructs a treatment plan and management approach after considering a range of treatment options. The module series will replace some tutorial and lecture content for both 4th and 5th final year dental students. The modules will not replace valuable clinical practice; but prior learning from the modules will enhance students' ability to perform clinical work. The modules will also be used for post-graduate students and in Continuing Dental Education programs for dentists.

Design and Development

In designing and developing the CHD module, the project team followed the model utilised by the Biomedical Multimedia Unit (Keppell, 1998). The design phase of the project focussed on developing the macro-structure for the module in the form of a concept map (Novak & Gowin, 1984) and completing the micro-structure in the form of a 'planning grid'. The content experts for the project were experienced specialists and educators in the field of paediatric dentistry. They worked with the instructional designer to develop the concept map and planning grids for the project. **Figure 1** http://www.medfac.unimelb.edu.au/Ed-Media2000/ outlines the resultant concept map which provided a scaffold for the development of the planning grids. The process used to develop the concept map and planning grids followed the Content Production Process (Keppell, 1999). A specific form of storyboard or 'planning grid' has been developed to provide a 'communication tool' for interfacing between the instructional designer, content expert and graphic designer/programmer (Keppell & Buschgens, 1995). The planning grid is useful in streamlining communication and providing a common ground for discussing the multimedia project. The planning grid is analogous to an 'architectural blueprint', which can be applied or 'engineered' by the graphic designer/programmer (see **Figure 2** http://www.medfac.unimelb.edu.au/Ed-Media2000/). The graphic designers developed the interface for the congenital heart disease module and the subsequent modules (see **Figure 3**. http://www.medfac.unimelb.edu.au/Ed-Media2000/)

Project Management & Evaluation

The project management focussed on carefully scoping the project, providing a detailed planning grid to the graphic designer/programmer and establishing the "look and feel" of the interface. England and Finney (1999) suggest that each project will define its "own quality priorities" (p.17). In this project the priorities of target audience, subject, budget and the time available impacted on the project management of the project. England and Finney (1999) also suggest that "design quality for media projects = content and treatment agreement" (p.17). These treatment parameters were carefully considered in the initial stages of the project conceptualisation. The first module was targeted to be completed within an hour by undergraduate users. The macrostructure for integrating the subsequent modules was also considered as an essential characteristic of the project. In order to analyse project costs and as a means to plan for the future modules, the total work hours were tracked for this module. A total of 390 hours was required to produce the CHD module (see **Table 1** http://www.medfac.unimelb.edu.au/Ed-Media2000/). The CHD module was completed in November, 1999 and was evaluated with a group of 15 recent graduates (interns and postgraduate students) at the School of Dental Science in December 1999, using a Likert-style questionnaire. **Table 2** http://www.medfac.unimelb.edu.au/Ed-Media2000/ shows the distribution of responses to questions concerning content. The majority of all responses were either "strongly agree" or "agree", with most modal responses being "strongly agree" (**Table 3**). http://www.medfac.unimelb.edu.au/Ed-Media2000/ Most respondents correctly identified the deliberately placed distractor, "confusing". In general appraisal, the majority of respondents rated the module as "good" or "excellent", and "very easy" to operate and navigate (**Table 4**). http://www.medfac.unimelb.edu.au/Ed-Media2000/ Of interest, one respondent rated the module "very poor" and "difficult" on these points. The module is currently undergoing beta testing at three national and three international locations, in departments of pediatric dentistry.

Discussion

Computer-assisted education in dentistry is in its early stages (Yip and Barnes, 1999). Developments are occurring very rapidly, and educators must evaluate modules developed internally or purchased externally (Mercer and Ralph, 1998). Sound instructional design indicates the goals of instruction must be made clear, so that users know what is expected of them in operating and navigating a module. This may not have been so in the instance of one respondent. Nonetheless, it is concluded that computer assisted instruction was enthusiastically received by most of the recent graduates. Experience in focus groups has shown that participants valued the tutor discussions that were held at the end of the module, which allowed extension of learning and further professional role-modelling.

References

England, E. & Finney, A. (1999). *Managing multimedia: Project management for interactive media* (2nd Ed). Addison-Wesley. Harlow, England.

Keppell, M. J. & Buschgens, R. A. (1995). *Optimising communication between instructional designers, graphic artists and computer programmers in the development of multimedia materials.* In A. C. Lynn Zelmer, Preceedings of the 1995 Annual Conference of the Higher Education and Research Development Society of Australia (HERSDA), Rockhampton, 4–8 July 1995. Volume 18, (pp. 431-441).

Keppell, M (1998). *Biomedical Multimedia Design and Development Cycle*

Keppell, M., (1999). *The crucial roles of the instructional designer and subject matter expert in multimedia design.* ED-MEDIA 1999 - In B. Collis & R. Oliver, Proceedings of ED-MEDIA 99 World Conference on Educational Multimedia, Hypermedia & Telecommunications, Seattle, Washington, USA., June 19-24. 1999. Volume 1 (pp. 598-603).

Mercer, P.E. & Ralph, J.P. (1998). Computer assisted learning and the general dental practitioner. *British Dental J. (184)*, 43-46.

Novak, J. & Gowin, D. B. (1984). *Learning how to learn.* Cambridge University Press. Cambridge.

Suvinen, T., Messer, L.B. & Franco, E. (1998). Clinical simulation in teaching pre-clinical dentistry. *Eur J Dent Educ (2)*, 25-32.

Yip, H.K & Barnes, I.E. (1999). Information technology in dental education. *British Dental J (187)*, 327-332.

Acknowledgements

This project was supported by a 1998 CUTSD grant #15119.

Using Electronic Portfolios to Demonstrate Beginning Teacher Competencies

Karen Kortecamp
George Washington University
2134 G Street, NW
Washington, DC 20052
karenkor@gwu.edu

Libby Hall
George Washington University
lhall@gwu.edu

Burcu Tunca
George Washington University
btunca@gwu.edu

Abstract: At the George Washington University teacher candidates in the master's program learn to apply technology in teaching and learning within the context of methods and curriculum courses and school-based practicum and internships. Teacher candidates acquire skills and understanding as they prepare presentations, develop curriculum materials, teach lessons, assess student learning, and reflect on practice. This short paper describes the ways in which teacher candidates' development of multimedia electronic portfolios to assess their ability to implement a variety of instructional models assists in learning to use a variety of hardware and software for instructional purposes. It is expected that teacher candidates will, on some level, transfer their proficiency in using technology to the secondary students with whom they work during their teaching internships.

Why Electronic Portfolios?

Performance assessment in teacher education programs commonly includes development of a teaching portfolio during the teacher internship. The purposes of the portfolio are to document professional growth (Campbell, et. al. 2000) and to cultivate outstanding teaching and learning (Wolf, 1996). Fulfilling these purposes requires that the portfolio is a dynamic, flexible documentation of student growth. Emerging technologies facilitate creating electronic portfolios that support flexibility rather than traditional portfolios constructed in 3-ring binders that tend to be collections of artifacts. The electronic format offers several advantages: the ease of storage usually on a computer hard drive or some sort of removable media (floppy disk, Zip disk, CD); easy access to information; portability is enhanced; multiple copies can be created at low cost; the opportunity to add sound, pictures, graphics, and even video make an electronic portfolio more attractive and interactive than traditional style binders; in the process of developing portfolios, students gain valuable technology skills as they create and edit this multimedia document. These skills can be transferred to 6-12 students during the internship and as the successful teacher candidate moves into classroom teaching.

Development of the Electronic Portfolio

A group of teacher candidates in the secondary education graduate program at The George Washington University are expanding their technology proficiencies through developing an electronic portfolio. The primary purpose is to provide teacher candidates with technology related skills that they can transfer to middle and high school students and use to support their teaching. A secondary purpose is to enable teacher candidates to demonstrate their teaching competencies using an alternative method to the binder-style portfolio currently in use in many teacher preparation programs.

The conceptual framework used to develop the portfolios is based on the Interstate New Teacher Assessment and Support Consortium Standards (Darling-Hammond, 1992) and the National Board for Professional Teaching Standards (1991). The domains addressed include: 1) commitment to students and their learning, 2) knowledge of the subjects taught and how to teach those subjects to students, 3) establishment and management of student learning in a positive environment, 4) assessment of student progress and adapting instruction to improve student learning, 5) commitment to reflective practices, and 6) professionalism. Several indicators are provided to students within each domain specifying ways in which each is exemplified in teaching or in course work.

Those participating are currently enrolled (spring 2000) in a class that teaches application of instructional and classroom management models. The instructional models reviewed include Direct Instruction, Inductive, Inquiry, Integrative, and Cooperative Learning. Each of the models represents a cognitive perspective of learning which views learners as active investigators of their environment. In these models, teachers are directly involved in guiding learning through questioning and discussion. Candidates construct a number of products to show their understanding of concepts and theory and their ability to apply them in a teaching-learning situation.

Specifically, teacher candidates learn how to use various technologies as they learn pedagogy. In the course, they will practice using technology to: present information; research content; organize and store data; track and record their development as teachers; and reflect on their teaching behaviors as a process for solving problems and growing professionally. For example, they will learn to use PowerPoint in the context of learning how Howard Gardner's Theory of Multiple Intelligences applies to the teaching of science, math, English, social studies or ESL. Each candidate will design a presentation that outlines how each of the 8 intelligences is used to frame curriculum development of a specific unit topic. Candidates select topics according to their content specialization. Each will focus on the utility of the theory in: 1) designing curriculum, 2) engaging and motivating students, and as 3) assessing students' learning.

In demonstrating their understanding of and ability to apply instructional models, candidates will teach lessons they develop to other members of the class. They will be videotaped using a digital video camera. After receiving feedback from peers and the course instructor, the teacher candidates will view the video and reflect on the effectiveness of their teaching. As a part of the reflective process, they will edit their video to capture those portions that exemplify what they have learned about their teaching and will include this shortened version in the electronic portfolio. In the process of creating the portfolio, teacher candidates will learn how to create a personal website. The goal is to expand their portfolios as they move through the graduate program. Unlike what typically occurs in the binder approach to portfolios in which students organize a collection of artifacts during the teaching internship which illustrate their best work, the approach taken here will concentrate on documenting growth as teacher candidates develop their knowledge and skills in both pedagogy and content. This means that candidates will begin assembling their work during their initial experiences in the program and, the work included in the portfolio will not necessarily showcase their best products. Rather, the final product will reveal the ways and extent to which each candidate has grown as a beginning teacher.

Conclusion

One major area of emphasis in the teacher preparation program at the George Washington University is to prepare teachers who will serve as leaders in the schools where they teach. An important aspect of that leadership role is technology. As our students develop their proficiency in this area, they will be encouraged to explore the connections to teaching in middle or high school. The ways in which technology use can enhance teaching and learning is of particular importance. Specifically, through the development of electronic portfolios, these teacher candidates will consider how the use of technology can assist secondary level students in: learning content; presenting information; conducting research; and, reflecting on their development as learners.

References

Campbell, D., et.al. (2000). *Portfolio and Performance Assessment in Teacher Education.* Allyn & Bacon. Boston, Massachusetts.

Darling-Hammond, L. (Ed.). (1992, September). *Model standards for beginning teacher licensing and development.* Unpublished draft, Washington, DC: Interstate New Teacher Assessment and Support Consortium, and Council of Chief State School Officers.

National Board for Professional Teaching Standards. (1991). *Toward high and rigorous standards for the teaching profession* (3rd ed.). Detroit, MI: Author.

Wolf, K. (1996). Developing an effective teaching portfolio. *Educational Leadership, 53(6), 34-37.*

Prospects and Limits of Conceptual Models for WBT Course Production

Huberta Kritzenberger, Jürgen de Wall, Michael Herczeg
Institute for Multimedia and Interactive Systems
University of Luebeck
Seelandstr. 1a, D-23569 Luebeck, Germany
Phone: +49-451-3909-506
{kritzenberger, dewall, herczeg}@imis.mu-luebeck.de

Abstract: This paper is based on experiences with the production of web-based training (WBT) courses for a course of studies in medical computer science. Course production is regarded as software development process, which starts with conceptual models shaping the design and defining the way the software product is presented to the user. This paper reports experiences with conceptual design models and shows the danger of being insufficient or incorrect.

INTRODUCTION

Our project "Distance Education in Medical Computer Science" (started in January 1999) aims at providing a complete course of studies for the specialization of students in medical computer science, offered at a virtual university. Our responsibility is to transfer the linear text documents (mostly MS-Word format) into hypermedia networks and multimedia courses, which means practicing reverse engineering for WBT course development.

PROBLEMS WITH CONCEPTUALIZING WBT COURSES

The transfer of a text document to hypermedia means transformation of format, gain of flexibility, interaction capabilities and so on. Hypermedia and multimedia courses can be used in ways beyond the intentions of the content author. On the other side, people occupying other roles in the development process, like multimedia designers, or quality managers do not know about the content domain or didactic aspects. The static version, which the content author had in mind, has only one dimension of presentation. Accordingly, the semantic (content) structure and the didactic structure of the course are intertwined. Most authors are not able to separate both structures in a way applicable for hypermedia production and vice versa the multimedia experts are normally no experts in the semantic domain or in didactics, therefore, they can hardly explain their needs to the content authors. This lack of knowledge in each others domain results in unintended course structures, unnecessary restrictions or other mismatches. A similar problem arises if the author for example has to start with specifying a semantic model and then would have to design for different learner groups.

Furthermore, we found in our projects, that media designers, producers, and content authors often have insufficient, incomplete, and partly incorrect models about the learners, the task and the situation of use. The models vary at different times during the period of course production.

COURSE PRODUCTION AS SOFTWARE DEVELOPMENT PROCESS

Our approach to course production as practised in our projects is to regard the production of hypermedia and multimedia WBT courses as a software development process. As for many other software systems, it is also true for the development of WBT courses: To realize a user and task adequate human-computer-system, developers have to take into consideration all system components: user, task and situation in order to form a conceptual model that is as adequate as possible [1]. The conceptual model of the developers shape the software product, in our case the WBT course, and therefore, will decide how usable and user-friendly the WBT course will be and how adequately it will support learning processes.

Figure 1 shows the different models we have to deal with in the context of WBT course production. First of all there is the developer's mental model the design process starts with. In the case of WBT course development we have to deal with diverse developers. In our project there is the conceptual models of the content author, of the designer, of the HT/MM producer and of the quality manager. Furthermore, there is the learner's mental model about the application domain, how the WBT course is implemented and how it supports learning processes. And last but not least, there is the system's model, which contains the way the application domain is implemented and sometimes information on the user's interaction with the system. Each model represents the complex domain of interaction with WBT courses from a certain perspective and in a specific way.

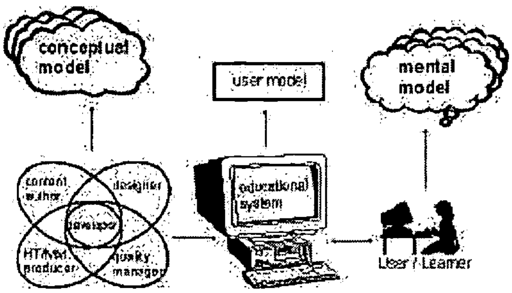


Figure 1 : Models in the context of WBT course production

Mismatches between these models lead to usability problems of the software product. Above all, the importance of the developer's conceptual model for shaping the software product has been noticed for other kinds of software applications for a long time [2], [3]. According to our view, this holds true for WBT courses as well.

CONCEPTUAL MODELS OF DEVELOPERS

A fundamental problem for the development process is, that the developers need substantial and relevant information about the user, the task and the situation of use. They need this information from the very beginning of the design process in order to specify the requirements and shape the WBT course adequately. However, in practice content authors start course production in the traditional way and produce a linear document that includes their conceptual model about domain knowledge and about teaching strategies. This production methods corresponds to the production of traditional lectures for classroom teaching. These courses will not match the situation of use in the virtual university of the future. Lectures on demand have to serve the needs of different user groups and different situations of use. The attributes for users, the task and the situation of use will differ [4] and should have an adequate representation in the conceptual model of all authors. A severe drawback with this situation is, that it is impossible for a content author (and also for the other developers) to take into consideration all these attributes at one time.

In some way, of course, the author is aware of the situations of use and the complexity involved. This might be the reason, why the conceptual model about the user group and the assigned attributes differ from phase to phase of the development process. This is a problem as well. If the conceptual model of the developers includes a prospective mental model of the user and if the design is based on this model, then it will be clear that varying the conceptual model during the development process will result in an inconsistent WBT course, which will be hard to understand and will not support learning processes.

FUTURE WORK

The conceptual models of the diverse developers shape the WBT course and determines the way the educational system is presented to the user and determines if it supports learning processes. Therefore, it is important for the developers to have sufficient and appropriate knowledge about the user, the task and the situation and it is also important that the conceptual models of the diverse authors can be communicated and complement each other during the design process.
With this background we are working on methods to adequately represent conceptual knowledge for the design process [5]. We also want to offer ways to communicate relevant knowledge components between all developers through the whole development process.

REFERENCES

[1] Herczeg, M. (1994): Software-Ergonomie. Addison-Wesley-Longman and Oldenbourg-Verlag

[2] Winograd, T. (1988): A Language/Action Perspective on the Design of Cooperative Work. Human Computer Interaction 3 (1), pp. 3-30

[3] Rouse, W.B.; Morris, N.M. (1986): On Looking into the Blackbox: Prospects and Limits in the Search for Mental Models. Psychological Bulletin 100, pp. 349-363

[4] Kritzenberger, H.; Herczeg, M. (2000): Completing Design Concepts for Lifelong Learning. To appear in: Proceedings of ED-Media 2000, Montreal (this volume).

[5] Hartwig, R.; Kritzenberger, H.; Herczeg, M.: Course Production Applying Object Oriented Software Engineering Techniques. To appear in: Proceedings of ED-Media 2000, Montreal (this volume).

Students' Acceptance of Videoconferencing in the Lecture Context

Patrick Kunz
Network for Educational Technology NET
Swiss Federal Institute of Technology (ETH)
Zürich, Switzerland
kunz@diz.ethz.ch

Abstract: The goal of this work was to develop a set of recommendations for the use of videoconferencing in large classrooms. The students' acceptance of synchronous videoconferencing, the role of the instructors as well as the influence of videoconferencing on motivation and interactivity were in the focus of this study.

Based on the statements of 178 evaluated students there are three main recommendations that can be made: (1) The didactic approach of the course must concentrate on an more active involvement of the participants. (2) The instructor must be willing to adapt his teaching style to the integration of new media. (3) Technic has to be so perfect, that it guarantees the first two aspects: an undisturbed transmission with possibilities to interact for all participants and support of the instructor to make teaching easy.

Introduction

A lot of studies report about the benefits of videoconferencing in the context of small classes with active student participation. Videoconferencing in small classes has been shown to increase student motivation as well as interaction among students and lecturers often leading to a redefinition of teaching (among others Abotte, Dallat, Livingston, & Robinson, 1994; Bramble & Martin, 1995). Experiences with videoconferencing in the large classroom context however differ at least in part in some of these results. Increased inhibition to speak in front of others and lowered spontaneity seemed to be real problems (Knox, 1997). Further, an improved motivation or satisfaction was not found (Fillion, Limayen, & Bouchard, 1999). The purpose of this study was to find out, which aspects are the most crucial for the use of videoconferencing in large classrooms.

Method

Equipement

The videoconferencing facility used in this evaluation is a synchronous system based on ATM. Its theoretical bandwidth of up to 155 Mbits/s allows the simultaneous transmission of three audio- and video-streams with high quality and perfect audio-video synchronisation between two and more connected sites. The system provides full interaction possibilities to all participants at all connected sites.

The setting in the examined lecture is a two-point configuration consisting of the following components:

Remote classroom: Three screens, projected by beamers, with 1.) the instructor, 2.) the PowerPoint slides and 3.) the other class.

Local classroom: Two screens, projected by beamers, with 1.) the PowerPoint slides and 2.) the remote class. For further technical details see (Walter & Hänni, 1998).

Participants

The examined sample consisted of totally 178 participants of a two year course in pharmaceutical chemistry (86 students in the locat classroom; 92 students in the remote classroom). Gender representation was not equal (139 female and 39 male).

Control data (normal course without videoconference) were collected from students of both locations during summer 1999. The experimental data resulted from the first half (13 weeks) of the academic year 1999/2000.

The constructs and its components consisted of items which were measured using a five-point Likert-type scale (1=strongly disagree to 5=strongly agree).

Results and discussion

The following presented results were based on a minimum level of significance of $p<0.001$.

Acceptance and Motivation

As expected, students in the local classroom accepted with M=3.3 the videoconference better than remote students (M=2.7). Furthermore there was a significant difference in the acceptance which is correlated with the infrastructure: While in location 1 the auditorium used for the transmission consisted of a permanent equipped room, location 2 had to build up all equipment for the lecture every week.

In contrast to studies who reported about increased motivation, the measured motivation construct (consisting of subject interest and self-efficacy) remained the same with versus without videoconference. Nevertheless, with r=0.57, motivation was one of the strongest predictor of the acceptance.

Influence of the quality of the transmission

The participants rated the quality of audio (M=3.9), the level of synchronisation (M=3.7) as well as the quality of the transmitted videos (picture of the lecturer (M=3.8) and projection of the slides (M=4.1)) more than satisfying. Only the video of the remote auditorium was assessed average (M=2.9). The quality of transmission seems to be so good, that there were no correlations greater than r=.34 with the acceptance or the motivation.

Role of interactivity

The largest impact on the acceptance of a videoconference-classroom exerted the possibilities of interaction. Students assessed this kind of lecture in comparison with a normal classroom less stimulating for discussions between them and the lecturer (M=2.5). This variable had with r=.61 thew strongest correlation with acceptance.

The hypothesis, that students were more inhibited to ask questions during the class, can be accepted. However, the level of inhibition was lower than expected (M=3.5). With r=-.27 ($p<0.002$) the correlation between inhibition and acceptance never reached the expected level.

The possibilities of spontaneous intervention were even rated slightly higher than in the traditional classroom setting (M=3.2) and did not coincide with the students' actual hesitance. This high rating is most likely due to the lecturers' efforts to integrate prepared questions in their slides. Its correlation of r=.43 with the acceptance underlined the importance of the possibility to interrupt the speaker at any time.

Role of the instructors

The correlation of r=.38 between the acceptance of videoconferencing and the performance rating of the lecturers (with M=3.6 both were assessed above average) emphasized the important role of the instructors.

It is encouraging to note, that the implementation of videoconferencing had positive side effects on teaching: The cooperation of the two involved professors lead to an overall improvement of the curriculum with better structure, more goal orientation and the integration of prepared questions.

Recommendations

Based on these results, the following guidelines are proposed for the use of videoconference systems in the lecture context with groups consisting of more than 20 participants on each side:

1.) Lecturers have to consciously plan possibilities to interfere and to create an atmosphere that motivates students to undertake a more active part.

2.) The instructor must be above average and be willing to accomplish an extra effort.

3.) The technical infrastructure must guarantee a clear transmission of video and audio as well as the possibility of interaction at anytime for all participants.

References

Abotte, L., Dallat, J., Livingston, R., & Robinson, A. (1994). The application of videoconferencing to the advancement of independent group learning for professional developement. *Educational and Training Technology International*, *31*(2), 85-92.

Bramble, W.J., & Martin, B.L. (1995). The Florida telelearning project: Military training via two-way compressed video. *The American Journal of Distance Education*, *9*(1), 6-26.

Fillion, G., Limayen, M., & Bouchard, L. (1999). Videoconferencing in distance education: A study of student perceptions in lecture context. *Innovations in Education and Taining International*, *36*(4), 302-319.

Knox, D.M. (1997). A review of the use of video-conferencing for actuarial education – a three-year case study. *Distance Education*, *18*(2), 225-235.

Walter, T., & Hänni, H. (1998). *Telepoly - A Teleteaching Scenario supported by High-Speed Networks - Extension and Evolution.* Paper presented at the ED-MEDIA/ED-TELECOM 98, Freiburg, Germany.

Understanding collaborative learning in CMC: A research in an elementary classroom

Qing Li, University of Toronto, Canada

Abstract: This study is intended to understand collaborative learning in a context that enables communication by computer text messaging. Particularly, the study seeks to determine the level of collaboration in a classroom that uses computer-mediated communication (CMC), as well as to examine the relationship between the language functions associated with CMC generated messages and the collaborative learning process. In this study, "language functions refer to ways we can use language to achieve a communicative purpose" (Olsen, 1992). It is what people "can do with language" (McDonell, 1992), or "what people want to do with the language" (Finocchiaro & Brumfit, 1983, p.13), such as: requesting information, requesting confirmation, making suggestion, apologizing, etc.

The study is prompted by following questions

1. What are the levels of collaboration (in terms of interactivity) in the classroom that uses CMC?
2. Are there any patterns in people using of language functions in relation to the degree of collaboration (in terms of interactivity) in the context of CMC? If yes, what are the patterns?

a). Are there any patterns in people using "requesting information" in relation to the degree of their collaboration (in terms of interactivity)?

b). Are there any patterns in people using "requesting confirmation" in relation to the degree of their collaboration (in terms of interactivity)?

Computer-mediated communication (CMC), is an effective electronic means of connecting geographically dispersed learners using computers, in order that they may collectively participate in a learning experience where the interaction is mediated. Despite it relatively short history as a distance medium, a great deal of interest has been shown in this technology.

Courses offered by CMC are gaining favor in schools and institutions of higher education. Students can interact at a time and in a place that is personally convenient, discuss issues as fully as desired without constraints (Henri, 1995). CMC promotes interactive activities such as active dialogue and sharing of information and knowledge, which help develop a sense of community among participants (Burge, 1993). The CMC can be used as a powerful tool for group communication and collaborative learning (Crook, 1995). The collaborative learning environment promotes active mental engagement in the experience (Grabowski, 1990).

Despite the large body of literature on peer learning and teaching, there are few acknowledgments of how well CMC may support collaborative learning. Although cognitive and social psychology have already provided much information about how students communicate and its relationship with collaborative learning, the context has usually been the traditional face-to-face setting with its paralinguistic cues to facilitate communication. What we do not yet know in published detail are how people learn collaboratively and how this collaborative learning relates to the communication in the CMC context. In addition, O'Malley (1995) calls for studies of collaborative learning that "focus more on the processes involved in successful peer interaction, rather than just on learning outcomes".

Therefore, this study seeks to understand how people learn collaboratively and how their collaborative learning relates to the communication in the context of CMC. By asking these research questions, I assume that if we, as educators, know more about the process of collaborative learning in a computer-mediated-communication environment, we have a better chance of developing practical guidelines for facilitating learning. In addition, the information obtained from the study may contribute to the present understanding of students learning in CMC environment and may suggest future studies in the area.

For instance, numerous studies (Johnson & Johnson, 1989) dealing with collaborative learning have suggested that students need appropriate social skills in order to be successful in their collaborative learning. Johnson and Johnson (1989) emphasize that collaboration is the most important and basic form of human interaction, and the skills of collaborating successfully are the most important skills anyone needs to master. Coelho (1992) explains that good social skills can promote collaborative learning and some negative behaviors can shut off future collaboration. In addition, the literature on collaborative learning emphasizes the need to teach social skills. Students need assistance in acquiring those social skills and many of these social skills can be regarded as communication skills. For example, Olsen and Kagan (1992) state that "social skills include ways students interact with each other to achieve activity or task objectives (e.g., asking and explaining) and ways students interact as teammates (e.g., praising and recognizing)".

However, all these conclusions are based on the works that have been done in traditional face-to-face settings. Are the conclusions still true in the CMC environment? This remains to be answered and it raises important questions in the field of collaborative learning. This study will try to understand how students go about communicating and learning in the CMC environment. Once we have this understanding, we might then compare the CMC learning strategies with those reported for face-to-face classroom contexts in order to search for new practices to facilitate collaborative learning and better suited to the CMC context. And only when we have a better understanding of computer mediated learning, we can make a better use of CMC.

The subject of this study will be a grade 5-6 classroom in an inner elementary school in Toronto.

Reference:

McDonell, W. (1992). Language and cognitive development through cooperative group work. In C. Kessler (ed.), Cooperative language learning: A teacher's resource book. Englewood Cliffs: Prentice Hall Regents.

Olsen, R. (1992). Cooperative learning and social studies. In C. Kessler (ed.), Cooperative language learning: A teacher's resource book (pp. 85-115). Englewood Cliffs: Prentice Hall Regents.

Finocchiaro, M. & Brumfit, C. (1983). The functional-notional approach: From theory to practice. Oxford: Oxford University Press.

Henri, F. (1995). Distance learning and computer mediated communicated : Interactive, quasi-inteactive or monologue. In C. O'Malley (ed.), Computer supported collaborative learning, (pp.145-161), NATO ASI series, Berlin: Springer-Verlag.

Burge, E. (1993). Students' perceptions of learning in computer conferencing: A qualitative analysis. Unpublished doctoral thesis, The Ontario Institute for Studies in Education, Toronto.

Coelho, E. (1992). Cooperative learning: Foundation for a communicative curriculum. In C. Kessler (ed.), Cooperative language learning: A teacher's resource book. Englewood Cliffs: Prentice Hall Regents.

Combining Instructional Models and Enabling Technologies to Embed Best Practices in Course Instructional Design

Paul M. Malone, Germanic and Slavic Languages, pmalone@artsmail.uwaterloo.ca
Catherine F. Schryer, English Department, cschryer@watarts.uwaterloo.ca
Vivian Rossner-Merrill, Lt3 Centre, vrmerrill@lt3.uwaterloo.ca
University of Waterloo, Ontario, Canada

Introduction and Overview

Two distinct fields of educational activity should inform instructional design of courses using teaching technologies. These are cognitive theory and instructional theory. Cognitive psychologists tend to analyze cognitive structures and processes at a conceptual level without due regard to how these may be implemented in the instructional setting. Conversely, content designers and instructors do not often recognize the value of undertaking the analysis of content and teaching practices from a cognitive analytic perspective (Reusser, 1993). We propose that one means to combine the best practices of both fields in teaching and learning is to ensure that the instructional design process integrates both perspectives. Three principles inform the proposed framework of design.

- Selected models of instruction that best support the teacher's purpose for mastery of content, and the selection of enabling technologies that mirror the selected model of instruction are combined in the design process.
- Models of instruction and enabling technologies are selected according to the nature of the content to be learned, the teaching styles and preferences of instructors, and the learners concerned.
- Promoting and supporting development of the active nature of the learner underscores the entire design process.

The development of this framework took place through a recursive process of experimentation and teaching in two different university courses. The campus course uses concept-mapping software as a teaching aid and as a study aid for students needing to master the more difficult and abstract content areas in the study of German Thought and Culture. The software used was chosen for its ability to mirror the 'meaningful learning' model of instruction developed by (Ausubel, Novak & Hanesian, 1978) and (Novak, 1998). The online course, Introduction to Academic Writing, uses a Web site as the primary teaching tool and its design mirrors the 'expert instructional scaffolding' model of learning developed by (Hildyard, 1996). This model supports the need to ladder content into instructor supported incremental steps that allows modeling of best writing practices through interactive feedback processes.

UsingVisual Organizers and Meaningful Learning to Teach Cultural History

Students unfamiliar with cultural history are frequently presented with a huge number of facts and dates that have little significance to them, encouraging – if not forcing – them to acquire as much as they can through rote learning. The nature of the assignments and examinations often further reinforces rote learning and tends to discourage the synthesis and creative application of the material. The use of visual organizers coupled with instructional design based on a model of meaningful learning permits the student to see how the information communicated in the course is interrelated internally, and also how it is connected with students' prior knowledge. Relationships and interrelationships can be seen and apprehended quickly and easily when represented visually.

Concept mapping conveys information by reducing it to concepts (perceived regularities in objects or events) and propositions (significant combinations of concepts), which are then structured hierarchically and linked by means of lines representing the relationships between concepts and labeled accordingly. Each concept is thus already presented in a contextual relationship with other concepts. This device can be used either as a visual aid in teaching or more actively as an aid to learning. Novak's strategy of concept mapping is based on Ausubel's principles of meaningful learning designed to promote retention and subsequent related learning. These principles include the following:

- The learner must have prior knowledge related to the new information to be learned
- The new material must be relevant to other information and must contain significant concepts
- The learner must choose to learn meaningfully, rather than by rote.

We focus on concept mapping as the most viable strategy to link prior knowledge with relevant new conceptual material, using the CMapTools software package to support this strategy. The software has the features needed for the strategic learning practices outlined above; it is downloadable as freeware and it is easy to learn and use.

Using 'Expert Scaffolding' and the Web to Teach Academic Writing Skills

The purpose of this course is to provide the foundation for scholarly writing that students can build on through further, related coursework and through application of their writing skills in other university courses. Because writing skills are best acquired sequentially, the material in this course is scaffolded into linked, incremental units that build on each other. Throughout the course, the instructor provides expert modeling through feedback as evaluative discourse. Using WebBoard as a vehicle for threaded discussion, students interact with an experienced writer who supports them until skills are mastered at each level. Drawing from (Langer and Appleby, 1986), four design principles for scaffolding were used to inform teaching practice and design of the Web site

- Students were encouraged to assume ownership of their writing tasks
- The assignments were designed to address students' incremental levels of knowledge
- The assignments were designed to support the sequence of skills acquisition in the course
- The instructor and tutors supported students in a facilitative manner

Successful teaching in a course of this nature requires providing ongoing feedback using multi-faceted dialogue with students through commentary on writing and involvement in peer editing sessions. Feedback comes from the instructor and tutors and from other members of the student group. The course begins with a shared basis of readings – reading groups which present their interpretation of texts – and continues with discussion groups which assist writers to refine and elaborate their thoughts, and concludes with peer revision and editing groups. Thus evaluation is embedded in the design of the course and specifically with the design of the assignments. The assignments and final project include interactive exercises, instructor and peer commentary and editing, and online areas for discussing course content.

Conclusion

To date, we have successfully demonstrated in two courses that instructional theory and enabling technologies can be combined in a useful framework to inform instructional design of a given course. The next step is to design research studies that address the impact of using this framework on teaching and student learning.

References

Ausubel, D.P., Novak, J.D., & Hanesian, H. (1978). *Educational psychology: A cognitive view*. New York: Holt Rinehart.

Hildyard, A. (1996), Writing, learning and instruction. In Erik de Corte & Franz E. Weinert (Eds), *International encyclopedia of developmental and instructional psychology*, pp. 577-580. New York: Pergamon.

Langer, J.A., & Appleby, A.N. (1986). Reading and writing instruction: Toward a theory of teaching and learning. *Review of Research in Education*. 13, 171-194.

Novak, J.D. (1998). *Learning, creating, & using knowledge: Concept maps as tools to understand and facilitate the process in schools and* corporations. New Jersey: Lawrence Erlbaum Associates.

Ruesser, K. (1993). Tutoring systems and pedagogical theory: Representational tools for understanding, planning and reflection in problem solving. In S.P. Lajoie & S.J. Derry (Eds), *Computers as cognitive tools*. New Jersey: Lawrence Erlbaum Associates, pp. 143-177.

To teach remotely by controlling the didactic interaction of a student with a multiapplication environment

Nathalie Masseux
Auvergne University Institute of Teachers Training
20 av. R. Bergougnan
63039 Clermont-Ferrand Cedex 2, France
nmasseux@auvergne.iufm.fr

Conceptual approach

The TeleCabri practices can be articulated with the whole of the experimental studies led these ten last years on remote teaching (Dessus et al. 97) in term of situated learning. The teachers seldom intervening in the realization of the computer-based environments that they use to teach remotely, the purpose of this research is to specify the cognitive influence (Balacheff 91) of the mediation of these environments on the student/teacher interaction. The computer-based didactic systems, with the constructivist meaning of the didactic theory of the situations (Brousseau 86), are its object of study. It is built according to the interactionist approach in HCI (Pochon & Grossen 97) considering these systems as a semiotic mediator by way of the didactic concept of computer-based milieu (Chevallard 92). A computer-based milieu is regarded as knowledge carrier aimed by the learning. We are particulary interested in the milieu which include microworlds or simulators characterized by a significant epistemological validity and a capacity to support a learning guided by the discovery (Masseux & Michau 96). It can thus include a computer-based tool identified like software or/and hardware support of a learning. Here, we center our study on the environments including several educational applications. This study aims at specifying the strategies of didactic regulation engaged by the teacher modelled before in the theory of the didactic situations. These strategies are analyzed using cognitiv models (Anderson et al. 90) of action/feedback between a user and an application who are declined for the student and the teacher. The finality of this research is to develop tools which help the teacher to diagnose in real time the learning activity of the student. It lies within the scope of study of computational didactics applied to mathematics (Balacheff & Kaput 97).

Functional integration of a platform to teach remotely

The functional integration of the platform is based on the capacity of a system to bring answers to the specific constraints of the students and teachers. The functionalities of the platform bring a technological response to the complexity of management of distributed human resources and of which the availability is unforeseeable.

The student/teacher interaction through PCs articulates three types of functionalities:
- functionalities allowing an autonomous work of the student (educational applications)
- functionalities of synchronous collaboration (video, audio, shared applications)
- asynchronous functionalities of interaction (email, sending of files)

Cognitive influence of a multiapplication environment on the remote student/teacher interaction

With TeleCabri, the student and the teacher interact remotely by way of three applications, each one considered here as didactic milieu and each one characterized by an epistemological validity specific to the stake of learning:
- an *oral* milieu, supported by the videocommunication,
- a milieu *Web on the geometry,* including a base of exercises, definitions and properties,

- a milieu *(CabriGéométre)* microworld of direct interaction with geometrical objects provides as a solving board of problem.

To control the student/environment interaction

The regulation which the teacher carries out is conditioned by the sequential organization of the various stages of use of the platform by the student.
This sequential organization can be schematized as follows:
- an autonomous stage of work for the student which precedes the stage by videocommunication with the teacher,
- a stage of videocommunication during which the student requests the assistance of the teacher to solve his difficulties by sharing its applications

The regulation processes of the teachers on the student/environment interaction

The observation underlines the didactic contribution of the property *multiapplication* of the environment. This contribution is observed through the diversity and the accuracy of the regulation processes carried out by the teachers. Those try to exploit the epistemological complementarity of the three *milieu* within the limit of their own functional and cognitive control of the environment.

In short, to control the student/environment interaction, the teachers proceed according to two types of interaction:
- co-operative interactions on the geometrical objects with the interface of CabriGéométre when the teacher focuses himself on the diagnosis while the student concentrates on the autonomous experimental solving of the problem,
- collaborative interactions to create, to modify and to remove objects with the interface of the microworld when the teacher wants to destabilize a balance of action/feedback of the student with the environment.

The process of destabilizing used by the teacher consists in questioning the student on the inaccuracies or the cognitive disjointednesses which arise from the interaction of the student with the three milieu. The regulation in *the oral milieu* in term of formulation, reformulation in the linguistic reference frame of the Euclidean theory, takes into account the collaborative interactions.

References

Anderson, J.R., Boyle, C.F., Corbett, A. & Lewis, M. (1990). Cognitive modeling an intelligent tutoring. *Artificial Intelligence*, 42, 7-49.
Balacheff, N. (1991) . Contribution de la didactique et de l'épistémologie aux recherches en EIAO. *Actes des XIII° Journées Francophones sur l'Informatique.* Grenoble - IMAG. Ed. Bellissant.
Balacheff, N. & Kaput, J. (1997). Computer-based Learning Environments in Mathematics. *International Handbook in Mathematics Education*. A. Bishop et al. (eds.), Dordrecht: Kluwer Academic Publisher. 469-501.
Brousseau, G. (1986). Fondements et méthodes de la didactique des mathématiques. *Recherche en Didactique des Mathématiques*, 7 (2), 33-115.
Chevallard, Y. (1992). Intégration et viabilité des objets informatiques dans l'enseignement des mathématiques. B.Cornu (d.). *L'ordinateur pour enseigner les mathématiques*, Nouvelles encyclopédie Diderot, Paris : PUF. 183-203.
Dessus, P., Lemaire, B. & Baillé, J. (1997). Etudes expérimentales sur l'enseignement à distance. *Sciences et Techniques Educatives*, 4 (2), 137-164.
Hoyles, C. & Noss, R. (1992). A pedagogy for mathematical microworlds. *Educational studies in Mathematics*, 23 (1), 31-57.
Masseux, N. & Michau, F. (1996). Découverte guidée sur simulateur pour l'apprentissage de l'automatique par des élèves-ingénieurs. *Sciences et Techniques Educatives*, 3 (1), 77-100.
Pochon, L-O & Grossen M. (1997). Les interactions homme-machine dans un contexte éducatif: un espace interactif hétérogène. *Sciences et Techniques Educatives*, 4 (1).

The Total Student Experience

Paul McKey
CTO NextEd Ltd
paul.mckey@nexted.com

Abstract

With the advent of online education the Universities of the world are for the first time exposing their wares in a public space, the Internet, in direct competition and comparison to similar commercial offerings.

While the argument for the University offering as being one of 'accredited academic quality' is easy to win against its unaccredited training and professional development competitors it is not necessarily as easy to suggest the university offering is always a better 'product'.

Universities typically have little experience selling their wares in a commercial environment where price, service and immediacy matter. It then comes as no surprise that when a mature adult learner is shopping around universities are often being overlooked for education alternatives more in tune with the requirements of a modern lifestyle.

The Total Student Experience offers a conceptual framework for the discussion, delivery and measure of an online educational system from the student's perspective. It suggests a model with four distinct layers, which individually and collectively, effect the learner's overall satisfaction with the system. The four layers are presentation, function, education and administration with a number of key variables occurring within each layer?

This paper will discuss the use of this framework and the importance of the underlying assumption that the university 'product' in the online environment will be measured not only by its traditional hallmarks but also by the key elements of the medium in which it is offered. When that medium is the Internet these elements are convenience and relevance, service and value, and the antithesis of the mass production era of education, personalisation.

The complete version of this paper is available at
http://www.nexted.com/news/papers/tse_mckey.html

Telematic Post-basic Nursing Education at the

University of Pretoria in South Africa:

Salomé M Meyer
Lecturer: Nursing Education
Manager: Telematic Education
Department of Nursing Science
University of Pretoria, South Africa
e-mail: smeyer@medic.up.ac.za

Abstract: This paper is on the Telematic Education (TE), which is not the mere use of the television set as a teaching tool/aid. . It should be viewed and managed as a strategic resource. TE refers to a comprehensive system of flexible learning. It emphasises the use of technology that will enhance the teaching and learning environment. Nurses/lecturers have been confronted with the fast development of technology for many years, but mostly in clinical practice. The Department of Nursing Science of the University of South Africa is providing in the learning needs of professional nurses in certain rural areas of the country by means of TE.

1. Introduction:

Broadcast television has been a solution to educational requirements such as the widely distributed campuses of some countries such as Australia and Canada, or even the widely distributed student populations of universities (Laurillard. 1993: 113). To be of any value to a student television education must be interactive in nature. This implies that student and lecturer must be able to communicate during a lecture that is being broadcast by means of television. This brings to mind the concept of Telematic Education (TE), which is not the mere use of the television set as a teaching tool/aid.

2. University of Pretoria (UP) :

No university is immune to the impact of technological change. Organisations can benefit tremendously by exploiting technological change. It should be viewed and managed as a strategic resource. The deployment of the Technology Plan of the UP has already borne fruit. The establishment of the unit for Telematic Teaching and the subsequent virtual campus initiative are direct benefits of the Plan.

3. Telematic Education:

Before one should attempt to understand what (TE) is, it is important to know what is meant by 'flexible learning'. According to Dr. Tom Brown of the Telematic Education Department of the University of Pretoria, TE refers to a comprehensive system of flexible learning. It emphasises the use of technology that will enhance the teaching and learning environment. TE is mostly delivered over a distance. The dependent learner will be more directed by the lecturer whereas the autonomous student who are capable of self-study will be able to employ the higher technological learning facilities. In the educational setting, all the dynamics of the traditional classroom are preserved, regardless of the distance separating the locations". This is the ideal situation to which finances and available sources not always lend it.

4. Interaction:

The structure of a typical teaching session must have two parts. During the first part of the lecture the lecturer delivers the lecture, i.e. passing on knowledge to the students. The second part of the lecture can be in the form of a discussion/question session with high interaction between the lecturer and the students (Jameson, Hanlon, Buckton, & Hobsley,1995:114). The need for students to have back up videos/copies of broadcast stems from the fact that some students might not be able to attend broadcast sessions due to employer demands, technical failure or such like reasons (Jameson et al. 1995:45).

5. The Nursing Education Situation:

Nurses/lecturers have been confronted with the fast development of technology for many years, but mostly in clinical practice. Telematic education (TE) is employed in nursing education (NE) for post-basic programs. Post-basic programs imply that people who have already registered as professional nurses at the South African Nursing Council (SANC) are continuing and furthering their skills and knowledge regarding certain specialities in the profession. Continued education for post-basic nursing requires a distance education method that will serve as an academic solution to professional nurses in rural areas of South Africa. The Department of Nursing Science of the University of South Africa is providing in the learning needs of professional nurses in certain rural areas of the country. Jack Yensen (1996:213), who calls this method of teaching 'telenursing', is of the opinion that the two key dimensions are distance and electronic mediation.

6. The Lecturer:

Lecturers who teach by means of telematic education must be skilled, self-confident, understand the uniqueness of the rural students and should be flexible. They should keep the concepts of adult learning in mind and respect the authority of experience that many students bring to the classroom. Lecturers who have not taught by means of this method need sufficient training. They do not need technical courses, but training on how to adjust their method of teaching as well as teaching aids to that of the telematic medium (Yeaworth. 1996:150). The use technology influences educational innovation.

7. Closing Remarks:

The twenty-first century will see many changes, the first of which will be the end of extensive emphasis on classroom teaching. Teachers, students, and preceptors will come together in dialogues to question, to demonstrate, and to participate actively in the learning process. Nursing will hopefully develop a 'world view'. "Remember, the information revolution will continue to roll on – with or without you. So, get on board and begin changing" (Simpson. 1997:27).

8. Sources:

-Book references:

Laurillard, D. 1993. ***Rethinking university teaching: A framework for the effective use of educational technology***. Routledge: London and New York.

-Online references:

Brown, T. 1999. ***Telematic Education at the University of Pretoria***. MS PowerPoint slide show.

(http://www.up.ac.za/academic/education/didactics/modules/ivx880/course/library.htm#show)

-Journal references:

Devaney, SW. 1996. Spotlight on: Health Education via Interactive Television. ***Nurse Educator***, vol. 21, n0. 4, July/August, pp15-16

Furnace, J, Hamilton, NM, Helms, P & Duguid, K. 1996. Medical Teaching at a peripheral site by videoconferencing. ***Medical Education***, vol. 30, pp215-220.

Jameson, DG, Hanlon, PO, Buckton, S & Hobsley, M. 1995. Broadband Telemedicine: Teaching on the Information Superhighway. ***Journal of Telemedicine and Telecare***, vol.1, pp111-116.

Penney, NE, Gibbons, MS & Busby, A. 1996. Partners in Distance Learning: Project Outreach. ***Journal of Nursing Administration***, vol. 26, no. 7/8, July/August, pp27-36.

Ranstrom, C. 1997. Restructuring Interactive Television: An Educator's Perspective. ***Nurse Educator***, vol. 22, no. 1, January/February, p5.

Simpson, RL. 1997. The Information Age: Influencing Practice and Academic Environments. ***Nursing Management***. November, pp26-27.

Tagg, PI & Areola, RA. 1996. Earning a Master's of Science in Nursing Through Distance Education. ***Journal of Professional Nursing***, vol. 12, no. 3, May-June, pp154-158.

Tangalanos, EG, McGee, R & Bigbee, AW. 1997. Use of the New Media for Medical Education. ***Journal of Telemedicine and Telecare***, vol. 3, pp40-47.

Yeaworth, RC. 1996. Consortia Arrangements and Educational Telecommunication. ***Journal of Professional Nursing***, vol. 12, no. 3, May-June, pp147-153.

Yensen, J. 1996. Telenursing, Virtual Nursing and Beyond. ***Computers in Nursing***. Vol.14, no.4, July/August, pp213-214.

Yucha, CB. 1996. Interactive Distance Education: Improvisation Helps Bridge the Gap. ***Journal of Bio-Communication***, vol. 23, no. 1, 1996, pp2-7.

-Research references:

Meyer, SM. 1998. ***Telematic Education in the Department of the Medical Faculty of the University of Pretoria: A Descriptive Study***. Dissertation for the Honours degree BCur IetA in Advanced Nursing Education.

http://www.aace.org/cfusion/conf/edmedia/paprsub2.cfm

Technology Acculturation among Adolescents: The School and Home Environments

Leslie Miller & Christine Brandenburg
Center for Technology in Teaching and Learning
Rice University
Houston, Texas, USA
lmm@rice.edu, christyb@rice.edu

Heidi Schweingruber
Rice University School Mathematics Project
Rice University
Houston, Texas, USA
schwein@rice.edu

Abstract: The greater prevalence of computer technology in the daily lives of middle school students is impacting their learning envrionment. Students of both genders and different levels of socio-economic status are well on their way to becoming part of the digital culture. This paper suggests that the gaps that once existed with regard to computer access, use, and perceived expertise are narrowing significantly. These findings are based upon survey data from 512 middle school students in three areas: (a) self-perception of computer skills and their acquisition; (b) exposure to technology at home and at school; and (c) media style and content preferences.

Introduction

Media and digital technology are pervasive in our lives. The advent of technology into the lives and culture of adolescents is not one of choice but of certainty. If we understand the influences at work among our youth, then perhaps we can address their educational needs in ways that maximize what we already know about how to structure effective content. Are there any signs of technology acculturation at work? Have computer presence and increased proficiency translated into any appreciable closing of the previously documented digital divide with regard to gender and socio-economic variables among middle school students?

The Study

Based on a series of small focus groups with middle school students, the authors compiled a 68-item questionnaire, both closed and open answer, to cover students' preferences and practice using different types of media. Students answered the paper and pencil questionnaire during either a science or computer technology class period. Typically, the questionnaire took 30 minutes to complete.

Between October 1998 and April 1999, 568 middle school students were surveyed from eight different metropolitan-area public and private middle schools covering four different school districts. The students ranged in age from 11 to 15 years ($\underline{M}$ = 12.59, $\underline{SD}$ = 0.66). Students who did not report essential demographic information were dropped from the analysis for a final sample of 512 students. Of the final sample, 43.4% were male ($\underline{n}$ = 222) and 56.6% were female ($\underline{n}$ = 290). Schools were recruited to obtain a diverse student population representative of urban and suburban schools, as well as all ranges of socio-economic status (SES). The final sample contained 31% high disadvantage students ($\underline{n}$=158), 33% middle disadvantage students ($\underline{n}$=170), and 36% low disadvantage students ($\underline{n}$=184). Within each SES category, male and females were represented nearly equally.

Findings

The digital divide separating the confidence levels of male and female adolescents with regard to computer use is narrowing. While some significant differences emerged, the patterns of computer use and the purposes of use were remarkably similar for males and females in our sample. As recently as 1994, one study by Sakomoto indicated that among fourth through sixth grade students considered "heavy users" of computers, the ratio of boys to girls was 4 to 1. Our results indicate that this gap is closing as we found no gender difference among those who could be identified as heavy users of computers. Additionally, when looking at the use of computers for identified school subjects, we found similar levels of self-reported computer use between males and females.

In contrast to previous research, both males and females indicate that games dominate the home use. Even in the school environment, games were one of the prime uses. Games remain an important part of adolescents' computer repertoire. These findings, in particular, argue for ways in which to infuse the gaming format with sufficient intellectual content to make the "game" a valuable learning tool. Some educators have already seized upon this notion and are producing more substantive Internet games that incorporate accepted learning theory. The theoretical framework of curriculum built around problem-based or case-based learning could lend itself to a gaming environment. Crucial issues of how intrinsic the problem is to the game scenario and how well do learning objectives translate into an appealing hypermedia format are all ones that would need to be explored.

Conclusions

While the content of educational web sites targeted for middle school students is still an issue for debate, the data from this survey point clearly toward web sites as an effective delivery mechanism. Access, use, and perceived self-confidence in navigating the Internet are less constrained by gender-related concerns than they were less than a decade ago. In addition to the rapid rise in adolescent female participation in technology, the data also echo the research of others in highlighting the prominence of all types of media in the life of adolescents.

The recent Kaiser survey (Kaiser Family Foundation, 1999) found that the average amount of time each day spent using all types of media for children from 8 to 18 years olds was 6.43 hours. The influence of all media in youth's life was reinforced by our survey participants' choices of "your favorite famous person." Of the 512 responses, 74% were performers or musicians. The remaining types of persons named could be categorized as 18% athletes, 3% historical figures, 2% religious figures, and 4% other.

Media of all types are playing a larger role in children's lives; however, it is mostly a solitary experience. Our data indicate that children are largely using the Internet and computers at home free of supervision. It also may not be the case that the computer is replacing other forms of media in adolescents' lives, but rather it is being "added" to the existing repertoire among those who are already "heavy users" of media.

One of the challenges before us is the creation of sufficient quantity and quality of digital materials to attract and retain adolescents' interest in an unsupervised environment. The materials must be free of gender-bias and bridge the gulf that currently exists between how kids learn and communicate on their own and how they are taught in school. Can the production of high-quality, educationally-grounded, and content significant materials attract adolescents to the world of learning via the Web?

References

Kaiser Family Foundation (K.F.F.). (1999, November). *Kids and media @ the new millenium: A comprehensive national analysis of children's media use.* Menlo Park, CA: The Henry J. Kaiser Foundation.

Sakamoto, A. (1994). Video game use and the development of socio-cognitve abilities in children: Three surveys of elementary school students. *Journal of Applied Social Psychology*, 24, 21-24.

The Development of a Standardized Evaluation Instrument in Educational Technology in a Post Secondary Setting.

Jack E. Morin
George Washington University
Washington, DC
U.S.A
morin@ucalgary.ca

Janice Bakal
The University of Calgary
Calgary, Alberta
bakal@ucalgary.ca

Abstract
This evaluation project examines the required elements for a standardized instrument for the evaluation of educational technology. The project will survey current users of educational technology and seek common threads and patterns in a successful evaluation. This study will attempt to answer this question: What should we be collecting, measuring and examining when evaluating technology in an educational setting? This project is the first step in a multi-stage, two-institution evaluation study that will develop a standardized evaluation instrument for use in the evaluation of education technology. The project will enlist the assistance of two post secondary faculties, clients, developers and students. Each group will be surveyed using an online form. A representative sample from each group will be interviewed in a focus group setting. Expected outcomes of this first stage include the collection of responses from users, developers and clients of educational technology. The survey responses (n=81) have provided a unique opportunity to share and compare educational strategies and concepts between post secondary institution faculty, users and developers. Common patterns were evident within and between groups relative to concepts of educational technology evaluation and important aspects of instructional design.

Introduction
This evaluation project will examine the required elements for a standardized evaluation instrument for educational technology tools and applications. The project will survey current users of educational technology and seek common threads and patterns amongst user groups for the design of a successful evaluation instrument. The goal of this project is to determine what users and developers deem important, valuable and relevant with respect to instructional design and the evaluation of technology in the post secondary arena. The survey data collected will be used to create a standardized evaluation tool. This evaluation tool will assist developers, instructors, teachers, and learners in the design, construction and use of an instructional design model and template suitable for use in the post secondary field of education.

Project Rational and Purpose

First, the research in this area has focused on the application of technology. Evaluation studies on educational technologies have traditionally focused on the particular technology tool and it's impact on the learning environment. While useful in producing data for that tool or application, generalizability to other technologies or application is not possible due to the design of the instrument. Typically these instruments survey specific program issues and fail to consider the larger pedagogical issues of technology (this link provides examples of about 50 instruments of evaluation used in educational technology) [1]. Such programs as the Annerberg's Flashlight Project[2] and McMaster University's EVNet[3] have been leaders in educational technology project, but have failed to develop a standardized instrument, useful in evaluating all types of projects, across multiple users in various circumstances.

Secondly, this project is the first step in a multi stage; two-institution evaluation study dedicated to the development, testing and dissemination of a standardized instrument for educational technology evaluation. The first stage is a necessary step in determining what should be evaluated when examining technology in the education field of study.

Several studies have identified survey instruments and other collection tools for use in educational technology[4 5]. While useful in assessing individual programs for a specific outcome, these types of instrument are difficult to generalize to educational technology, regardless of platforms, users or programs. Determining what should be evaluated in a format that can transferred across technologies and application is a critical next step in valuing educational technology's' contribution to learning.

Conclusions

The first step of this multi-stage evaluation project produced an extensive database of information on what users, developers, clients, and educators think about educational technology and its application to learning. The collection of data ranges from attitudes towards technology to perceptions of technology and its affect on learning. It also provided a resource in the development of a standardized tool for evaluation educational technology.

From this study sample, it is clear that respondents agree on a number of issues in terms of importance and relevance to instructional technology. It is also important to note that there are some differences between respondent groups relative to the evaluation process for educational technology. This information supports previous research in educational technology that has identified key concepts and factors of educational technology.

This first stage of the project provided an opportunity to validate the survey instrument, by seeking some responses to confirm that the evaluation of educational technology is an important aspect of the instructional design process. These findings can be used to development a survey instrument designed to evaluate the important constructs of instructional design with the use of technology.

This first stage of this project provided a unique opportunity to share and compare educational strategies and concepts between two post secondary institutions. It is hoped that the two institutions will share a common ground with respect to the development, application and delivery of educational technology.

References

---

[1] URL: http://www.millsaps.edu/www/cdiac/tech_eval.html

[2] URL: http://www.learner.org/edtech/rscheval/

[3] URL: http://olt-bta.hrdc-drhc.gc.ca/about/index.html

[4] Jacobsen, D. M.. *Using technology in higher education. New Currents in Teaching and Technology:* The University of Calgary Gazette, 27(29), 4. [On-line]. Available: http://www.acs.ucalgary.ca/pubs/Newsletters/Currents/Vol5.2/usingtech.htm

[5] Reeves, Thomas and R.M. Lent .*Levels of Evaluation for Computer Based Instruction*. Paper presented at the Annual Meeting of the American Educational Research Association. New York, March 1982.

Using Mobile Computer Technology and Internet Tools to Promote Constructivist Teaching

Chrystalla Mouza
Teachers College, Columbia University
United States of America
cpm12@columbia.edu

Introduction

This paper investigates how continuous access to laptop technology and telecommunication tools can promote a student-centered, inquiry-based, problem-solving teaching practice. The purpose of the study is to deepen our understanding on how technology and Internet tools can best be utilized in K-12 classrooms. We present an Internet-based project that utilizes laptop computers in a sixth grade classroom.

Research Questions

We explore how laptop computers and Internet tools are used by a sixth grade teacher who has extensive experience with technology and multiple opportunities for professional development. The overall questions that guide this research are as follows: a) What are the teacher's beliefs about teaching and learning? b) What is the nature of students' assignments? c) What is the role of the teacher and the student in the classroom? d) How are laptops being utilized in the curriculum? e) How is the Internet being used in the classroom?

Methodology

This study began in September1998 and takes place in urban elementary and intermediate schools in New York City. The primary data collection techniques that are utilized include classroom observations, teacher interviews, and document analysis. These activities have been carried out during school visits since the academic year of 1998-99. Participants for this initial research effort include a sixth grade teacher and her students. All students in the class are minority students; the teacher is a white female.

The classroom is part of the Laptop Project, which was initiated by the school district in 1997. All students in the project have been issued a laptop computer. The classroom is also part of the Eiffel Project, a major effort of the Institute for Learning Technologies (ILT) at Teachers College, Columbia University to assist schools and teachers integrate computers and telecommunication tools effectively in their classrooms. ILT provides teachers with technological and pedagogical support, as well as with opportunities for communication and collaboration with other teachers and researchers involved in the Eiffel Project.

Project Design and Preliminary Results

Mary, the sixth grade teacher participating in our experiment, started teaching for first time using laptop technology during the academic year of 1997-98. That first experience provided her with valuable training on the use of computers in teaching. Mary was ready to try new ideas, experiment with different projects, and go beyond traditional instruction. Therefore, she volunteered to participate in the Reach the World (RTW) project.

RTW (www.reachtheworld.org) is a virtual expeditionary venture that uses the world circumnavigation of Makulu II, a sailboat, as an interactive tool for classroom teaching in the United States. RTW utilizes the Internet and other telecommunication tools to bridge the student classroom with different cultures of the world. The crew of the Makulu II communicates with students regularly via satellite email. Since September 1998, Mary accommodated her social studies curriculum to the RTW project. Soon after she started participating in the project, she became the most active teacher. Some of the lesson plans she developed are posted on the RTW web-site as examples for other teachers.

Nature of Student Assignments

Planning an Itinerary. In this project students were asked to form groups and conduct research in order to identify possible sites that the Makulu II should visit on their trip to Singapore. Each group researched different attractions and recommended sites of interest. Students used travel brochures to locate tourist attractions, maps to figure out distances and ways of transportation in Singapore, and historical information from the Internet to identify museums of interest. When the final itinerary was put together it was sent out via email to the Makulu II crew. The Makulu II crew completed the tour and sent back relevant information and pictures to the students via email and air-mail.

Comparing religions of the world. Students studied different religions using information and videotapes that were sent by the Makulu II crew. In sequence, students formed groups and selected one religion to study in-depth. Final reports were presented to other sixth grade students in the school using PowerPoint slides.

The Role of the Teacher and the Students

Teaching was organized around two types of pedagogies: Collaborative knowledge construction and direct verbal instruction. Direct instruction did not represent the dominant mean of communicating knowledge to students. Students were rarely asked to memorize facts. They were instead asked to locate facts using CD-ROMs, books, the Internet, and other resources. The information was then analyzed in order to complete projects and solve problems.

The teacher was mostly a facilitator of learning and a "guide on the site". Students were given opportunities for self-directed inquiry. In many cases they were asked to generate their own questions and search for the answers. Laptops were very helpful because they put a lot of the resources into the hands of the students.

Utilization of Laptop Computers and Telecommunication Tools in the Classroom

Laptops were a vehicle to support the curriculum and expand the classroom's walls. Students typically used application programs such as a word processor for typing and editing documents, databases for organizing information, and graphics packages for developing multimedia presentations. Email was also used extensively in the classroom for communication purposes. Moreover, all students used First Class, an Intranet service that allowed them to communicate with their classmates and teacher after school hours.

Laptops were effective in promoting collaborative work and problem solving. Very often students were required to work in groups and create projects. In collaborative projects, students were required to perform research, collect information, analyze it, synthesize it, and produce a final product.

Conclusions

This paper presented an effort to integrate technology in the classroom. Laptop computers and telecommunication tools were used to provide students with authentic, meaningful, and motivating experiences. Learning became a challenge and students exhibited increased levels of control and creativity. Successful use of technology in the classroom depends, however, to a great extend, on the teacher. Therefore, in any implementation effort, adequate time must be devoted in helping teachers become comfortable with the equipment and absorb the new teaching principles associated with the use of the new technologies.

We currently work with a number of teachers in the New York City area assisting them with their technology implementation efforts. Many teachers use laptop computers and Internet tools for instructional purposes. Therefore, we continue our research by observing what is happening in these classrooms and analyzing changes in the instructional beliefs and practices of the teachers.

Scenario Building to Design a Distance Learning Program

Lisa Neal
EDS
3 Valley Road
Lexington, MA 02421 USA
lisa.neal@eds.com

Abstract: Scenario building is a process that can be effectively used to design a distance-learning program. It begins with the identification of the key stakeholders, who are typically students or participants, course developers, teachers or facilitators, support staff, and administration. Then, for each perspective, the relevant characteristics are identified, followed by a determination of what is required to meet the needs of a person in that category. The process also has the benefit of being a group activity that can facilitate team-building and commitment. We have used this process with multiple organizations and report on these case studies.

Introduction

Distance learning programs are designed in many ways: some evolve from individual efforts, some are designed using available technological capabilities, and others, more recently, are purchased from or co-branded with e-learning providers. Scenario building provides a systematic process for the group of people involved in planning and implementing a program to work as a facilitated team to design a program. The process can be used for any type of organization, including a university or business. It involves a number of steps: determining who will be involved in developing, delivering, supporting, administrating, or taking courses, and prioritizing these to order the next phase. Starting with the most important perspective, usually that of thc student or participant, the relevant characteristics of members of that category are determined by the group. This may include computer and Internet literacy, work environment, and time commitments. The group then determines what happens when a representative of that category carries out their role, i.e., taking, teaching, or supporting a class. This results in a list, which is then prioritized, of the needs and requirements from that perspective for the distance learning program. Subsequent perspectives are usually easier to consider after the first, and the entire process leads to requirements analysis and planning for the program. This process has been used for a number of organizations that are planning distance learning projects, including the University of Puerto Rico.

The University of Puerto Rico

The Puerto Rican government funded an ambitious distance-learning program at The University of Puerto Rico. To help get the program underway, the university called on a team of EDS consultants to structure and support the program's essential planning and implementation processes. The team began with strategic planning to determine the tasks and responsibilities needed to ensure the program's on-schedule readiness. During this process, it became clear that the distance-learning concept conjured widely different images for members of the steering committee depending on their knowledge of its theory and practice. Many assumptions were based on the association of distance learning with the room-based videoconferencing that dominated distance education prior to the introduction of Web-based technologies in the mid-1990s. Some of these images did not account for the level of interactivity and engagement that students and teachers experience using state-of-the-art distance-learning technologies or failed to accommodate the important differences between learning and teaching in traditional and technology-mediated settings.

The team proceeded with scenario building, an activity designed to help the program's steering committee understand, envision, and specify technology's role in the new distance-learning offering. Scenario planning began by determining the roles that people will play in the university's distance-learning program; those roles are student, professor, teaching assistant, and a number of support and administrative positions. The scenario-planning work led to each role being assigned characteristics that are relevant to the how a person in that role operates in a distance learning program or that give the role dimension and interest. Characteristics of a student, for instance, included age, family/home situation, educational background, technology literacy, Spanish and English literacy, and typing skills.

The goal was to agree upon the role of technology, the specific types of technology, and the support requirements for technology in the distance-learning program. To achieve this goal, we developed a prototypical member of each role in order to envision, as a group, what a day in that person's life would be like. We carried this to the level of detail of which relevant activities they were engaged in, where they carried out the activities, and what technological and human support was required. There were implications from some of the characteristics of a role; to discuss the activities of a person in a day, we needed, for instance, to know if there was access to a computer and, if so, under what conditions or with what possible distractions it would be used. If there was no access, then a staffed computer room must be available during reasonable hours. Additionally, we considered the implications of atypical but plausible cases for each characteristic, such as the ramifications if a student was older and returning after a period out of school.

Conclusions

The scenario-building process uncovered many issues, concerns, assumptions, and previously unarticulated misconceptions, which led to constructive discussion that culminated in a consensus about technology's role in the project and about the people who would manage and support it. Equipped with the scenarios' insights, we completed a thorough analysis of the program's specific technology needs, identifying and prioritizing the components of the supporting technology. In subsequent discussions, we continued to refer to the prototypical characters, and found that they continued to help clarify issues since the group could look at that person's specific (imagined) needs. Ultimately, the process of identifying each role's relevant characteristics and the hypothetical activities and interactions of a person in that role pointed directly to the criteria against which the entire program will be evaluated, ensuring that the overall effort's success will be measurable and more easily repeatable.

Initiating and Sustaining Collaboration in Technology: Critical Elements

Paula Nichols and Stephenie Yearwood
Department of Educational Leadership, Lamar University
pnichols@tenet.edu; yearwoodso@hal.lamar.edu

Abstract: Collaborative technology projects require new types of relationships and distinctive management strategies. This paper outlines three critical elements in creating and continuing such partnerships: common vision, a reward system, and consensus.

Technology ventures often demand collaborative efforts which bring together personnel, financial resources, needs and solutions from diverse entities. Older models of cooperation worked within top-down power structures; new structures of collaboration are complex and require long-term thinking and conflict management. Furthermore, sustaining collaboration is critical because the payoffs of such efforts are often long-term. We identify here three elements critical to building and sustaining collaboration: common vision, a reward system, and consensus operations.

Common Vision

Diverse groups who collaborate in technology ventures always face semantic difficulties, terms are defined differently and goals are stated in language only the originators understand. As a result, common definitions of terms and in-depth discussion about problems, solutions, and common issues are essential (Winer 1994). In this initial establishment of common understanding, group members must adopt a posture of tentative knowing, a non-judgmental stance which reserves value judgments and allows for continuing conversation. Although individuals may be experts in their domains, they need to drop their "know it all" perspective when they work collaboratively. Rarely does any entity get all it wants, but group members must be honest about what they are willing to put into a collaborative effort as well as what they wish to get out of the collaboration.

A Reward System

Different entities have different currencies and rewards. Rewards must come to group members in the currency valuable to them in their system, be it promotion, tenure, credit hours, test scores, or bonuses. Furthermore, different stakeholders define accountability differently, as staying within budget or positive publicity (Report 1997). As specific rewards are discussed, entities must spell out to whom and how they are accountable and how that will affect their participation.

Consensus

In diverse collaborative groups, absolute agreement is rare. Thus it is essential to establish that the group will operate by consensus and to establish a process for achieving consensus and resolving conflicts. Even when members do not agree on an outcome, if they have subscribed to a specified process which has been followed consistently, they will be able to accept the result (Winer 1994). Once established, conflict resolution needs to be called into play quickly when problems arise. Difficulties which drag on are much harder to deal with.

Clearly collaborative ventures in technology are neither simple nor easy. However, the power of successful collaboration is synergistic. Collaborative groups which are able to sustain their efforts can achieve a whole which is indeed greater than the sum of the parts.

References

Winer, M. and Ray, K (1994). Collaboration Handbook: Creating, Sustaining and Enjoying the Journey. St Paul, MN: Amherst H. Wilder Foundation.

Report to the President on the Use of Technology to Strengthen K- 12 Education in the United States. (1997). Panel on Educational Technology.

Integrating Learning agents in a virtual laboratory

Roger Nkambou and Yan Laporte
Département de Mathématiques et informatique
Université de Sherbrooke, Sherbrooke, J1K 2R1
Canada
roger.nkambou@dmi.usherb.ca

Abstract: This paper presents a system called Cyberscience[1] dedicated to distance education. The learning interface of Cyberscience includes a component consisting in activating an interactive multimedia simulation in which the student can carry out direct manipulation tasks making the simulation a virtual laboratory (vitual lab in short). A virtual lab for genetic study is currently realized. As an intelligent distance learning system, Cyberscience includes a number of intelligent learning agents that operates in the space of the virtual lab in order to help students to achieve their goals. This paper presents an overview of those agents.

Introduction

There is already a lot that has been said about software agents, especially intelligent agents' technology. While this is a really a current trend in software engineering. The concept of intelligent agents is at the same time simple in principle and complex in classification (Jennings and Wooldridge, 1998; Nwana, 1999) While intelligent agents systems are widely being developed, most of the frameworks available simplify the architectural and technical aspects and provide relatively no support to implement agent behavior. The goal of this research is to provide people with a strong basic architecture and shell to handle the complex task of implementing intelligent behavior in software agents. The tools provided must have a fairly generic aspect so they can be applied to a wide variety of problems and systems while still being able to adapt sufficiently to a problem to provide relevant intelligent features. It should be possible to achieve such capability by building a set of general-purpose agents that would be easily customizable and reusable.

A set of multiple agents

The first part of building such a set of agents is to determine a set of feature that are desirable and that are sufficiently high level to be reusable. The current proposal includes a planning agent, a decision making agent, a data mining agent, a rule-based reasoning agent, a data extracting agent and a case based reasoning agent. These agents cooperate in the context of CyberScience in order to: create an action plan for the current instructional objective associated with the selected course or theme, according to the student model, select the relevant resource the student will use to achieve the goal, update the student state of knowledge, help the student during the learning process and so on. In the following, we describe each of the agents.

Data Mining Agent. The Data miner has a high probability of being highly useful to many different applications. Basically, this agent's purpose is to retrieve useful information from databases and electronic documents both on a local machine, a network or even the Internet. Of course it can mean only search for certain keywords but it is also possible to implement more complex and advanced intelligent search algorithms. It remains to be decided how it is most convenient to interface with such an agent. It is also to be considered if such an agent should be mobile or not or even if it should decide whether it should move itself to a different host system to be able to accomplish it's job more efficiently.

Rule-Based Reasoning Agent. The rule-based reasoning agent acts mostly as an expert system. Expert systems have proven over time to be efficient to a large number of tasks. The goal of this agent is to derive conclusions from a knowledge base consisting of facts and knowledge. It needs an engine and a set of

[1] This project is funding by the University of Sherbrooke.

deductive rules. It needs an interface to specify the content of the knowledge base. An interface also needs to be defined to query the truth of undefined facts. The engine would be most likely based on the Rete algorithm that is already well known and extensively used and tested.

Case-Based Reasoning Agent. The case-based reasoning agent on the other hand compares the different cases and makes generalizations out of them. When the case-based reasoning agent is invoked on a particular situation it tries to find already known cases that are similar to the current one.

Planning Agent. The planning agent is software capable of making plans. The goal is to come up with a combination of actions to be executed in the future in order to achieve a desired behavior. The interface to the planner agent is a bit more complicated than previously discussed agents, but this is expected considering the complexity of planning problems. First it needs a way to specify an initial state and a goal specifying the desired task to be achieved. It also needs a set of specifications of the actions feasible by the system. Finally it needs a planning strategy, a starting plan and a set of bound parameters both in time and space. The agent's engine would be most likely to base on SIMPLAN because of its capacity to operate in highly variable environments (Nkambou and Kabanza, 1999). This agent will generate a plan of actions repairing the plan given in input that best satisfies the goal from the initial state, given the restrictions implied by the bound parameters.

Decision-Making Agent. Finally the decision-making agent and the knowledge extraction agents are making extensive use of previously discussed agents in this paper. They would probably encapsulate specific instances of these. The decision-making agent, as its name implies, takes decisions about the different tasks to be done and how they must be accomplished effectively. It would work by using the rule-based agent to generate a goal as of what to do. A planning agent starts to search how to best achieve the goal by calculating a new plan while case based reasoning agent tries to find a relevant plan that was previously used in a similar situation.

Knowledge Extraction Agent. The knowledge extraction agent finds relevant information from different digital data sources, Like the decision-making agent, the knowledge extractor uses a combination of three internal agents. It obviously uses a Data Mining agent to retrieve pieces of documents or database information related to a subject requested by an internal rule-based reasoning agent. But a case-based reasoning agent also tries to find similar cases as where relevant was found to help the data mining agent. Once it is retrieve the information can then be used by the system.

Conclusions

The development of the set of intelligent agents involved in CyberScience will lead to a shell to easily implement intelligent learning agents systems. Most of the required features for each agent have already well known solutions. There are also numerous frameworks that already offer facilities to create agents and to give them mobility abilities. It is expected that a higher level of intelligence in behavior of the system would be achieved by close collaboration of these agents. It has to be defined how it should be organized to provide a generic functionality that would be reusable. Also, it must be established how would the specification for a custom system based on these agents would take place. With this shell the use of intelligent learning agents system is likely to widespread. But the first application it is used on, as a test case, is the Cyberscience virtual laboratory. While it could merely be used as a replacement for current expert system to add them a higher level of intelligence, adaptability and interaction level, it is also expected they could be applied to new breeds of problems directed at a less specialized category of users. It can be easily assumed how this system could be used to create assistants or coaches in a context of an Web-based intelligent tutoring system.

References

Hyacinth S. Nwana & Divine T. Ndumu (1999), "A Perspective on Software Agents Research", *The Knowledge Engineering Review*, Vol 14, No 2, pp 1-18.

Jennings, N.R. and Wooldridge, M.J. (1998). Applications Of Intelligent Agents, in Nicholas R. Jennings and Michael J. Wooldridge (Ed.), *Agent Technology Foundations, Applications, and Markets* , Springer-Verlag, 1998.

Nkambou, R. and Kabanza, F. (1999). Designing Intelligent Tutoring Systems: A multiagent Planning Approach. *ACM Journal of SIGCUE Outlook, Special Interest Group in Computer Uses in Education*, Vol. 27, No. 2., 1999.

SGML BASED COURSE DEVELOPMENT: BALANCING INSTRUCTIONAL DESIGN AND TECHNOLOGICAL REQUIREMENTS

Solvig Norman, MA
Coordinator of Instructional Development
Open Learning Agency, Canada
snorman@openschool.bc.ca

Abstract

The Open Learning Agency in British Columbia, Canada, is involved in a multi-year project aimed at producing a number of courses that are derived from structured SGML documents. Presently, fourteen courses are being delivered on-line in 33 School Districts throughout British Columbia. This paper describes the use of structured documents for course development with a focus on the benefits and challenges of balancing technological and instructional design issues.

Background

The Open School, a division of the Open Learning Agency, is involved in a multi-year project aimed at producing a number of courses that are derived from structured SGML documents. The goal is to offer innovative and current educational resources for students and teachers that are directly linked to the government's curriculum and provide flexibility through delivery of alternative formats within a distributed learning environment (e.g., for use in a classroom environment and also within an independent self-paced learning environment). Fourteen Grade 11 and 12 courses were developed within a structured document environment using SGML (Standard Generalized Mark-Up Language) technology to meet Open School's goal. These courses are presently being delivered to about 1200 students registered either in one of the nine Distance Education Schools or within one of the regular classroom-based schools in British Columbia.

Open School has traditionally developed large print -based courses with some complimentary wrap around media such as text, video, or audio. Development time from the planning stage to delivery took, on average, two years to complete. Once a course was delivered, it was cumbersome and time consuming to update and maintain. Courses were seen as being out of date, too large, too much work, and provided primarily a singular pathway for students to learn. Open School had some previous experience with developing courses for on-line use, but realized the need to change their course development processes in order to develop more timely and flexible content. The implementation of SGML as an underlying course development tool for planning, development, production and delivery was identified as a means to an end. This technology can facilitate the following:

- creation of courses from instructional design to deliver,
- creation of assessment types and mechanisms,
- identification, association, and categorization of resources within,
- identifies the course architecture,
- creation of custom views of materials for different types of learners,
- storage and management of parts and pieces of course materials,
- output to both print and web, as well as to other media.

SGML has roots in the high tech and publishing industries and is the international standard for representing electronic text in a mark-up language. The mark-up provides a means for interpreting the text. SGML is not dependent on any specific hardware or operating system SGML provides a consistent approach to identifying the components of a document and how they relate to each other. The process permits explicit tagging to identify the components of a "course": lessons, learning outcomes, glossary terms, activities, online resources, etc. There are an infinite number of document structures that can be defined depending on the specific requirements. SGML is a descriptive mark-up language rather than a procedural mark-up language. A descriptive mark-up language uses codes, called elements, to name and categorize parts of a document. Procedural mark-up language, like that of HTML, is often used to represent text in a certain style like bold. SGML also includes a DTD: Document Type Definitions. The DTD defines the "allowed" elements and specifies the order in which the elements may or may not appear. The authoring process must produce documents that conform to the specifications of the DTD.

The Marriage of Instructional Design and SGML: The Benefits

Open School, as part of the Open Learning Agency, has a long history and experience with implementing sound instructional design practices for developing learning materials. Fundamental stages of instructional design including needs assessment, learner analysis, planning (review), development (prototype, formative evaluation), production (evaluation), delivery, and summative evaluation – all have been at the heart of course development practices for over twenty years. Various instructional technologies have been used over the years and have often been perceived as tools whether they were word processing software programs, computer conferencing systems, videos audiotapes, and more recently the World Wide Web/Internet.

However, with the implementation of SGML, instructional design methods became more explicit as part of the structured process dictated by the technology. Open School's SGML based courses have been developed with very explicit Document-Type-Definitions that lay out the architecture of courses from the instructional design planning stage to the delivery stage. This process has permitted course developers to explicitly examine the contents of their courses in a more detail manner that was never before possible. A course basically "grows" from an instructional design plan (e.g., consisting of learning profiles, learning outcomes, resources, proposed activities and assessment) into a fully authored final product (e.g., completed modules with lessons including narrative, instructions, content, activities, and assessment). Because of the structured information approach to course development, "bits and pieces" (e.g., granules, learning objects) of a course can be re-used and re-purposed for other learning situations or outputted to different formats (e.g., print or the Web). Developing 14 courses for on-line and in the print at the same time would not have been possible without the use of SGML as an underlying tool.

The Marriage of Instructional Design and SGML: The Challenges

Although there are many benefits in the implementation of SGML as a course development framework, Open School has also faced a number of challenges. Here is a list of the main challenges:

- Adopting a new technology that entailed a whole new infrastructure (e.g., with new hardware, software, additional staff, extensive training for internal staff, new procedures to follow).
- Reviewing and analyzing existing processes and products in order to come up with consistent structures and language for different course architectures (e.g., deciding on what constitutes a course, a module, a lesson, an activity, etc).
- Designing content to be used in different learning situations. With a database as a backbone, SGML files can be used by other course developers to re-use existing content. There are issues around designing content to be stand-alone (e.g., learning objects). How granular can content be (e.g., a paragraph or a lesson)?
- Ensuring that content which is designed in "bits and pieces" (e.g., learning objects) is pulled together into a cohesive manner which provides an effective learning environment for students.

World Wide Web Course Delivery in Developing Countries: A South African Perspective

Shaun Pather Geoff J.Erwin
School of Mathematics, Information Technology & Computer Science
University of Durban Westville, Private Bag X54001
Durban, South Africa
spather@is.udw.ac.za erwin@is.udw.ac.za

Abstract: There is increasing international usage of the World Wide Web for course delivery. The current South African education system is still structured as a legacy of the apartheid system. The South African government currently promotes the uses of technology to enhance access to education and to foster resource-based learning. The authors report findings of a survey of Web-based course delivery at South African tertiary institutions, including problems being experienced by academics in adopting Web-based techniques.

Introduction

The Internet and the World Wide Web (WWW) are part of a shift away from traditional classroom based course delivery methods (*See* for example Pilgrim & Creek, 1998, p. 189; Kinzie et.al., 1996 p.59). The South African situation does not reflect this trend. South Africa is characterized by a transforming education system that aims to address imbalances brought about by the apartheid era. Disenfranchised sectors of the South African population have historically had limited access to higher education (Christie, 1986).

Background

The South African Department of Education promotes the use of technology (including the World Wide Web) to enhance and widen access to higher education and to foster resource-based learning. The Department of Education is actively engaged in promoting *technology-enhanced learning*. It has initiated a five-year strategic plan, through the National Centre for Educational Technology, to build an infrastructure to support technology-enhanced learning (Department of Education, South Africa). The current social and education systems are still heavily influenced by inheritances from the apartheid political system before 1994. For example, the majority of South Africa's population (mainly black) do not have access to the Internet (*Webcheck* National Survey, 1999). Potential university students have no experience in the use of information and communication technologies (ICTs). Currently, only 0.02% of South African schools have an Internet connection (IDRC, 2000). Their ability to use Web-based education is limited. The lack of telecommunications infrastructure, combined with low levels of technological literacy of the population is a major obstacle to deployment of Web-based material..

The Survey

A survey of academics from fourteen South African tertiary institutions was conducted between June and September 1999. A non-experimental survey method, using a structured questionnaire, was used to investigate the following: *The extent of usage* of specific WWW features for course delivery. In particular the authors assessed to what extent current adopters have used the WWW to move away from traditional teaching methods. Specific features listed in the survey were: Use of Email, posting of syllabi (dynamic & static), detailed course information updated regularly, distribution of lecture notes, links to external sites, feedback mechanisms to students, online chat-room, streaming video, multimedia online lectures, animation, submission of online homework, testing and examinations. *Problems* that exist at tertiary institutions that are impeding the implementation of WWW technology. Specifically the survey examined areas of availability of human and physical resources, organizational conditions, and the attitude of academics to the use of WWW as compared with traditional classroom based methods.

Findings

1. **Current and intended usage of the WWW by South African academics:**
Figure 1 (*see http://is.udw.ac.za/staff/research/web/figure1.htm*) indicates that current levels of adoption of the thirteen WWW based activities listed in the survey fall into two broad categories. The first category reflects a relatively high level of use. The seven activities in this category (e.g. Email, syllabus postings, distribution of lecture notes) are activities that are widely used and are those that support traditional styles of teaching. They do not necessarily change the actual method of classroom-based delivery. A possible reason for this could be that such activities could be implemented at a low cost and with no need to spend a large amount of time doing in-depth planning and design. The second category reflects very low or non-existent levels of use (six activities). This category involves activities (e.g. Chatrooms, multimedia online lectures, online testing) that would significantly move away from traditional teaching methods. These are activities that require intensive planning and design, and are also dependent on a high availability of a technological infrastructure supported by adequately trained staff. There is an increased level of usage. Respondents also indicated an intention to increase level of use of activities that fall into the second category listed above. This is a positive indication, since the activities that fall into this category are those that will realise a paradigm shift away from traditional course delivery methods to a student-centred, constructivist approach.

2. **Comparison of level of South African tertiary institutions with international usage**
The WWW features listed in the survey echoed those from an international survey that was conducted by an American university at the end of 1998 (Peffers & Bloom, 1998). Figure Two (*see http://is.udw.ac.za/staff/research/web/figure2.htm*) provides a comparison between the South African tertiary educators surveyed and those of the international survey. The similarities in the trends are noted in the paper. However, it must be noted that this not imply that the broad state of WWW adoption for course delivery in South Africa is at the same levels of usage as our international counterparts.

3. **Existing difficulties in the implementation of Web-based course delivery.**
Staffing problems: The results of the survey suggest that academic staff do no have the necessary skills to implement Web-based courses. The situation is further compounded by the absence of support staff needed to run Web-based courses. *Organizational conditions*: The Survey suggested that the organizational conditions such as time and flexibility in respect of work commitments do not allow academics (especially if they are novices at implementation of Web technologies) to experiment with WWW technologies. *Financial Restraints*: The problem of shrinking financial resources is affecting service delivery at all levels of education in South Africa. The survey indicates that current budgets do not allow them to invest in Internet technologies.

Conclusion

The desire for on-line teaching at South African tertiary institutions is increasing. The survey indicates that academics acknowledge the positive role of the WWW in course delivery. Key recommendations are: Adopters of Web technology in the classroom need to be encouraged to utilise the Web for more than merely support of traditional lectures; Management at the faculty and institutional level should be encouraged to create the possibility for and invest in adequate training of both academic and support staff. Heads of academic units support the adoption of Web technologies by providing incentives to staff. Tertiary institutions should investigate possible collaboration with external partners in the private sector as a means of alleviating high costs. Some of the issues that require further research and investigation are: international experiences and collaboration with counterparts; Development of guidelines for designing Web-based courses; the long term effectiveness of Web-based teaching on students; the role of academics in developing Web-based courses; and user- friendly authoring tools.

References

Christie, P. (1986). *The Right to learn - The struggle for education in South Africa.* Raven Press/SACHED, Johannesburg.

Kinzie et.al Kinzie, M.B., Larsen, V.A., Burch, J.B., Baker, S.M. (1996). Frog Dissection via the World Wide Web. *Educational Technology Research and Development,* **44**(2), 59-69.

Peffers, K. and Bloom, S. (1999). Internet Based Innovations for Teaching IS Courses: The State of Adoption, 1998-2000. *Jitta* 1(1).

Pilgrim & Creek Pilgrim, C.J., and Creek, M.J. (1998). The Swinburne On-line Educational Project. *SIGSCE Bulletin*, **30**(3), 189-192.

IDRC, *The Teacher/Mail & Guardian*, 21 February 2000. Most without classrooms - Study by International Development Research Centre(IDRC).

Webchek (1999). *Survey of South African Internet Users.* <http://www.webchek.co.za/reports.html>

Online Conferencing: Variations on Structure and Participation

Hsinyi (Sindy) Peng
University of Missouri-Columbia
152 Parkade center
Columbia, MO 65211
Sindy520@mizzou.edu

Gail E. Fitzergald
University of Missouri-Columbia
152 Parkade center
Columbia, MO 65211
Fitzgerald@missouri.edu

Louis P. Semrau
Arkansas State University
P.O. Box 1450
State University, AR 72467

Abstract: This paper looked at the variation of structure and participations for online conferences. Four different structural models were used in designing the conferences, which were (1) Open-ended discussions by expert, (2) Scaffolded discussion with facilitated follow-up, (3) Scaffolded discussion without facilitated follow-up, and (4) Open-ended discussion without facilitated follow-up. Data were collected on frequency of messages, word count of messages, and key word analysis for themes. The findings will provide comparative and descriptive data related to conference structures, participant variables, and levels of participation for future research in online conferencing.

Use of Online Conferencing as a Vehicle for Training Special Educators

There is evidence that materials designed to assist teachers in working with students with behavioral problems are currently in high demand. The design and development of the Internet as a delivery medium for such continuous training in both preservice and inservice teacher education has been documented in special education (Smith, Martin, & Lloyd, 1998). A team of researchers, funded by a U.S. Department of Education grant, has been hosting a series of online conferences for preservice and inservice educators under the auspices of the Virtual Resource Center in Behavioral Disorders (Fitzgerald & Semrau, 1998-2000). These virtual conferences involve the participation of national experts in the behavioral disorders field for the purpose of providing in-depth discussion of topics and social discourse regarding the application of the information.

Design and Structure of the Virtual Conferences

Four different structural models were used in designing the online conferences. Each conference ran for two weeks, but the degree of openness and structure, involvement of the online expert, and the use of discussion facilitators differed across the conferences.

Conference #1: Open-ended Discussion by Expert. 95 participants; 477 messages.
One expert online for two-week duration with all participants in one large discussion group; no required pre-conference preparation or readings; messages not organized by themes or available via archives.

Conference #2: Scaffolded Discussion with Facilitated Follow-up. 105 participants; 283 messages.
One expert online for first week with all participants in large group; participants grouped into four smaller discussion groups directed by project facilitators for second week; required writing of a case scenario; suggested readings offered via web site; messages organized by themes and available on web archives.

Conference #3: Scaffolded Discussion without Facilitated Follow-up. 37 participants; 155 messages.
One expert online for first week with all participants in large group; participants continued discussion for second week without expert or facilitators; pre-conference self-evaluation encouraged; suggested readings offered via web site; messages organized by themes and available on web archives.

Conference #4: Open-ended Discussion without Facilitated Follow-up.
Three national facilitators for first week with all participants in one large discussion group; participants continue for second week without national or project facilitators; no required pre-conference contributions required; free CD-ROM provided prior to conference containing suggested software and resources for viewing; messages organized by themes and available on web archives; greater mix of field teachers participating with preservice teachers.

Preliminary Findings & Importance of the Work

The findings reveal equivalent levels of participation regardless of prior computer experience, teaching experience, access to equipment, typing skills, learning styles, writing anxiety, or frequency of e-mail and Internet use. Writing anxiety may play a role in length of message but not frequency of responding. Graduate students demonstrate significantly higher levels of participation compared to undergraduate students. Less structured conferences allow participants to initiate more of their own topics of concern. Instructors have an important role in providing technical assistance. Instructors and course requirements impact participation and authenticity of involvement of preservice participants. Readings provide common ground for discussion. Written scenarios can be requested from participants, but they emerge naturally. Structure and facilitation provide an even level of participation and ongoing discussion. Messages must be archived by threads for asynchronous access.

This research provides a comparison of online participation <u>during</u> conferences that differ in open-ended vs. scaffolded features and the use of facilitation. Online conferencing appears to be a valid and valued method of providing preservice and inservice training, but the variables of designing and running virtual conferences are more of an art than a science at this stage of research. These studies will provide comparative, descriptive data related to conference structure, participant variables, and levels of participation to guide future research in this mode of instruction.

References

Fitzgerald, G., & Semrau, L. (1998-2000). Virtual Resource Center in Behavioral Disorders. U.S. Department of Education Grant # H029K0089.

Newmarch, J. (1997). Courseware on the web: An analysis of student use. <u>Proceedings of AusWeb 97</u>: Third Australian World Wide Web Conference, [Online]. Available: <u>http://ausweb.scu.edu.au/proceedings/newmarch/paper.html</u>.

Schwier, R. (1999). Turning learning environments into learning communities: Expanding the notion of interaction in multimedia. In Collis & Oliver (Eds.) <u>Proceedings of Ed-Media 99</u>: World Conference on Educational Multimedia, Hypermedia, and Telecommunications, 282-286.

Shotsberger, P. G. (1997). Just-in-time professional development using the World Wide Web. <u>Technology and Teacher Education Annual</u>. [Online]. Available: <u>http://www.coe.uh.edu/insite/elcc_pub/HTML1997/to_tg.htm</u>

Windschitl, M. (1998).The WWW and classroom research: What path shoud we take? Educational Researcher, January/February, 28-33

Winnips, J.C., Collis, B.A., Moonen, J. J. C. M. (2000, in press). Implementing a 'scaffolding by design' model in a WWW-based course considering costs and benefits. <u>Proceedings of Ed-Media 2000</u>: World Conference on Educational Multimedia, Hypermedia, and Telecommunications.

CAMPUS: An Innovative Web-based Approach for Simulative, Flexible, Case-oriented Education in Medicine

Jens Riedel, Reiner Singer, Franz Josef Leven
Laboratory for Computer-based Training
University of Heidelberg, Germany
riedel@fh-heilbronn.de

Heiko Geiss
Department Hygiene and Medical Microbiology
University of Heidelberg, Germany
Heiko_geiss@med.uni-heidelberg.de

Burkhard Tönshoff
University Children's Hospital Heidelberg, Germany
Burkhard_Toenshoff@med.uni-heidelberg.de

Introduction

In medical education, Problem-Based Learning (PBL) is becoming appreciated more and more. The design and implementation of a problem-oriented medical curriculum, however, is very time-consuming for the educational staff. Case-based, Web-based training systems can help the educators to develop, implement, organise and reuse well-structured multimedia cases. For students, such a system can be used to improve and test their problem-solving competence. With respect to heterogeneous learning environments, the system should be flexible and adaptable. CAMPUS tries to meet these requirements by covering the needs of different user groups (e.g., students, educators, physicians) in different application scenarios (e.g. self-study, presentation, learning groups) to get maximum benefit of integrated medical cases. With the CAMPUS player component (learner's front-end), users can work out medical cases in a simulative - and therefore realistic and interactive - way or let the system present a case in different manners. Users can get help via expert comments or context-sensitive systematic knowledge which is available in addition to the case data. With the CAMPUS authoring component, medical experts can feed the system with cases from any medical field. CAMPUS, part of a comprehensive virtual university project, is going to be integrated in a reformed medical curriculum approach at the University of Heidelberg.

Methods

The idea of CAMPUS is to develop a case-based, Web-based training system in Medicine including a broad variety of usage modes with the aim of minimizing acceptance problems and maximizing the effectiveness and efficiency of case-data input, which is time-consuming and still one of the central problems of case-based systems.
To achieve such a functionality, CAMPUS provides the following features:

a) Integration of medical cases from any medical field
b) Storage of case data in a very detailed manner in a relational database
c) Presentation/treatment of cases in different adaptable ways
   The degree of interactivity/realism of a case presentation/treatment is optional. The most interactive form is 'decision', where the student has to treat a case in a realistic, simulative way leading to a maximum of active knowledge processing. The user has to ask questions of anamnesis, order physical, lab or technical exams, make diagnostic decisions and propose a therapy. In the form 'compact' the student only has to make diagnostic decisions and propose the therapy. The results of the different tests are shown en bloc. If a user is only interested in medical case data he can choose the form 'total', where the whole case is presented at once with no interactivity at all.
   With these different forms of application the user can look at a case the way he likes and is able to. For example, if a user does not want to do the anamnesis on his own for any reason, he may choose the form

'compact'. If, on the other hand, he wants to concentrate his learning activities on the physical exam, he may choose the form 'decision'.

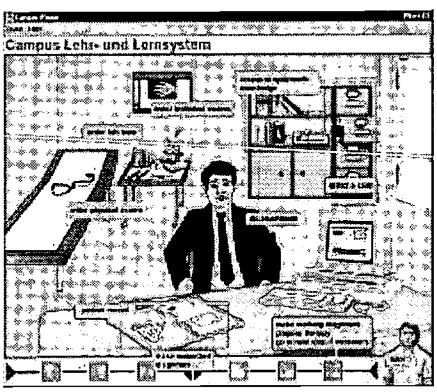
d) Expert comments on demand
It is very important to explain certain things about a case, e.g., why a diagnosis has been made or why a particular exam has been done. Hence, for every particular point within a case the CAMPUS author can define an expert comment.

e) Questions if wanted
Questions are - besides other things - an important aspect of interactivity and active knowledge processing. Thus the case author can define questions of different types on every definable point within a case, e.g., after or before the user gets the answer to a certain question of the anamnesis or after or before the whole physical exam. The user can choose if he wants to see only case-dependent questions, case-dependent and case-independent questions or no questions at all.

f) Distinction between case data and systematic knowledge
Every user has a different state of knowledge. Therefore, every user needs help at different points when working on a case. Hence, CAMPUS shows context-sensitive systematic knowledge only on demand. The knowledge can be internal (integrated by CAMPUS authors) or external (using external knowledge sources from digital libraries over the internet).

g) Detailed case search
Cases are searchable by defining symptoms or diagnoses. For example, one could look for cases with fever, shivering and chest X-ray abnormal. Such a specific search is possible because of the detailed database.

h) Execution over the internet/intranet or locally
To acquire platform-independence, permanent actuality and world-wide access along with all capabilities of a programming language, CAMPUS is implemented in Java as a Browser applet. For users at home, it may be better to have a local application to save time and costs. Therefore, CAMPUS is also executable locally using a local database.



In order to avoid the structure and vocabulary of cases varying from author to author, a case has a well-defined structure and has to use a defined vocabulary for anamnesis questions, exams, diagnosis (ICD-10) and therapies. Every case has the following structure: anamnesis, physical exam, suspected diagnosis followed by one to many passes of a therapy loop with examinations (physical, technical, lab), working diagnosis and therapy. That means that, unlike many other case-based training systems, CAMPUS doesn't stop at the first diagnosis given by the user but considers a case in a more detailed and realistic way.
To give the user an easy to understand user interface, we implemented a so-called situated learning environment, where the 'situation' is a physician's room.

Conclusion

CAMPUS implements a new dimension of flexibility of a case-based, medical Web-based training system. It can be used by different user groups in different learning environments. Therefore, the effectiveness and efficiency of the time-consuming case data input has been improved. CAMPUS offers the chance to develop a case-database with well-structured multimedia cases to be used by students as well as educational staff (especially in problem-oriented curricula) who can use and - more important for the educators - reuse cases in several scenarios.
A first prototype is available and is going to be integrated in the reformed medical curriculum at Heidelberg at least. A comprehensive evaluation is taking place in June/July 2000. An international version of CAMPUS is planned.

Acknowledgements

This project is supported by the Ministry of Science, Research and the Arts of the State of Baden-Württemberg in Germany.

Evaluating the Effects of Web-based Collaboration in a Distance Education Program

Paul Rodes, Haejin Chung, Dennis Knapczyk, Carrie Chapman
School of Education, Indiana University, Bloomington, USA.

Abstract: To study the effects of asynchronous web-based collaboration in an existing video-based distance education program, the authors structured coursework to enable evaluation of differences in cognitive and emotional aspects of learning between those using web-based collaboration and those completing assignments through traditional independent methods.

Educators have increasingly recognized the important role collaboration can play in learning. Asynchronous web conferencing has been identified as a unique tool in promoting such collaboration, particularly when applied in distance education coursework [Knapczyk, Chung & Baik 2000, Moller 1998, Duffy et al. 1998, Bonk & Cunningham 1998, Ernest 1995, McMahon, O'Neill & Cunningham 1992]. In the past three years we have integrated web conferencing into our existing video-based distance education program at Indiana University to promote collaboration and ownership among learners [Rodes et al. 2000, Rodes, Knapczyk & Chapman 1999, Chung, Rodes & Knapczyk 1998].

While we have been pleased with the results of web conferencing in our program, we recognize the need to evaluate its effects in verifiable terms. In fact, although much has been written about the benefits of asynchronous web conferencing, few studies have been conducted to verify these findings. The education literature typically offers descriptions of programs and effects, with little controlled study or verification. Furthermore, little has been written on the possibilities of web conferencing when integrated with other distance education technologies. To address this lack, we have been conducting a study in Spring 2000 to investigate the effects of asynchronous web-based conferencing on both cognitive and emotional aspects of learning.

The Collaborative Teacher Education Project at Indiana University offers graduate-level special education coursework to cohort groups of teachers in rural Indiana communities. Classes are delivered via two-way video and are supplemented by e-mail, fax machines, and web-based conferencing using the SiteScape Forums web conferencing system [Knapczyk et al. 2000, Knapczyk, Rodes & Chung 1998]. In the Spring 2000 semester we offered a single course on behavior management to in-service teachers at six sites.

For the current study we divided our course content into four units. The independent variable of our study was the use of asynchronous web-based conferencing. For each unit, we developed two parallel sets of assignments and activities: one set was to be completed individually with collaboration taking place at the learners' discretion; the other set was to be completed collaboratively in web-based learner teams. During each unit, learners at three sites completed their work using web-based collaboration, while learners at the other three sites completed their work using the "traditional" assignments.

To facilitate direct comparison, during every unit each web-based site was paired with a non-web-based site to meet for a video-based course once a week. In this way we ensured that the sites to be compared received the same instruction. After each unit the roles assigned to the groups were reversed. For example, learners in Tell City were linked each week with learners in Spencer in a video session originating from the IU-Bloomington campus where the instructors were located. For the first unit of the course, the Tell City group completed assignments in web-based teams, while the Spencer group completed assignments individually or using informal collaboration. For the second unit of the course, these roles were switched, and so on. By pairing sites in this way, by switching the assigned roles at the end of each unit, and by repeating this full cycle two times during the semester we aimed to minimize the effects of any differences among learner characteristics and environments across the different sites.

The dependent variables we have been investigating reflect both cognitive and emotional aspects of learning. We are evaluating the following three elements of content learning [Bloom 1956]:

- acquisition--through product evaluation and content-based tests
- application--through product evaluation and field reports from learners
- retention--through follow-up tests and surveys on content issues

In the emotional domain, we are using both immediate and follow-up surveys to evaluate learner satisfaction, which is a particularly important factor to consider in working with adult learners [Galbraith 1998].

A specific grading rubric was used to ensure uniformity of evaluation and to be sure products were assessed for issues of applicability as well as acquisition. To facilitate clear comparison, all surveys, testing, and product evaluation have been linked to the four individual units of the course. In this way we can compare the results at each study site not only to the linked cohort site using the opposite approach, but also to the results at that same site during other units, to track any differences as learners moved from web-based to non-web-based activities.

By completing this study we hope to have gathered reliable data on the effects and the effectiveness of web-based collaboration when combined with other distance education technologies. We anticipate that our findings will contribute to an understanding of the importance of collaborative learning and web-based conferencing in distance education programs, and for education in general.

References

Bloom, B. S. (1956). Taxonomy of educational objectives: Cognitive domain. New York: David McKay.

Bonk, C. J., & Cunningham, D. J. (1998). Searching for learner-centered, constructivist, and sociocultural components for collaborative educational learning tools. In C. J. Bonk & K. S. King (Eds.) *Electronic Collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse.* Mahwah, NJ: Lawrence Erlbaum.

Chung, H., Rodes, P., and Knapczyk, D. (1998) Using web conferencing to promote ownership in distance education coursework. *Proceedings of WebNet 98—World Conference of the WWW, Internet and Intranet.* Association for the Advancement of Computing in Education.

Duffy et al. (1998). Critical thinking in a distributed environment: A pedagogical base for the design of conferencing systems. In C. J. Bonk, & K. S. King (Eds.) *Electronic Collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse.* Mahwah, NJ: Lawrence Erlbaum.

Ernest, P. (1995). The one and the many. In L.P. Steffe & J. Gale (Ed.), *Constructivism in education*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Galbraith, M. W. (1998). Adult learning methods : a guide for effective instruction. (2nd ed.) Malabar, FL: Krieger Pub. Co.

Knapczyk & Chung (1999). Designing effective learning environments for distance education: Integrating technologies to promote learner ownership and collaborative problem solving. Paper presented at Ed-Media, Seattle, WA.

Knapczyk,D., Chung,H. & Baik, E. (2000). Instructional Design Principles for Creating Effective Distance Learning Environments: Fostering collaborative problem-solving in teacher education programs. Paper presented at AERA, New Orleans, LA.

McMahon, H., O'Neill, W., & Cunningham, D. (1992). "Open" software design: A case study. *Educational Technology, 32*, 43-55.

Rodes, P., Knapczyk, D., Chapman, C., & Chung, H. (2000--in press). Using web-based instruction to increase in-service teachers' involvement in professional development. *Technical Horizons in Education Journal.*

Rodes, P., Knapczyk, D. & Chapman, C. (1999). Using web conferencing to shift learner expectations. *Proceedings of WebNet 99—World Conference of the WWW, Internet and Intranet.* Association for the Advancement of Computing in Education.

Knapczyk, D., Rodes, P. Chung, H. & Chapman, C. (2000--in press). Collaborative teacher preparation in rural communities through distance education. *Teacher Education and Special Education.*

Knapczyk, D. Rodes, P. & Chung, H. (1998). Collaborative learning program addresses demands for special education teachers. *Technical Horizons in Education Journal.* 26. 57-60.

The Design, Development and Implementation of Education in Edubox

Ellen Rusman,
Open university of the Netherlands
Valkenburgerweg 167
Heerlen, The Netherlands
ellen.rusman@ou.nl

Peter B. Sloep
Open university of the Netherlands
Valkenburgerweg 167
Heerlen, The Netherlands
peter.sloep@ou.nl

Abstract: *Edubox®* is a system, built at the Open University of The Netherlands, that supports educational innovation processes in higher education. The system allows maximal *flexibility* in that it enables educational designers to model an instructional system completely after their ideas. In this paper the phases of the design, development and implementation of an instructional system are described with particular attention to *Edubox®*.

Introduction

Edubox® is a system, built at the Open University of The Netherlands, that supports educational innovation processes in higher education. The system allows maximal *flexibility* in that it enables educational designers to model an instructional system completely after their ideas, unhindered by implicit didactic beliefs similar systems often harbor.

An *instructional system* is here defined as the assembly of 'objects' that collectively assist a student in acquiring a set of learning objectives. At a more concrete level, an educational system features such items as *people* (e.g. teacher, fellow students, experts), *tools* (e.g. word processor, browser), *knowledge sources* (e.g. books, videos, cd-rom's), and *activities* (e.g. writing a paper, peer-assessing a fellow student).

Design Stage

Edubox® is able to provide the eductional designer with such freedom and flexibility because it makes use of a didactic metamodel embedded in an Educational Markup Language (EML) - a generic XML-based language - as described by Koper (1999).

In principle, everything the learner or teacher will experience in *Edubox®* has to be modelled by the designer. In contrast with traditional electronic learning platforms it does not make any (implicit) assumptions (Onstenk & Meijer,1998; Dabbagh, Bannan-Ritland & Silc, 1999) on preferred didactic scenarios, thus providing the designer with a didactic "clean slate".

When working with *Edubox®* the educational designer, needs to focus his design activities on two main questions right from the start:

- What is the structure of the instructional system needed to support the acquisition of certain learning objectives by students?
- What will be the delivery medium of the designed instructional system?

Decisions on the Instructional System

The instructional system to be developed may be modelled at several levels: the micro-level (e.g.module), meso-level (e.g. course), and macro-level (e.g. curriculum). The designer has to make up his mind about the main level for his design activities. Subsequently, the designer has to opt for a pedagogic approach, taking into account several ingredients of his instructional system:

- educational objectives and prerequisites, (aimed at the acquisition of knowledge, skills, attitudes, competences, complex cognitive skils) and target group
- relations between the stated educational objectives, prerequisites and the structure of the instructional system
- the context in which the education takes place (roles, sources, instruments, on-the-job)
- situational experiences and domain specific information in education
- individual differences
- co-operation and collaboration
- communication
- the use of different educational materials
- assessment
- the kind of activities which have to be performed to assure learning processes
- the learning process and transfer processes passes off
- stimulating motivation
- sequencing actvities

Descisions on the Delivery Medium

The educational designer has to make a decision on how the educational system will be delivered to the learners. For example: will the product be a book or will it be delivered on the Internet? Depending on this decision and the level of implementation of the instructional system, the designer will have to design a style sheet for the lay-out of a book or an entire graphical user interface (G.U.I.).

Development

Developing the Instructional System

In the development phase the whole instructional system has to be structured using the Educational Markup Language (EML). For specific pedagogical orientations (e.g. problem-based learning, case-based learning), ready made EML-templates may be available. EML knows the following main elements (Tab.1):

element	description
metadata	all general data concerning an educational object
roles	the different roles persons can have within an instructional activity
objectives	(learning) objectives which are related to an instructional system
prerequisites	prerequisites (e.g. in terms of knowledge, personal charactaristics, instruments available to learner) related to an instructional system
content	all componounds (defined within the elements 'activity' and 'environment') which are conditional for the acquisition of (learning) objectives
activity	a stimulation of the learner to perform certain behavior
environment	componounds (e.g. tests, knowledge sources, instruments) which are conditional for the acquisition of (learning) objectives
method	structure, didactics and processes within an instructional system

Developing the delivery medium

In the development phase the necessary features for publication to the medium chosen during the design phase should be developed.

Implementation

Because of the richness of EML and the flexibility of *Edubox®*, different designers may implement similar ideas in very different ways.

References

Dabbagh, N., Bannan-Ritland, B., & Silc, K.(1999). Web-based course authoring tools: pedagogical implications. In: *Keynote speakers Ed-Media 1999. World conference on Educational Multimedia, hypermedia & Telecommunications.* Charlottesville: AACE

Koper, R., Manderveld, J. (1999). Modeling educational content with XML. In: *Proceedings Ed-Media 1999, World conference on Educational Multimedia, hypermedia & Telecommunications.* Charlottesville: AACE

Onstenk, J., Meijer, J. (1998) *De elektronische leeromgeving in de BVE-sector.* 's-Hertogenbosch: CINOP

Technological Tests of Educational Theories: A Research Role for the Generative Virtual Classroom

Dr. Lynette Schaverien
Faculty of Education, University of Technology, Sydney
PO Box 222,
Lindfield NSW 2070 Australia
Lynette.Schaverien@uts.edu.au

Abstract: Throughout history, technological advances have led to scientific breakthroughs. Computer-mediated learning environments have the potential to function similarly: as technological tests of educational theories. Here, this unexplored research role, for one such learning environment, is illuminated. The Generative Virtual Classroom, a web-delivered virtual classroom for teacher education, is demonstrated and preliminary research findings with respect to theory advancement reported. Some emerging implications for computer-mediated learning and for the generation of educational knowledge are discussed.

Cultural development is littered with striking examples of technological advances that have led to scientific breakthroughs. The successful building of European cathedrals provoked the development of a detailed engineering science (Bronowski 1973/1992). In our own time, pioneering brain-imaging technologies have brought important new neuroscientific insights (see, for example, Carter 1998 and McCrone 1999). Similarly, technological tools for learning, especially those designed on particular educational principles, ought to expose the worth of those principles. In action, such technologies may well constitute a potent and, as yet, unexplored research tool by means of which educational theorising can be advanced. In this work-in-progress paper, I explore this research role for one such technological tool for learning: the Generative Virtual Classroom.

The Generative Virtual Classroom

This paper begins by demonstrating the Generative Virtual Classroom itself, so as to elucidate its educational principles. Emerging from a series of classroom studies of learning and learning to teach (in particular, Cosgrove & Schaverien 1996 and Schaverien & Cosgrove 1997), this web-delivered learning environment attempts sophisticated computer-mediated teacher education in elementary technology-and-science. Its design embodies a generative view of learning in which learning is conceived as a generating and testing cycle (after Minsky 1986, Wittrock 1974, 1994 and Plotkin 1994,1997). According to this view, learners generate ideas that they then test on their value, keeping those that survive their tests (Schaverien & Cosgrove 1999, 2000). In a nested pair of virtual classrooms (a virtual elementary one and a virtual tertiary one), Education students can develop their views of learning by observing exemplary learning by young children from an archive of pre-recorded digitised video excerpts. They can formulate their thoughts about these excerpts and communicate with others about them, considering others' views of them, including, in particular, a generative view of learning. As an environment in which learners can develop a generative view of learning, in ways consistent with such a theory, the Generative Virtual Classroom is poised to be a powerful tcchnological test of this generative theory itself.

Do Learners Learn Generatively in the Generative Virtual Classroom?

Already, pilot research conducted in the Generative Virtual Classroom affirms the fruitfulness of viewing learning generatively. For example, in a nine-month autobiographical study of the development of her views of learning in the Generative Virtual Classroom (Allard 1998), an Honours Education student was able to establish her conceptual progression, for herself, and to identify what she still needed to understand. On analysis, this student's learning was well explained in generative terms; and, as well, on the basis of her experience, minor alterations were able to be made to the learning environment itself. Such studies suggest the value of proceeding to larger scale tests of the worth of this theory. Consequently, a large-scale collaborative research trial of the Classroom is now in its beginning stages. In this trial, a full cohort of First Year Education students (n=~100) has begun to work in the Generative Virtual Classroom, yielding early data on the nature of the learning of a diverse range of individual students over a semester. Students' text contributions to the Classroom's community database and e-mail discussion group will be collated, described and analysed for evidence of generativity, in an attempt to assess the worth of such a theory in making sense of what they did.

Implications for Computer-mediated Learning and the Generation of Educational Knowledge

Clearly, the recent proliferation of technologically mediated environments in which learners can teach themselves has brought new opportunities to explore the nature of learning. Even more recently, such writers, inter alia, as Alexander & McKenzie 1998 and Hannafin, Hannafin & Oliver 1997 have begun to insist that these new learning environments be explicitly grounded in educational principles. From these positions, it is a short but significant step to conceiving of computer-mediated learning environments as instruments for the testing of educational theories, an idea whose time has come. Once crystallised in these terms, such a research program has the potential to redress long-standing dissatisfaction with the apparent lack of theoretical progression in Education in particular (Thagard 1992) and in the social sciences in general (Ziman 1978/1991). The paper closes speculatively by discussing the implications of such a re-conceptualisation for computer-mediated learning and for the generation of educational knowledge.

References

Allard, M. (1998). *What is learning in itself? One teacher education student's autobiographical account of her developing views of learning in the Generative Virtual Classroom.* Unpublished Bachelor of Education (Honours) thesis, University of Technology, Sydney, Sydney.

Alexander, S., & McKenzie, J. (1998). *An Evaluation of Information Technology Projects for University Learning.* Canberra, Australia: Committee for University Teaching and Staff Development, Australian Government Publishing Service.

Bronowski, J. (1992). *The Ascent of Man.* London: Warner Books. (Original work published in 1973.)

Carter, R. (1998). *Mapping the Mind.* London: Weidenfeld and Nicolson.

Cosgrove, M., & Schaverien, L. (1996). Children's conversations and learning science and technology. *International Journal of Science Education,,* 18:105-116.

Hannafin, M.J., Hannafin, K.M., & Oliver, K. (1997). Grounded practice and the design of constructive learning environments. *Educational Technology Research and Development,* 45(3): 101-117.

McCrone (1999). *Going Inside: A Tour around a Single Moment in Consciousness.* London: Faber and Faber Limited.

Minsky, M. (1985). *The Society of Mind.* New York: Touchstone.

Plotkin, H. (1997). *Evolution in Mind: An introduction to evolutionary psychology.* London: Penguin Books.

Plotkin, H. (1994). *The Nature of Knowledge.* London; Allan Lane, the Penguin Press.

Schaverien, L., & Cosgrove, M. (2000). A biological basis for generative learning in technology-and-science: Part II - Implications for technology-and-science education. *International Journal of Science Education,* 22(1):13-35.

Schaverien, L., & Cosgrove, M. (1999). A biological basis for generative learning in technology-and-science: Part I - A theory of learning. *International Journal of Science Education,* 21(12):1223-1235.

Schaverien, L., & Cosgrove, M. (1997). Learning to teach generatively. *Journal of the Learning Sciences,* 6(3):317-346.

Thagard, P. (1992). *Conceptual Revolutions.* Princeton, N.J.: Princeton University Press.

Wittrock, M. (1994). Generative science teaching. In P. Fensham, R. Gunstone and R. White (Eds.), *The Content of Science: A constructivist approach to its teaching and learning.* London: The Falmer Press. 29-38.

Wittrock, M. (1974). Learning as a generative process. *Educational Psychologist,* 11(2):87-95.

Ziman, J. (1991). Reliable Knowledge. Cambridge: Cambridge University Press. (Original work published in 1978.)

From Student Needs to Instructor Roles: An Ethnographic Viewpoint

Richard Schmertzing
Valdosta State University
Department of Educational Leadership
Valdosta, Georgia, USA, 31698
rwschmer@valdosta.edu

Lorraine Schmertzing
University of West Florida
9520 Scenic Highway
Pensacola, Florida, USA, 32514
ldavis@uwf.edu

Abstract: This paper draws on data gathered during a year-long ethnographic study of graduate education classes in a 2-way audio 2-way video distance education classroom. Cultural analysis of transcript excerpts indicating student reactions to their experiences in the technologically mediated classroom highlight the anxiety and confusion they experience in making the shift from the familiarity of traditional classroom culture to the uncertainty of a new, often strange environment. This transition phase in classroom cultures, what Turner (1969) calls the liminal phase, is a time of high anxiety but also of high learning. Our data suggests that instructors who take on the role of technology guide and provide students the opportunity to vent anxiety and learn about the technology, create environments that significantly increase the comfort levels of students and receive much higher ratings from them.

Introduction

Distance learning, via web based and two-way interactive video classes has changed the market areas of educational institutions from how far faculty are willing to drive to how far the Internet or phone lines will reach. Given this new global market, institutions of higher education are rushing to fill the niche. Students are recruited, new learning environments are created and faculty are suddenly asked to teach classes in front of computer screens and cameras. Although the literature encourages the use of instructional design principles when teaching this way (Moore & Kearsley 1996), in the rush to stake out new territory, such classes are often thrown together with little planning and less understanding.

According to Willis (1993), "research suggests that distance education and traditionally delivered instruction can be equally effective if the distance educator puts adequate preparation into understanding the needs of the student and adapting the instruction accordingly" (p. 22). But how does one do that? How can students and teachers anticipate their needs in a substantially new learning environment? Are these new learning environments traditional classrooms with a few technological add-ons where the assumption can be made that student's needs are little changed? Or are they complex new environments that require descriptive and analytic illumination by researchers such that student needs can be assessed and then addressed? Our research suggests the latter.

It is our contention, that the situation people face in distant classes is, from a cultural perspective, radically different from the traditional classroom. The enculturation process that occurs during years of schooling solidifies in the learner norms for the role of the teacher, for methods of classroom communication, and for student interaction that lasts a lifetime (Henry, 1955). The entire dynamic of teaching and learning, which is deeply grounded in traditional classroom culture, is changed in complex and nuanced ways when the class becomes technologically mediated. The study on which this paper is based used the approach of ethnography and the perspectives of cultural anthropology (Geertz 1973) and social interactionism (Mead 1934) to uncover these changes in classroom culture and illuminate changes in the teaching/learning dynamic.

In this brief paper we can do little more than present fragments of interviews to show how descriptions by students of their distance education experiences and an awareness of traditionally based student expectations can inform a deeper understanding of the needs of students. This understanding then becomes the basis for strategies that instructors can use to help learners through the cultural transformation process and to have more successful learning experiences.

The Study

The study is based on data gathered for an ethnographic case study of graduate education classes during the inaugural year of a 2-way audio 2-way video interactive distance learning classroom. Courses included in the study varied significantly in teaching style, course objectives, course content and student responses. Traditional ethnographic and qualitative research methods facilitated data gathering and analysis (Agar 1996; Maxwell 1996). Data gathering involved more than 400 hours of participant observations in classrooms, formal interviews and informal conversations with students and faculty, weekly e-mail correspondence, open ended surveys, focus group interviews, and video of all classes. Thematic coding, frequency counts, and frequent debriefings between ethnographers L. and R. Schmertzing contributed to interpretation and ongoing analysis of the data (Spradley & Mann 1975).

The Data

Excerpts of student comments from e-mails and interview transcripts introduce the complex culturally based issues that students face in the interactive televised classroom. All of the following passages were written by students in response to questions from the researchers regarding the students first night in the distance classroom. We will present the excerpts in the data section and comment on them in our discussion.

> When I saw the room set up I was in shock, actually. It was my first interactive distance learning class and I walked into the room thinking "why did I sign up for this?" At the sight of all these different video screens and cameras all around the room, I didn't think that the grades would be the same. I thought they would favor the class that had the most physical interaction with the professor. I became sort of jealous of the other campus and resented the fact that she (the instructor) was there. I felt like I was at the main campus where the professor should have been. If the other class was at a branch campus, they should have primarily been in the distance learning aspect of it. My GPA is very important to me. I feel that the grade I earn will be affected by how much time I will have to spend watching her on a monitor. There were so many distractions, it was hard for me to stay focused. Also, there was so much zooming in and out with the video cameras, I honestly got motion sickness and walked out of class feeling sick to my stomach with a headache. I did not like it. The cameras were set up in awkward angles and you couldn't see the professor's head when she was talking. We got great views of the back of her head.

Many students made similar comments, although the attitudes of others were more like the following who noticed the difference but struggled to adjust.

> I was really surprised at my reaction. I've taken a web-based class before and I have seen the equipment for this classroom before. I didn't think I would feel any different, but I did! I was surprised at how I looked on camera and feel that I will have to work on this so that it doesn't impact my participation. Also, I forgot several times, where to "look" so I would be facing the remote group when I "spoke". I also found that as the night wore on, I kind of avoided responding to questions 'cause I felt like I was monopolizing the session. I did like being able to "face" the other group and do not feel that the experience effected my learning. I found myself "concerned" about the remote site when we had a few technical problems and am concerned about the learning experience when the instructor goes to the other class and I am in the remote site, having to rely on the technology.

For some students the two-way audio/video class they participated in was an entirely positive experience. "After the first night of class I am totally satisfied with everything. I especially enjoy being able to take the class at this campus and am excited to have the opportunity to be a part of this class."

Other students cited particular elements of the technologically mediated classroom that fed their anxieties and complicated their ability to focus in the classroom. "I'm just much more aware of asking questions and making contributions, because I have to do this mechanical thing." The necessity to physically encounter technology in order to participate in class confused students and contributed to a magnified concern for the value of their own comments. "You don't have the ability to just sit there and say, 'Wait a minute;' you're on camera now, you're on air-time, and so if you have what you think may be a *little* question, you're wasting class time [if you ask it]."

Discussion

The variation in student responses points toward the diversity and complexity in their perspectives. Students from each class all have different ideas about their experiences in their new classroom environment. They all, however, enter the classroom with an understanding of the way a traditional class works and quickly confront the differences. Students expect the classroom to look a certain way; they expect to focus on a teacher standing at the front of their classroom; they expect to have easy means to speak and be heard. When these culturally based expectations are not met, students are often left with a sense of anxiety and feelings of uncertainty. We found that complex technologically mediated interactions between learners, instructors, and content forced the re-construction of the way participants had previously "done class." Learners, caught between the old way and the new way, moved through a liminal state (Turner 1969) to find a balance that provided enough comfort with the environment so that distractions were minimized and learning maximized. The student need indicated in this paper is the need to be guided through this liminal state, the need to be helped through the adjustment phase. In such a context, the new role for the instructor is as a guide.

Instructors that we observed to be successful guides used various strategies to speed up and enhance students' adaptation to the new classroom. Students found balance more quickly when instructors recognized, articulated, and showed sympathy for the "awkward," "uncomfortable," "surprising," "overwhelming" state of the learner. When instructors talked to their students in an "up front," "understanding," "sensitive," (from student transcripts) manner about the strangeness of having class in the new environment, students were more responsive to instructions on how to use the technology to accomplish class goals. When learners were allowed opportunities to express their feelings about the environment without fear of repercussions, they appeared to overcome the added burden of "hiding [their] anxieties" about to taking a distance class and became more "willing" to work with the new technologically-mediated environment. The instructor who provided students the opportunity to "vent" through both class discussions and online threaded discussions achieved the highest rating for classroom interaction of all the instructors considered in this study and did so in the least amount of time.

The style, manner, and attitude an instructor established the first night of class was also a key factor in how long it took students to learn the technological system and for the ease and speed with which they learned to function effectively. First class meetings rated highly by students were those that were characterized as "fun," "calm," and "slow enough to understand." Instructors who, in early classes, laid ground rules for communication, clearly and completely explained the technology of the classroom, gave students an opportunity to use the system in a non-threatening manner, and provided a thorough picture of what would be expected throughout the semester built bridges between participants and the technology. Once the bridge was built and the connection made, the environment felt "safer" and interaction took place more easily.

These are a few of the insights and strategies that have emerged from our analysis so far. We expect that our continued analysis will produce many more.

References

Agar, M. H. (1996). *The professional stranger* (2nd ed.). San Diego, CA: Academic Press, Inc.

Geertz, C. (1973). *The interpretation of cultures.* London: Perseus.

Henry, J. (1955). Docility, or giving teacher what she wants. *Journal of Social Issues 2,* 33-41.

Maxwell, J. A. (1996). *Qualitative research design: An interpretive approach.* Thousand Oaks, CA: SAGE.

Mead, G. H. (1934). *Mind, self and society.* Chicago: University of Chicago Press.

Moore, M. G., & Kearsley, G. (1996). *Distance education: A systems view.* Albany, NY: Wadsworth Publishing Company.

Spradley, J. P., & Mann, B. (1975). *The cocktail waitress: Woman's work in a man's world.* New York: Wylie.

Turner, V. (1969). *The ritual process: Structure and anti-structure.* Chicago: Aldine Publishing Company.

Willis, B. (1993). *Distance education: A practical guide.* Englewood Cliffs, NJ: Educational Technology Publications.

Introduction of a New Media Concept for a Teaching Profession Degree in „Computer Science“: A Formative Evaluation

Axel Hunger, Stefan Werner, André Bresges and Frank Schwarz
Gerhard Mercator University Duisburg, Department of Dataprocessing
Bismarckstr. 81, 47057 Duisburg, Germany
e-mail: {hunger | swerner | bresges | schwarz}@uni-duisburg.de

Abstract
Within the scope of the development of a new multimedia education concept for the teaching profession "Computer Science", the strengths and weaknesses need to be constituted already during the development-phase and weaknesses need to be eliminated if necessary. Therefore, the concept is examined within the formative evaluation on its tangibility and effectiveness.
The newly developed education concept, which was developed at the Gerhard Mercator University Duisburg under usage of new media, aims at creating new possibilities for differentiation and decentralized learning by a multimedia teaching and learning concept. The didactical new conception of the course is supposed to take the students different learning prerequisites into account. Thus, procurement methods are striven for that enable individual preparation, consultation and practice dependent on the students educational background.

Introduction

The teaching profession with the vocational field "Computer Science" at the Gerhard Mercator University Duisburg can be attended by students with different main subjects. Students can combine the specialized professional field "Computer Science" with different main subjects, e.g. mechanical engineering, chemistry technique or textile and clothing technique. So a teaching concept had to be developed due to the different bases in the information technical education of the different courses. It has to consider the heterogeneous foreknowledge of the students and offer according intensive procurement methods.
The developed concept is used in the basic course "Fundamentals of Computer Science" as first trial phase. The course covers topics such as the Boolean algebra or switching algebra, the technical implementation of logical operations, which are based on the Boolean algebra and finally the fundamental digital circuits and systems as well as simple digital computers, which are based on these operations.
The procurement of contents and the conversion of the quoted objective requires the completion of the course forms so far by means of a suitable concept on computer base and the transfer by means of multimedia technique. The interactive, multimedia teaching and learning software is set up in such a way that the different learning methods of the students are taken into account. Therefore, different points of entry are available for the software.
One entry point runs over the content structure, here the student can choose his learning path in accordance with the content of the lecture. The course so far included exercises for practicing and applying the taught methods. This exercise part is also integrated in a suitable form into the interactive learning concept. The second entry point clarifies the interaction between the acquired knowledge and the latter practice on the basis of a descriptive task. Thus, a learning goal oriented or res. a problem based learning is enabled. The student receives an course of action. A detailed description of the concept is given in (Schwarz, Hunger, Werner, 1999).

Initial Considerations for Evaluation

Sources of information that are available for a study group are on the one hand conservative sources such as books, scripts and patterns, the instructor and laboratory/experiment device. Additionally, fellow students also count as information source, since notes, sources of information and interpretations can be exchanged with them.

New media can take the place of an information source (book) and the place of an experiment device (simulations). It can also partly take over the role of a teacher, by answering standard questions and checking exercise results, as far as the exercises are machine controllable. Furthermore, new media creates more extensive communication possibilities (Dweck, 1988).
The entire focus during the introduction of new media in complex, problem based learning situations is determined and already distributed on different learning tasks. The attention can not be increased by the introduction of new media! In the case of new channels being available, the individual must redistribute its bandwidth and thus its attention on the available channels. A rearrangement takes place on expense of other channels. Refocusing might lead to a favoring of channels due to improved accessibility of information through new media, which enables individuals to receive information more easily and thus the attention on other channels is encouraged. We can speak of a positive modification of the social behavior induced by introducing new media, if both possibilities deal with the channels which the individual use to interact with other members of the group.

Formative Evaluation

The concept is evaluated in several steps. In the first step, the teaching and learning processes are evaluated by observing and interviewing the participants. The experiences of students from different subgroups are of importance and thus raised in particular. The members of the group are interviewed by using a questionnaire. This questionnaire ranks important data through accordingly formulated questions on socio-metric matters for the 4 partitions of the theory model (economy of attention, social behavior, motivation control, accessibility of information). The behavior and movements of the user is recorded at the same time. Thus, it is to be determined, whether the mapped mental model is applicable on the learning group and whether weaknesses in the navigation and comprehensibility can be discovered. The results flow directly into the development. Furthermore, an expert workshop is set up in order to determine suitable scenarios of different emphasis. The expert workshop primarily consists of professors of the respective field.
The evaluation leads to the following results:
70 participants were interviewed, among them where 25% that use MODULO regularly. The participants hardly use MODULO for stringent reading, but rather for the direct search of information. This functions well to outstanding; students indicated that finding information under usage of MODULO is substantially better. The links between exercise and lecture were considered as helpful. The complex scenarios, which are supposed to clarify the application of knowledge in vocational practice, are considered less helpful for understanding the material. Most students rather find the scenarios helpful at ranking the material into vocational practice.
In a further step, a summative evaluation will take place after final completion in order to elevate the acquired knowledge of numerous years and using it for advancements of the concept.

Summary and Prospect

In this article a new concept for supporting the theory of the teaching profession course "Computer Science" and an appending formative evaluation was presented. The concept aims at media-technical editing of the disposition, the development of a training concept and the development and implementation of a WEB-database with dynamic access. This concept holds the advantage of being able to go into different needs, previous knowledge and learning methods of students, due its modular structure. It enables a self-controlled learning, promotes media competence and offers demanding possibilities of acting.
The first evaluation which accompanied the development of the system had positive results and constructive criticism. The entire system is to be completed by September 2000, so that the summative evaluation can be started in the winter semester 2000/01.

References

Schwarz, Hunger, Werner (1999). Development and Evaluation of a Multimedia Education Concept for the Subject "Fundamentals of Computer Science", *Advanced Research in Computers and Communications in Educationin*, 1999, Proceedings of ICCE 99, Chiba, Japan, 219-222
Dweck, Leggett (1988). *A social-cognitive approach to motivation and personality.* Psychological Review

NSA PARTNERSHIP WITH CAL STATE L.A.: COURSEWARE CONVERSION AND EVALUATION PROJECT

Penelope Semrau, Ph.D.
Educational Foundations & Interdivisional Studies

Barbara A. Boyer, Ph.D.
Art Department
California State University, Los Angeles
United States
psemrau@calstatela.edu
bboyer@calstatela.edu

Abstract: CSULA was charged with assisting the NSA in the research, development, documentation and the necessary expertise to convert a traditional face-to-face platform course to a multimedia web-based course. We converted a platform-based course taught by the NSA called "EEO 100: Equal Employment Opportunity Law and Diversity Training for Selection Boards." To accomplish the task, an interdisciplinary team of graduate and undergraduate students from Instructional Technology, Art Education, Computer Science, and Design collaborated on producing the website.

Constructivism

Recent studies in education have promoted the constructivist approach to learning "...where students develop their knowledge through team collaboration, discuss different interpretations of a problem, and negotiate and synthesize ideas drawing from various disciplines" (Boyer & Semrau, 1995, 14). Technology can play a significant role in this process by having students become more proactive in their own learning and more independent in their search for knowledge. Students using technology have access to ongoing real world problems, on-line dialog with scientists, and access to the latest technological advances. Ultimately, students will be engaged in their learning, see relevance in it, and take on an ownership in it. To meet the needs and interests of students, education must emphasize problem solving and application of information, instead of memorization of facts. Roberts et al state, "...students need to be able to find and use relevant information, share and discuss data and ideas, and collaborate on problem solving" (1990, 116).

Year One of Project

July of 1998, California State University, Los Angeles (CSULA) began a 3-year project sponsored by the National Security Agency (NSA) entitled "NSA Partnership with Cal State L.A.: Courseware Conversion and Evaluation Project."

CSULA was charged with assisting the NSA in the research, development, documentation and the necessary expertise to convert a traditional face-to-face course to a multimedia web-based course. CSULA students were selected to work on the project with a focus on collaborative group work and a constructivist approach to learning. An interdisciplinary team of graduate and undergraduate students from Instructional Technology, Art Education, Computer Science, and Design were brought together under the direction of two faculty members.

In this project we are converting to the web a platform-based course taught by the NSA called "EEO 100: Equal Employment Opportunity Law and Diversity Training for Selection Boards." EEO100 is directed to employees who serve or who may serve on boards, panels, or committees charged with the responsibility of rating workers for selection purposes. The course is designed to provide participants with an understanding of the extent to which their rating activities are subject to applicable civil rights laws, and to appreciate the value and contributions of every candidate. Students after taking this course will be able to:

1. Understand the requirement for EEO 100
2. Understand legal rights and responsibilities for fair and equal treatment in the decision-making process
3. Gain a common understanding of "diversity"
4. Recognize "blind spots" and conditioning from society, and how these factors impact decisions
5. Provide a hands-on opportunity to improve the decision-making process
6. Appreciate the value and contributions of every individual

Training was provided to the CSULA student team on the basics of html, Adobe Photoshop, Premiere, and Pagemill in order for them to be able to undertake the task of courseware conversion to the web. They were also trained on the use of WebCT for developing the website, uploading of web pages to website, and designing of web pages. . WebCT is an online Internet authoring tool for web-based courses. The students were guided regarding the overall layout and screen designs. For a foundation in working collaboratively in building a website the students first designed a demonstration site on streaming media—RealAudio and RealVideo. The demonstration site was developed for sharing our research and for communication among the students and project faculty. Focus was placed on developing an educational website demonstrating various applications of streaming video and audio in education as well as being a source of research data and instruction for creating streaming video and audio for web-based training.

The students investigated the hardware and software requirements for streaming media, selected examples of streaming video, and html coded web pages documenting their gathered data about streaming media and its role in web-based training. The WebCT course site also offered additional built-in communication features including e-mail, chat rooms, a bulletin board, and white board. Students used the bulletin board to provide help to each other and to assess each other's web pages.

For the foundational first part of our collaborative work, the students researched and structured their content on streaming media into the following sub-areas:

1. Introduction to Streaming Media
2. How Does It Work--Streaming Video?
3. How Does It Work--Streaming Audio?
4. Aesthetics of Streaming Video
5. Aesthetics of Streaming Audio
6. Educational Applications of Streaming Media
7. Our Examples of Streaming Video
8. Project Report 1998-99
9. About Us

Each student was charged with the design, structure, research, and development of one content sub-area.

Year Two of Project

During the fall, 1999 we moved onto converting the EEO 100 course content into a web-based course. We followed the pattern established in the prior year where each student was assigned full responsibility for the research, design, development, and coding of a topic. The EEO 100 content was subdivided into the following main topic areas: Current requirements, additional requirements, definitions of discrimination, disparate impact, harassment, affirmative action review, and tools. Each student studied and learned the EEO 100 course content and was then individually tested on it. In the process of understanding the content, they realized that it would be necessary to rewrite and revise the content, as well as integrate multimedia to accommodate a web-based learning environment. Next they html coded the EEO 100 course content and thus begun the creation of the web-based course. One of the students developed the screen design incorporating American Disabilities Association (ADA) guidelines.

They developed new test items for the content. They researched websites and selected appropriate ones related to the content and created external links to these websites. We designed draft layout for structuring the menu and content. And, we investigated, selected, and adapted a quiz format for use in this website to set up pop quizzes that were integrated within content areas.

In the winter of 2000, the students analyzed a video that was a tape of an original face-to-face traditional approach to teaching the class, which was provided by the NSA. They made a list of the video clips matching the content they were responsible for. Before we started digitizing the content, we inspected the length and filesize of each video clip to determine how to reduce the size of very large clips. We came up with several solutions which included digitizing only the audio for certain clips and accompanying the audio with still diagrams of key points and cutting up the longer clips in to shorter segments. Next the students captured the video using Adobe Premiere and the Osprey 100 video card in a Dell Precision 401 computer. They edited down the clips using Adobe Premiere. The audio was captured and edited with SoundForge. Next, the clips were streamed with RealProducer and html coded into their relevant web pages of content.

To polish off the interface design, we brought on an art student who was charged with developing an easy to use menu of topics and navigational system.

In the spring of 2000, it is our intent to synthesize various course components (content, video, test items) into a final course website and to design visual learning aids (diagrams, charts, and pictures) and tools (glossary, law books, and court cases) to enhance learning of the course content. We are preparing to design and incorporate simulations into the website. NSA has been encouraging and supportive of this idea as an extended project.

Conclusion

The new web-based version of this course will make the content accessible to more NSA employees located in various places throughout the world. Plus, the online version will include interactive pop quizzes with immediate scoring and feedback as well as streaming media lectures to complement the course content, which is presented as text on the web pages.

Through this project the students became constructively involved in their own learning and have acquired in-depth experiences in collaborative learning. The students became empowered to be creators of their own curricular materials and web pages instead of being passive viewers of others'. In this project all of Bloom's higher level taxonomies are implemented. Students are analyzing websites, synthesizing criteria that they have researched, applying their book readings, comparing and contrasting their criteria, designing and producing their own web pages, and more.

References

Boyer, B. A. & Semrau, P. (January/February, 1995). A constructivist approach to social studies integrating technology, *Social studies & the young learner,* 7(3), 14-16.

Roberts, N., Blakeslee, G., Brown, M., & Lenk, C. (1990). *Integrating telecommunications into education.* Englewood Cliffs, NJ: Prentice-Hall, Inc.

The Internet Chemistry Set: Web-based Remote Laboratories for Distance Education in Chemistry

Frederick A. Senese
Dept. of Chemistry, Frostburg State University, USA (senese@antoine.frostburg.edu)

Christopher Bender
Dept. of Chemistry, Frostburg State University, USA (bender@antoine.frostburg.edu)

Abstract: The convergence of modern data acquisition technologies with the Web's interactivity, connectivity and multimedia capabilities presents an exceptional opportunity for distance education in the physical sciences. Web-mediated access and control of laboratory equipment can improve utilization of expensive and specialized instruments, facilitate collaborative data sharing and analysis, and provide essential practical experience in physical science courses delivered at a distance.

This paper describes a remotely controlled experiment for determining the rates of fast chemical reactions. The experiment is not a simulation; it involves actual equipment controlled in real time from remote locations on the Web. The experiment is the first in a series designed to provide a pedagogically on-line laboratory experience for Web-delivered general chemistry courses. Students use the experiment's Web interface to collect data, to obtain interactive technical support and background information, and to display and analyze results. Each experiment is designed to encourage sharing of data and collaboration with users at other institutions, providing students with a valuable first look at work in a distributed laboratory environment.

Introduction

Chemistry is an experimental subject. Chemists construct knowledge by systematically examining quantitative data for patterns. Patterns suggest hypotheses, which in turn form the basis for theories. Theories are then critically evaluated in the light of new experimental data. This is the only sanctioned approach for progress in science. Pedagogy that is not founded on the interplay between theory and experiment poorly serves students by not involving them in the essential process of science.

The experimental nature of chemistry presents severe challenges for teaching the subject at a distance. Many current online chemistry courses either have no laboratory experience at all or use simple kits or 'kitchen chemistry' experiments that can be performed with household materials. Obtaining accurate, quantitative data from which relevant and interesting conclusions can be drawn is difficult with such simple equipment.

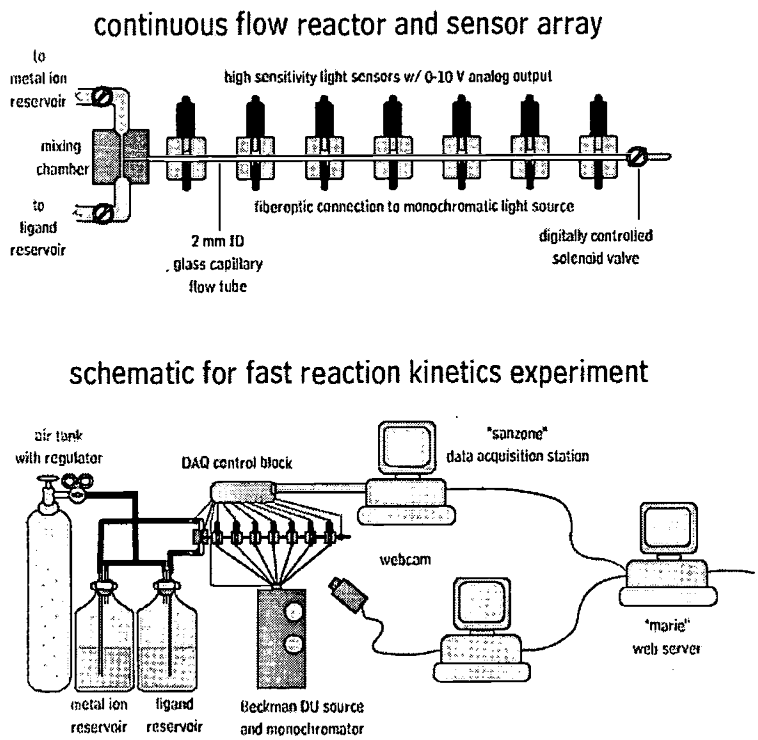
Online chemistry courses often make heavy use of simulations. While simulations can be quite effective, they are theoretical constructs that cannot substitute for practical experience. For example, students regarded the output of simulations in a statistical analysis experiment at Oxford University as "pretend" data (Cartwright, 1998). They sometimes failed to carry over the lessons learned from analyzing simulated data to data collected in actual experiments. Concerns about the pedagogical quality of the simulations were addressed by the development of a simple, economical "optical rig" (Cartwright, 1999), which allows students to collect and analyze actual data over the Internet.

This project addresses the problem of practical experience in Web-delivered courses by providing students with remote access and control of real equipment. A remote-control reaction kinetics experiment suitable for chemistry students at the undergraduate or advanced secondary level is described. The apparatus monitors the course of a fast chemical reaction spectrophotometrically using a simple continuous-flow method. Students can use the data they collect to determine the rate laws for the reaction under a variety of conditions. By collaboratively analyzing the results of a large group of experiments performed by peers, students can propose mechanisms for the reaction. While the experiment is conceptually quite simple, it involves specialized apparatus that is unavailable in most undergraduate laboratories. Rapid data acquisition can allow many users to perform experiments in real time, and nearly spontaneously.

Method

The experiment is an adaptation of a classic continuous flow method for studying the rates of fast reactions (Dalziel, 1953; Roughton & Chance, 1963). The apparatus can be used to determine the rate of any sufficiently fast reaction that produces a colored product, although practical considerations limit the choice of reaction(Shoemaker, 1974). Pilot investigations studied the formation of $FeSCN^{2+}$ (an orange complex that absorbs at blue light at 455 nm) and "Prussian blue", an intensely colored complex used in blueprinting, paints and inks (Sharpe, 1976).

A schematic diagram of the apparatus is shown in (Fig. 1).



Reactant solutions are forced from large reservoirs into a T-shaped chamber, where they mix completely in less than 1 millisecond. The reacting mixture then travels down a long capillary tube. The product of the reaction is intensely colored and strongly absorbs a characteristic wavelength of light. Product concentration rises as the mixture moves along the tube. Seven light sensors placed at fixed positions along the tube monitor the increase in concentration. Monochromatic light is passed through the capillary at each position using a fiber-optic cable. High sensitivity photocells placed on the opposite side of the tube record the intensity of transmitted light at each point; the intensity drop caused by absorption of the light by the complex is simply related to the concentration. A flow rate sensor allows the position of each of the spectrophotometers to be associated with a reaction time.

Data from the sensors is acquired by "sanzone", a 500-MHz PC equipped with a National Instruments data acquisition card. A LabView program collects, labels, and writes the absorbance, temperature, and flow rate data to an "outgoing" queue. The program then checks for requests in an "incoming" queue. If one exists, a new run is started. Otherwise, the system is flushed and the valves are closed to avoid unnecessary waste of reagent solutions.

A Webcam collects pictures of the apparatus during the run. The camera view includes the reservoir manometer and a digital thermometer, so it is used for data collection as well as for helping students monitor the progress of the reaction. The Webcam is attached to a second PC to avoid contention.

A Unix Web server (Marie) mounts Sanzone's hard drive across the local network. Perl scripts running on Marie fetch data from the outgoing queue, interpret it, and prepare the results for display.

Students perform the experiments via a "smart" instrument panel served from Marie, displayed in a standard browser. The instrument panel recreates the actual look and feel of the remote experiment. Operators immediately see the results of their actions via the Webcam, as well as on a rich data display. The panel's panic button launches a conferencing connection with the system's caretaker via Netmeeting during working hours and by email at other times. The panel monitors and interprets student activity to diagnose and correct conceptual problems and to prevent actions that could damage or tie up the apparatus for long periods of time.

The instrument panel front end is implemented in JavaScript and Macromedia Flash. When students submit a run from the instrument panel, backend Perl scripts label and process the request and write it to an "incoming" queue on Sanzone and the expected time of completion for the job is displayed on the panel. Jobs complete within a few seconds when the incoming queue is empty. Queues are intelligently managed by consecutively scheduling jobs with similar operating parameters and by assigning lower priority to non-local IP addresses (to prevent 'walk-in' users from monopolizing the experiment).

Future versions of the experiment will allow students to manipulate additional parameters, such as reagent concentrations, pH, temperature, ionic strength, and flow rate. Data from different groups can then be pooled and analyzed. Students will then use these results to evaluate proposed mechanisms for the reaction. Further developments will be outlined on the project home page at http://antoine.frostburg.edu/chem/senese/inetchemset.

References

Cartwright, H. M. (1998). Remote control: How science students can learn using Internet-based experiments, in *New Network-based Media in Education; Proceedings of the International CoLoS Conference*, Maribor, Slovenia, 51-59.

Cartwright, H. M. (1999). An Internet-based Experiment in Error Handling. *International Conference on Conceptual Learning of Science*, Lisbon, Portugal.

Dalziel, K. (1953). *Journal of Biochemistry*, 55, 79-94.

Roughton, F. J., & B. Chance (1963). Rapid Reactions, in *Techniques of Organic Chemistry*, 2nd ed, S. L. Friess, E. S. Lewis, A. Weissberger (eds), v. VIII, Interscience-Wiley, New York. 704-778.

Sharpe, A.G (1976) *The Chemistry of Cyano Complexes of the Transition Metals*, New York: Academic Press.

Shoemaker, D. P.; Garland, C. W.; & Steinfeld, J. I. (1974). *Experiments in Physical Chemistry*, New York: McGraw-Hill. 335.

A Distance-Learning Model Based on Web Mining

Ruimin Shen
Qijun Wang
Dept. Of Computer Science and Technology
Shanghai Jiaotong University, Shanghai, 200030, P.R.C
Email: rmshen@mail.sjtu.edu.cn

Abstract: Distance-Learning based on WWW has become a trend for the development of education. But the distance-learning site based on WWW is static, the designers of the courses don't know whether the design of courses is rational or consistent with the teaching law. While there is a lot of students' information accumulated in the web site, and the information is useful for our course designers. In this study, we present a distance-learning model based on Web Mining, which can take advantage of those students' information accumulated in the web site.

1.introduction

Distance-learning based on WWW has become a trend for the development of education. The available distance-learning model based on WWW is discussed in (Xuejun Li 1999). But recently the distance-learning site based on WWW is static, and the designers of the courses don't know whether the design of courses is rational and consistent with the teaching law. While there is a lot of students' information accumulated in the web sites, such as students' access patterns and registration and communication data information, and these information is useful for our course designers and teachers.

In this study, we present a distance-learning model based on Web Mining, which can take full advantage of those students' information accumulated in the web sites.

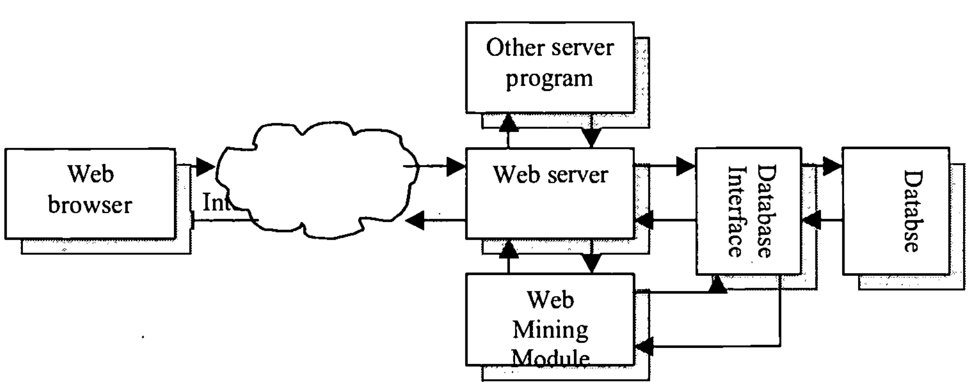
2.A Distance-Learning Based on Web Mining

The model integrates the Web Mining technology into the available model base on WWW. It's architecture is shown (Fig.1). In this model, we add the Web Mining module into the available model. The Web Mining model is located in the server-side and performs in the server-side.

According to our special system for distance learning, the Web Mining process as shown in (Fig.4). The Web Mining module has three phases(Robert cooley et al. 1998): Preprocessing(Yilin yang et al.1999), mining process and pattern analysis.

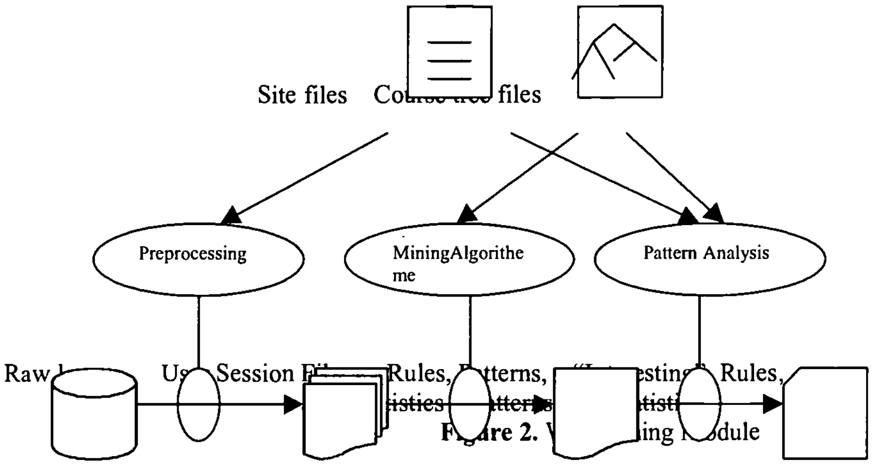
3.Conclusion

our model has following points: The course designers can reconstruct a Web sites in order to better serve the needs of students of a site according to these information such as the students' access patterns and page access frequency statistics; it can provide individualised page or different course content for individual student; and it can provide teachers the students' feedback, and teachers can redesign their teaching plans,too.



Client-side Server-side

Figure 1. A Distance-Learning Model Based on Web Mining



Reference

Xuejun Li(1999). *Integration of Synchronous & Asynchronous Distance Learning System with Q&A Ability* Mater's thesis, Shanghai Jiaotong University, Shanghai, PRC

Robert Cooley, & Bamshad Momshad Mobsher, & Jaideep Srivastava(1998). *Data Preparation for Mining World Wide Web Browsing Patterns*

Yiling Yang, etc.(1999). SJTU Doctoral Dissertation: *SWLMS: A Web Log Mining System*

Scenario-Based Prototyping: a User-Centered Method for the Design of CALL Systems

Jae-Eun Shin
Department of Computer Science
University of Manchester
United Kingdom
jshin@cs.man.ac.uk

David G. Wastell
Department of Computer Science
University of Manchester
United Kingdom
dwastell@cs.man.ac.uk

Introduction

The aim of this paper is to illustrate and demonstrate the value of a user-centered method for CALL systems development. We accept the argument of Hubbard (1996), Levy (1997) and other the deficiencies of current CALL system can be attributed to the lack of a systematic methodological theory guiding their design. Accordingly, a CALL design method has been developed which draws on recent developments in the field of human-computer interaction regarding scenario-based design and prototyping in relate to the user-centered design of computer-based learning material.

Scenario-Based Prototyping

The main features of the method include the use of scenarios to identify user requirements (Carroll, 1995), the development of prototypes embodying key design issues, and a series of formative workshops to evaluate the prototypes. The overall results confirm the general validity of the user-centered, scenario-based methodological approach.

There were three cycles of prototyping process in this research. Each cycle was based on a set of User Satisfaction Scenarios. The scenarios were used to build prototypes in two different ways: user dissatisfaction scenarios were used to define existing problems that have been found from the current CALL products; and user satisfaction scenarios were used to clarify possible problems that could be found in the CALL product to be built. A template for scenarios is proposed for the educational environment. The template include the user environment (i.e., age, school, class, user's conception toward CALL system, motivation of using CALL software, software type), learning environment (i.e., classroom, self-studying, group-studying), and narrative user interaction scenario to define features user satisfied/dissatisfied. Overall, this paper is to suggest the method of use of scenarios explicitly for designing CALL systems, not to show the results of prototypes which have been constructed and evaluated

Developing prototypes is an integral part of iterative user-centered design process bccause it enables designers to try out their ideas with real users and to gather feedback. There were three major cycles of prototyping process with different prototypes embodied different design issues, which is based on user-satisfaction scenarios. The main design issue of the first prototype systems was to find how user-control could affect to achieve high quality CALL systems in terms of both educational and technical value. Two comparative systems were built for this initial stage: one was a high user-control (learner-based) system, and the other was a low user-control (teacher-oriented) system. According to the feedback from a series of formative user workshops, it has been found that the effectiveness of user-control were dependent on learners' experience in CALL systems and their learning environments. Based on the feedback from the first workshops, the user satisfaction scenarios were revised to find the design issues for the second prototype.

The second prototype system was a hyperlink system between three different systems: Tutorial system for listening skills with low user-control, Main Lesson system for practicing listening skills with high user-control for experienced users, and a sub-system called Speaking Dictionary to provide learners linguistic help. The user response about the hyperlink system was that it would be better to have a different user-control by learning stages concerning user experiences. Users also showed positive opinions about the user satisfaction scenarios because they agreed that scenarios make it easy to visualize the real-world environment and to comprehend users' perspective toward CALL systems. On the other hand, users responded that learners need more support to control their learning process more effectively.

Therefore, the third prototype constructed was focused to investigate the effectiveness of Teaching Agent to support learners' learning process with respects of HCI aspects and educational achievement. At this stage, we argue that TA should have domain knowledge (i.e. English), Training knowledge (i.e. listening skills), and Specific pupil knowledge. Here, the specific pupil knowledge is the most significant to advise learners what to do next. While the knowledge of domain and training are static and independent on student or teacher, the knowledge of specific pupil depends on followings: how well is the learner doing?; what listening skills have been used?; what personality does the learner have?; and what is the learning goals? The TA system called Magic Mirror has been developed to apply those aspects based on the revised user satisfaction scenarios, in which learner personality and learning goal of specific pupil knowledge were not considered. The result from the third workshop with teachers was positive towards the concept of TA in general, but some teachers questioned how TA could act as a substitute for a teacher. On the other hand, learners showed more positive attitude towards the TA because they compared the TA with Help functions in other CALL system, not with their teachers. The conclusion is that TA could make CALL systems more effective if all the aspects of the specific pupil knowledge are regarded on the development.

Conclusion

The essential elements of this user-centered method for designing CALL systems are scenarios, prototypes, and formative workshops. Prototyping helps designers to make user-oriented decisions by eliciting information from the formative evaluations of users, and scenarios are useful to articulating new design concepts like TA. In HCI practice, *scenarios of use* are increasingly being used to help set overall design objectives for guiding various aspects of the design process. Carroll (1995) argues that if we believe the scenario approach to be a valuable enhancement of current development practice, we must ask how the use of scenarios in system development can be evoked, supported, and brought to bear on various activities within the system development cycle. Overall, this user-centered method is very effective regarding the following aspects. Firstly, Scenarios are used as a bridge between designers and users to define learners' or teachers' needs and learning environment in order to achieve learning goals. Secondly, prototypes are used to apply design issues and to demonstrate the expected learning environment concerning pedagogical value. Finally, user workshops are held to investigate user satisfaction to evaluate design issues and principles in terms of both technical and educational value.

References

Carroll, J. M. (1995). *Scenario-based design: Envisioning work and technology in system development.* NY: John Wiley & Sons, Inc.

Hubbard, Philip L. (1996). Elements of CALL Methodology: Development, Evaluation, and Implementation. In M.C. Pennington (Eds.) *The Power of CALL* (pp.15-32pp). NY: Athelstan

Levy, Mike (1997) *Computer-Assisted Language Leaning: Context and Conceptualization.* Oxford: Clarendon

Flexibility and Facilities
In Children's Electronic Textbooks

Norshuhada Shiratuddin
Department of Information Science, University of Strathclyde, Glasgow, UK
shuhada@dis.strath.ac.uk, shuhada@uum.edu.my

Monica Landoni, PhD
Department of Information Science, University of Strathclyde, Glasgow, UK
monica@dis.strath.ac.uk

Abstract: Design of electronic books should take into account the diversity of learning styles, intelligences and preferences of each user. This project main aim is to provide high level of electronic book interaction and flexibility by matching different categories of electronic pages (graphic page, talking page, hypermedia page and web page) to the different learning styles. Each page exhibits programs and activities that attempt to cater for each learning style. The same content in each page will be presented in four different presentation modes. In addition to the technical system development, a conceptual model of children's electronic textbook will also be proposed. This model is based on Howard Gardner's theory of Multiple Intelligences and Philip Barker's generalization of electronic books model.

Introduction and definition of electronic book

Educational environment stresses the importance of reading materials: textbooks, reference books, encyclopaedias, magazines and newspapers as media of knowledge carriers. Hence converting printed publications especially textbook into interactive electronic form should prove to be extremely useful and helpful. There are various definitions of electronic book (e-book). Bonime et al. (1998) described any kind of information ranging from a CD-ROM title to an online interactive database including collection of web pages as electronic book. Barker (1998) defined e-book as essentially a computer-based information storage that embeds a book metaphor. More precisely (Barker, 1999), e-book is usually considered to be composed of a collection of reactive pages of electronic information that are organised in a thematic way and that exhibit many of the characteristic features and properties of a conventional book. Barker categorises e-book into ten types depending on the types of information embedded: textbooks, picture books, talking books, moving picture books, multimedia books, polymedia books, hypermedia books, intelligent books, telemedia books and cyberbooks. While Barker categorises ten types of e-book, Landoni et al. (1993) classified e-book according to three different criteria: books which are portable (e.g. personal digital assistant), books which preserve the logical structure (i.e. chapters, sections and subsections) and lastly, books that support both the physical and logical aspects of a paper book. In context of this project, definition of an e-book will be defined when the study is completed.

Research Question

Children learn in different ways. There are many theories on how people learn and one example is the Multiple Intelligences (MI) theory proposed by Howard Gardner (1993). This theory states that there exist seven intelligences (thus seven learning styles): verbal/linguistic, logical-mathematical, visual/spatial, bodily-kinesthetic, musical, interpersonal and intrapersonal (to date, two more intelligences have been added). Based on this theory, Armstrong (1994) wrote a book on how to apply this theory into the classroom environment. He identifies that each child could learn in any one of these ways or through a combination of several ways. With these different learning styles, design of e-books should take into account these diversity and attitudes of each user particularly young children. Thus, one question can be extracted: how to give young children better flexibility so as to cater their differences?

Proposed Solution: Giving E-Book Flexibility

There are many methods to give flexibility in e-books. One example is by providing tools or facilities, which can be used by users while consulting the e-book. Landoni et. al (1993) in her project provided users with facilities such as personalisation (highlighting, bookmarking, note taking), searching through TOC table of content and index, and printing. Other examples include providing system adaptivity, supporting for group-based learning, considering the likelihood that teachers will use the program in class and including different levels of contents in the books.

It is the intention of this on going project to suggest that another method to achieve flexibility is through flexible presentation modes that include programs and activities which match each learning style. The following gives few examples on how to match MI theory to the existing e-book model:
(a) Verbal/linguistic – Is matched with e-book concept of *hypermedia page* through programs such as letting users create essays, read aloud and include storytelling.
(b) Visual/spatial – Is matched with e-book concept of *graphic page* through programs such as letting users draw and paint and allowing users to read and see information as graphics, maps, charts and diagrams.
(c) Musical – Is matched with e-book concept of *talking page* through programs such as combining stories with songs and letting users sing along.
(d) Interpersonal – Is matched with e-book concept of *web page* by including programs, which need two or more users at the same time and group project or discussion.

Proposed electronic book model

Page = Contents + [Object A + Object B + Object C + Object D]
Object A = Graphic page + {Program G1 | Program G2 | …| Program Gn}
Object B = Talking page + {Program T1 | Program T2 | …| Program Tn}
Object C = Hypermedia page + {Program H1 | Program H2 | …| Program Hn}
Object D = Web page + {Program W1 | Program W2 | …| Program Wn}

Conclusion

In conclusion, our e-book shall exhibit four different concepts and include a number of presentation modes and styles, in order to provide readers with a high level of flexibility. Users can choose between the four different presentation modes when he/she opens any page. Upon completion, this project will be used to prove these assumptions:

H1:It is possible to address diverse learning styles by providing users with flexible presentation modes of each page.
H2:These flexible presentation modes are probably more appropriate to use and as such give e-book high level of flexibility.
H3:It is then possible to suggest that due to this high level of e-book flexibility, users are more likely to prefer this type of e-book.
H4:If H1,H2 and H3 are proven, then we could postulate that an additional desirable feature for e-book would be to present contents by mixing many presentation modes.

References

Armstrong, T. (1994). *Multiple Intelligences in the Classroom*, Assoc. for Supervision and Curriculum Development, Alexandria, USA.
Barker, P. G. (1998). The role of digital libraries in future educational systems, *Online Information 98 Procedings*, 301-310.
Barker, P.G. (1999). Electronic Libraries of the future, *Encyclopedia of Microcomputers*, 23(2), 121-152.
Bonime, A., & Pohlmann, K.C. (1998). *Writing for new media. The Essential Guide to Writing for Interactive Media, Cd-ROMs and the Web*, John Wiley & Sons.
Gardner, H. (1993). *Frames of Mind: The Theory of Multiple Intelligences*, Fontana.
Landoni, M., Catenazzi, N., & Gibb, F. (1993). Hyper-books and visual-books in electronic library, *The Electronic Library*, 11(3), 175-186.

What Is So Revolutionary About The Internet In Education?

Peter B. Sloep, Ellen Rusman
Educational Technology Expertise Center, Open University of The Netherlands
The Netherlands
peter.sloep@ou.nl; ellen.rusman@ou.nl

Abstract: The Internet is making inroads into almost all quarters of our society. Education is no exception to that, nor should it. Exciting new ways of building content, of delivering it, of interacting with our students, indeed of managing our educational 'industry' can be seen to evolve. Even if one may not wholeheartedly support all these innovations, particularly for all those with an inquisitive mind it is inspiring to see education being rethought in so many and fundamental ways. Or is it?

The Internet revolution clearly is a technological revolution. It pushes developments in various fields, education being no exception to that. However, are the new technologies used to innovate education, that is, to bring about a genuine transformation; or do they just substitute older technologies for new ones?

An educational model that is widely implemented these days - although it doesn't alway go by this name - is that of the *extended classroom*. As the name suggests, an extended classroom takes the ordinary classroom as its starting point and extends it, mainly spatially. So the dominant didactic model here still is a teacher who addresses a group of students; students and teacher are simultaneously present; the teacher takes the lead; students may ask questions but those only serve to clarify the exposition of the teacher; students seldom interfere with the choice of content, which is the teacher's exclusive realm; students hardly ever have a say in the didactics used, this also is the teacher's prerogative. In the extended classroom, teacher and students may be in different locations, the distance being bridged by television, videoconferencing, audiographics and similar technologies. Put extremely, with the extended classroom one aims to mimick a regular classroom to the largest possible extent. Hence the call for ever larger bandwith, for systems that allow for 'natural' interactions between the teacher and the remote classroom, etc.

However cleverly designed our communication systems, however large our bandwidth, extended classrooms will always be second best, a substitution for the real thing, only useful as a means to reach out to the remote student, perhaps to serve larger groups of students and achieve some economy of scale. Lecture notes that are being put on the web as a service to the students, or e-mail and newsgroups that deliver additional support only serve to underline the main conclusion: in the extended classroom technology is used to substitute or augment existing teaching modalities.

Obviously, there is nothing inherently wrong with this. Technology is a means to an end and should be used accordingly, that is, how *we* see fit. However, if it is our lack of imagination or if it is the rigidity of our institutions that prevent us from using technology in more creative ways, then we should not rest content. We should reexamine our educational practices and ask ourselves to what extent they were limited by existing technologies and to what extent the new technologies empower us to innovate. And indeed, it is our claim that we only stand at the beginnings of truly innovative educational practices and genuinely new didactic principles.

Distributed learning is a term that is often used in this context. In distributed learning systems, there are no classrooms anymore, no teachers offering students prepackaged chunks of education carefully aranged to conform to the needs and capacities of the average student. Students now occupy center stage, assembling and arranging content that fits their specific needs; they take it in when and where it suits them best, perhaps in a didactic style that optimally matches their learning style. The role of the teacher now is not communicating knowledge, but to make it available, to empower students via intakes and assessments and help them assimilate knowledge, to offer custom support. In distributed learning, technological innovation is not the push behind educational innovation, as is the case in the extended classroom. Rather, the converse holds true, educational innovation pushing technology. And indeed, distributed learning requires specific technologies that extend beyond the mere facilitation of communication. Technologies are needed for creating learner centered content, for the delivery of such content, for flexible intake and assessment procedures, for portfolio management, etc. In our presentation we will discuss these technologies at some length.

Online Mentoring: A Case Study Involving Cognitive Apprenticeship and a Technology-Enabled Learning Environment

Kathleen Snyder, Applied Learning Sciences, IBM T.J. Watson Research Center, U.S.A.
ksnyder@us.ibm.com

Robert Farrell, Applied Learning Sciences, IBM T.J. Watson Research Center, U.S.A.
robfarr@us.ibm.com

Norma Baker, Project Executives Programs and Support, IBM Global Services, USA
njbaker@us.ibm.com

This paper describes a study aimed at investigating the impact of a technology-enabled training program for Project Executives (PE's) in the IBM Corporation. The program is focused on a mentoring approach to learning whereby PE's considered to be experts in specific skills coach less experienced colleagues in the development of critical skills. Since job demands prevent ongoing face-to-face mentoring relationships, technology which enables collaboration at a distance is implemented to support the mentoring relationship. Of interest in this study is the effectiveness of instructional design approach, the impact of the technology-enabled learning environment on sustaining mentoring relationships, and the nature of online discussions between experts and students.

IBM PE's are responsible for managing large information technology contracts. These professionals deliver on commitments to customers, ensure customer satisfaction, secure business opportunities, and mentor other project executives. Their role of mentor is critical to the professional development of less experienced colleagues. While traditional face-to-face mentoring is desired and encouraged, job demands often prevent mentors and students from sustaining the type of relationships needed for the transfer of critical skills.

In the current study, a combination of face-to-face instruction and a technology enabled learning environment is used to develop and sustain mentoring relationships among expert PE's and less experienced colleagues. The face-to-face instruction includes a two day workshop consisting of five sessions led by the expert PE's. The purpose of the workshop sessions is to 1) initiate a mentoring relationship among expert PE's and a group of colleagues and 2) to begin the mentoring process which includes the transfer of a specific set of problem-solving skills.

At the conclusion of the workshop participants are introduced to *e-mentor*, a Lotus Notes discussion database which can be accessed using a Lotus Notes Client or a Web browser. The discussion database is used to provide an online learning environment in which the mentor-protégé relationship is preserved. Mentors post mini-lessons on topics relevant to the development of complex problem-solving skills needed in customer situations. Participants respond to the lessons in discussion format, post questions and collaborate with one another in solving customer problems. Mentors are available to assist participants with appropriate strategies for addressing customer problems.

The instructional design approach used in the workshop and online is based on cognitive apprenticeship, an instructional approach developed by Collins, Brown and Newman (1989). Cognitive apprenticeship focuses on the development of higher level thinking skills such as problem-solving. Because of its focus on the teaching of cognitive and metacognitive knowledge, cognitive apprenticeship may be a more appropriate instructional design model for online mentoring than more traditional instructional designs such as a lecture approach. Whereas text and lecture-based instructional design models focus on teaching concepts, facts, and procedures in non-situated environments, cognitive apprenticeship focuses on teaching the processes and strategies used in expertise and how this knowledge is used to solve real-world problems. Snyder (2000) demonstrated the effectiveness of cognitive apprenticeship as an instructional design approach for teaching technical skills in an online environment.

Collins, Brown, and Newman (1989) and Collins (1991) identify four aspects of cognitive apprenticeship learning: content, instructional methods, sequencing of instruction, and sociology. Content refers to the different types of knowledge required for expertise and includes domain knowledge and strategic knowledge. Domain knowledge consists of concepts, facts, and procedures; strategic knowledge refers to knowledge which underlies an expert's ability to make use of concepts, facts, and procedures to solve problems.

Instructional methods are the learning activities used during instruction to help students construct, use, manage, and acquire new knowledge (Collins, Brown, & Newman, 1989). Seven instructional methods are recommended. These methods include teachers "modeling" skills, "coaching" learners as they attempt to mimic expert skills, providing "scaffolding" in the form of support for learners, and gradually "fading" support, as learners become more proficient. Learners are also encouraged to "articulate" their knowledge, "reflect" on their problem-solving processes, and "explore" new approaches to problem solve on their own.

Sequencing involves the staging of learning whereby tasks are presented in increasing complexity and diversity so that students develop a broad understanding of the domain of expertise. Sociology deals with the authenticity of the learning environment. Technological, social, time, and motivational characteristics of real-world situations are designed into the learning environment so that students will learn when, where, and how the knowledge applies to other situations (Collins, Brown, & Newman, 1989).

The PE workshop in this study and the e-mentor database are designed to incorporate the four aspects of cognitive apprenticeship learning. In the workshop, learning takes place in the context of solving a variety of real-world complex customer problems. Mentors begin sessions with an introduction a complex customer problem. Facts and concepts about the customer environment are presented (domain knowledge) and followed by modeling of the strategies and processes used to solve the problem. During this activity, mentors use think-aloud protocols to model the strategic thinking required to solve the problem. Next, tips and techniques (scaffolds) for remembering the processes and strategies are provided to students. Students are then assigned to small teams of six and work together to develop a solution to an existing customer problem. The problems used in this exercise are real-world and are brought to the workshop by students. Students are required to articulate the processes and strategies used to address the customer problem and then briefly explore alternative approaches to problem-solving. At the conclusion of this exercise, mentors model their thinking with respect to solving the team problems. When the two-day workshop ends, the mentor- protégé relationship is maintained using the Lotus Notes discussion database. Workshop participants use the database to request help from colleagues and mentors regarding problems experienced in the workplace. Mentors use of the cognitive apprenticeship method when responding in the online environment.

The results of this study to date have been successful in that this combination of face-to-face and online mentoring has enabled a community of IT executives who are geographically dispersed to form working relationships and share knowledge on a regular basis. This model has also provided participants with an environment for continuous learning on a just-in-time basis, convenient to their demanding work schedules. The instructional design approach has been notably successful in providing an effective way for PE's to learn new skills. Participants in the workshop quickly adopted the habit of thinking about problem-solving from a strategic perspective (that is, identifying the processes and strategies needed to solve customer problems and using reflection and exploration techniques before identifying a solution). This learning approach has also provided a common ground for PE's to work together to solve customer problems. Results of a survey administered to participants of the workshop indicated high ratings with respect to the methods fostering working relationships among PE's, the value of the content of the workshop, its structure (instructional design approach) and the value of the e-mentor database in providing a continuous learning environment which facilitates collaboration.

Collins, A. (1991). Cognitive apprenticeship and instructional technology. In Lorna Idol and Beau Fly Jones (Eds.) Educational values and cognitive instruction: Implications for reform (pp121-138). Hillsdale, N.J. Lawrence Erlbaum Associates.

Collins, A., Brown, J., & Newman, S. (1989), Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In Lauren B. Resnick (Ed.) Knowing, learning, and instruction: Essays in honor of Robert Glaser. Hillsdale, NJ:Erlbaum Associates.

Snyder, K., (2000), Asynchronous Learning Networks and Cognitive Apprenticeship. A Model for Teaching Complex Problem-Solving Skills in Corporate Environments. Dissertation Abstracts.

An Online Environment that Scaffolds Moving from Novice to Expert Collaborative Learners

Joseph B. South
Center for Instructional Design
Brigham Young University
Provo, UT 84606
Joseph_South@byu.edu

Laurie Miller Nelson
Instructional Psychology and Technology Department
Brigham Young University
Laurie_Nelson@byu.edu

Digital Learning Environments Research and Development Group
Brigham Young University

Abstract: This work-in-progress paper describes a pedagogical approach to designing an online collaborative learning environment that scaffolds learners in becoming better collaborative learners. This environment is based on Collaborative Problem Solving (CPS) instructional theory. The paper will overview the need for the environment, and the design principles used to design and develop it.

Need

As online education becomes more prevalent as a system for distance education, a need arises for an online structure that supports instructors and learners engaging in small group collaborative problem solving or project work at a distance from one another. Particularly, there is an increasing need for online learning environments that support effective, efficient collaborative processes, such as those used by expert group problem solvers.

When online environments impose restrictive structures or do not account fully for these processes, they may hinder the flow of learning, and curtail effective, efficient problem solving. Most online environments that attempt to use collaboration as a learning strategy incorporate a smorgasbord of communications technologies that are not structured according to research into the most effective ways to scaffold effective collaborative interactions. Furthermore, the applications included in these systems (such as email, threaded discussions, and file storage) are generally lower-level communication tools as opposed to tools that could support robust collaboration. Because they do not use a guiding theory that is pedagogically based, the resulting interaction often do not adequately address the social, intellectual, and logistical complexity of effective collaborative learning. This is partially due to the fact that until recently, no comprehesive theory capable of support effective online collaboration existed.

Specifically, the weakness of these approaches is their primary reliance on a document-based paradigm (such as Lotus QuickPlace or Hyperwave), conferencing-based paradigm (such as Microsoft NetMeeting or Lotus Sametime), or room-based paradigm (such as BioMOO or Diversity University) (Miao, Fleschutz, & Zentel 1999). For the design to fully support a cohesive collaborative learning approach, the strengths of each of these approaches must be synthesized into a context-based system that allows for a more flexible combination of people, places, tools, documents, and interactions than these other types of systems afford, thus providing robust support for the communication, collaboration, and coordination necessary to learn effectively as a small group.

Proposed Solution

We propose to design, develop, implement, and evaluate an online collaborative learning environment that both supports pedagogically sound instruction and provides appropriate scaffolding for moving learners from novice to expert collaborative learners. It will be based on Collaborative Problem Solving (CPS), an instructional theory designed for effective, efficient small-group problem solving (Nelson 1999). This theory outlines a detailed collaborative learning process derived from a series of carefully documented case studies of expert learning groups integrated with findings from current research in areas such as small group dynamics, cooperative learning, and problem-based learning. The goal of this theory is to provide step-by-step scaffolding to both instructors and learners that will help learners make the difficult transition from novice to expert collaborative learners.

Unlike existing tools that merely provide a collaboration platform, this online system will be designed to serve as a robust teaching and learning environment that will provide guidance for both instructors (in designing their instruction and in appropriately monitoring, supporting, and assessing the learners' progress) and learners (in developing effective collaborative skills while learning at a distance). This learning environment will be capable of scaling to any number of small groups and will support instruction in a variety of disciplines desiring to engage learners in project- or problem-based learning around complex, real-world problems. Its structure will afford support for every phase of effective small group collaboration, from building readiness to providing closure, by providing all the collaborative learning spaces, tools, and resources necessary to do so, such as "just-in-time instruction" for learners as they progress through the given project or problem scenario.

Project Goals

The goal is to create an online learning environment that has the following features and characteristics:

- Teaches and supports the nine phases, not just isolated activities, of Nelson's effective collaborative problem solving process, which includes: building readiness, forming and norming the groups, determining a preliminary problem definition, defining and assigning roles, engaging in an iterative collaborative problem-solving process, finalizing the solution or project, synthesizing and reflecting, assessing products and processes, and providing closure to the learning experience,
- Employs proven pedagogical theory and arrays tools around this theoretical structure,
- Responds to the needs of the users by being flexible, customizable, and reconfigurable,
- Runs entirely on open standards-based Internet protocols,
- Enables distributed groups to learn and work together at least as effectively as co-located groups,
- Provides guidance for both instructors and learners in effective collaborative learning, and
- Archives the work of small groups for both the group's reference and for research analysis.

Project Design

Our design approach is to translate each element of CPS theory into a corresponding aspect or structure of the environment, such that it both implicitly and explicitly supports effective, efficient collaborative problem solving philosophy and methods. From this blueprint, we will work with a software designer to create a data model. From the data model, the software designers will create a database-driven, internet-based collaborative environment that will scale to any number of small teams. Simultaneously, we will begin a paper prototyping phase to determine the initial visual design, working with a target user pool of instructors and students at the two distance education entities. We will then employ a rapid prototyping method to improve our visual design and address the usability issues of instructors and learners testing alpha versions of the system. Once we have a beta quality environment, we will conduct pilot studies with instructors and learners in diverse content areas and geographical locations. Finally, we will evaluate case studies of the system fully implemented in a variety of learning, work, and research settings and use the data to refine a final version that we will release for use on the local servers of any interested partners.

References

Miao, Y., Fleschutz, J. M., Zentel, P. (1999). Enriching learning contexts to support communities of practice. Proceedings of Computer Support for Collaborative Learning, USA, 99, 391-397.

Nelson, L. M. (1999). Collaborative problem solving. In C. M. Reigeluth (Ed.), Instructional-design theories and models: A new paradigm of instructional theory. Mahwah, NJ: Lawrence Erlbaum Associates.

Technology Learning Communities: Collaborations to Increase Technology Integration in Education

Mary L. Stephen
Department of Arts and Sciences
Harris-Stowe State College
St. Louis, MO
USA
stephenm@acm.org

Diane M. Smoot
Department of Arts and Sciences
Harris-Stowe State College
St. Louis, MO
USA
smootd@hssc.edu

Abstract: This paper describes the implementation of a pilot project involving the formation of networked technology learning communities designed to nurture the growth and sharing of expertise in meaningful uses and integration of technologies into teaching and learning among college faculty members, student teacher candidates and classroom teachers. The paper focuses on issues related to the establishment of technology learning communities and includes brief studies of selected members of the learning communities.

Introduction

Recent studies (Trotter, 1997; U.S. Department of Education, 1998) indicate that a large majority of classroom teachers in the U. S. continue to feel inadequately prepared to integrate technology into classroom instruction. This work-in-progress paper describes the implementation of a pilot project that focuses on ways to address this problem. The project involves the formation of networked technology learning communities designed to nurture the growth and sharing of technological expertise among college faculty members, teacher candidates and classroom teachers in the integration of technologies into teaching. The project studies potential for such communities to enlarge the number of technologically proficient current and future teachers by increasing the number of college faculty members who model the use of technologies in their teaching, the number of teacher candidates exposed to technology-proficient college and classroom teachers, and the pool of technologically proficient classroom mentor teachers. Ultimately, the goal for this project is to support a cycle of increased meaningful integration of technology into teaching.

Technology Learning Communities

Technology learning communities provide "a culture of adult learning and mutual support" (McKenzie, 1999, p. 71) that enable individuals with different skill levels to assist each other in the learning of ways to integrate technologies meaningfully into teaching. Technology learning by members occurs in both informal and formal settings, with support and expertise provided when requested by members of the communities. These communities sustain the different learning styles of the members. The strength of a learning community lies in the emphasis on members teaching each other what needs to be learned and at a pace that meets individual needs and preferences (McKenzie, 1999). Emphasis in the pilot learning communities is on supporting projects that have a direct impact on teaching and learning.

Inherent in the formation of learning communities with membership from diverse groups, i.e. college faculty, college students, and classroom teachers, are many challenges. If a learning community is to be successful, membership must be "flat and non-hierarchical" (McKenzie, 1999) in the sense that all members are equal partners. Ideally, the learning communities should have an impact on education that radiates beyond the communities. The focus of each member of a community must be on ways to use technology to improve teaching, not simply on the development of individual technological expertise. Members of a learning community must accept the responsibility to take the acquired skills and knowledge back to their circle of professionals. Each member must be willing to build on acquired skills and knowledge, even after the pilot project ends.

Each ten member learning community in this project is composed of college faculty members, teacher candidates, and preK-5 teachers, with varying degrees of technological expertise. Criteria for membership were established prior to the formation of the learning communities. Student members were selected based on meeting those criteria and documented faculty support for their membership. Faculty members and K-5 teachers meeting the criteria and having a range of technological expertise were identified and invited by project leaders to participate in the project. The members of the current learning communities appear to have successfully established a non-hierarchical relationship partly due to the selection process. Each member of the learning communities is equipped with a laptop computer and Internet access to facilitate collaboration.

In the initial meeting of the learning communities, members were surveyed on their levels of technology expertise and discussed their learning expectations. This information assisted the coordinator of the learning communities in planning group learning sessions. In addition to these face-to-face meetings, members of the communities interact using email and a discussion list. The discussion list, TechTalk, provides a mechanism for members to share and request resources, and to obtain fast response to technology-related inquiries. With support from learning community members, the college faculty members are increasing technology use in the courses they teach. The teacher candidates have the opportunity to assist in the implementation of technology-based lessons, to design lessons and materials to be used during student teaching with preK-12 students, and to work with the college faculty members as they integrate technology into courses. The classroom teachers are sharing and expanding their expertise in integrating technology into the preK-5 curriculum.

Members of the learning communities have formed partnerships as reflected in interviews done with one student and one faculty member in the communities. Faculty Member A is a beginning technology user, though she is knowledgeable about the Internet. As a college history professor, she wants to explore the use of the Internet not as an electronic library reflected in the web sites that she includes in her syllabus bibliography, but as a vehicle to encourage her education students to think critically about events in history. She finds the learning communities helpful in learning about social studies issues important to clementary teachers but receives the most help from one-on-one tutoring from individual members. She is especially appreciative of the help from Student B, an above average technology user, who acquired many of her skills at the college. In addition to tutoring Faculty Member A, Student B is helping two classroom teachers in her learning community to teach their students HyperStudio. She finds that the learning communities aid her goal of being a teacher because through this collaboration she is spending time in a classroom setting working with children.

Evaluation of the progress being made by members of the learning communities in meeting the initial goals of this pilot project is encouraging. This project is providing the groundwork for modification and expansion of future technology learning communities.

References

McKenzie, J. (1999). *How teachers learn technology best.* Bellingham, WA: FNO Press.

Trotter, A. (1997). *Training called key to enhancing use of computers, poll finds.* [On-line]. Available: http://www.edweek.org/ew/vol-16/29jost.h16.

U.S. Department of Education, National Center for Educational Statistics (1998). *Teacher survey on professional development and training.*

Acknowledgements

This project is supported in part by a U.S. Department of Education grant (P342A990151). However, the contents of this paper do not necessarily represent the policy of the Department of Education, nor endorsement by the Federal Government.

Four Challenges for TeleTeachers in Rural Schools

Ken Stevens, Memorial University of Newfoundland, Canada

The introduction of telelearning in schools in Canada, as in other developed countries, has been particularly noticeable in rural areas and has been influenced by declining school enrolments. There are four challenges common to the technological enhancement of rural schools: the building of appropriate infrastructures, the location of appropriate technologies, the development of pedagogy for teleteaching and the need for on-going professional development.

Challenge One: Building Appropriate Structures (Digital Intranets)

By constructing web-sites both teachers and students in a rural school can enable people located almost anywhere to connect with them and learn about their programs and activities. In Canada regional and national educational networks link classes in schools on dispersed sites. Stem-Net in Newfoundland and Labrador in eastern Canada is the provincial arm of the federal SchoolNet System. These federated electronic structures enable teachers to extend the curriculum available to learners in dispersed and, often, very isolated sites. Schools in rural Canada are developing open and flexible academic and administrative structures as they electronically link with one another. These new structures exist within the traditional and, by comparison, closed school systems in each school district. In the open educational structure of teleteaching within digital intranets, constructed to link schools for the delivery of specific courses for some students, participating institutions academically and administratively interface for that part of the school day during which classes are being taught. This is a very different educational structure from the traditional and, by comparison, closed educational environment of the autonomous school with its own teachers and its own students. In Canadian networks such as Stem-net, each site becomes an inter-dependent part of a virtual school, without which it could not provide all the courses that local people are increasingly accessing.

Challenge Two: Finding Appropriate Technology

As schools become teaching and learning sites within digital Intranets, there is increasing demand for adequate technological support and co-ordination. Few teachers have the skills to provide adequate technological support for the increasing numbers of computers and computer users in their schools. The result is that the emerging teaching and learning infrastructure in many places is often very fragile. An essential aspect of the development of open electronic classes is the coordination of both hardware and software between schools. Without coordinated technology, schools cannot fully participate in electronic networks. However, the purchase of appropriate hardware and software is a matter of confusion for many principals, teachers and School Boards who seek support and advice. Many rural schools with open electronic classes realize that the successful administration of a network requires local technical support. Unless adequate technical support systems can be established, electronic networked classes could be curtailed by teachers who could argue, with justification, that there is insufficient back-up to justify their investment in telelearning. The need to have people in schools, or available to schools, to maintain information technology hardware and software is, for many teachers, a matter of growing importance. In geographically isolated communities the assurance of adequate technical backup is, however, often particularly difficult to provide for teachers and principals. In schools in Newfoundland and Labrador, the majority of which are designated rural, telelearning often depends on the goodwill of one or two teachers with enough knowledge to keep computers going when they mal-function.

Challenge Three: Pedagogy for TeleTeaching

In the changing technological environment, teachers often have a choice of teaching face to face and, for part of a school day, providing or receiving instruction for their students at a distance. This can be done in synchronous or asynchronous mode, with a range of technologies, and with a range of learners. The use of information technologies in schools has been vigorously promoted by the federal agency, Industry Canada (Information Highway Advisory Council, 1995;1997). Students often have more independence in managing their learning in open electronic classes but most have to be assisted by teachers in the setting of goals, the meeting of deadlines and in evaluating their progress (Stevens, 1996). Teachers are effective in open electronic classes if they can be flexible in ways that they allow students to participate in on-line lessons. Strategies and protocols for on-line teaching have to be developed between participating schools if all students are to be able to fully participate. The introduction of a rural school to an open electronic network considerably improves its resource base for both teachers and learners, but does not solve all of its problems. It is often difficult to coordinate the timetables of networked schools and a considerable measure of inter-institutional and intra-institutional cooperation is required to develop detailed and effective plans for collaboration. The need for rural networked schools to have a close relationship with the suppliers of technology has become increasingly apparent to schools, school boards and to technology retailers. Rural schools with telelearning infrastructures require expert advice and support from technology suppliers at the network rather than at the individual school level. There are several immediate pedagogical challenges to be considered for effective teaching in a digital Intranet:

1. Teachers have to learn to teach from one site to another. This is fundamental to the success of teleteaching. Teaching face to face and on-line are different skills.
2. Teachers have to learn to teach collaboratively with colleagues from multiple sites.
3. Teachers have to judge when it is appropriate to teach on-line and when it is appropriate to teach students in traditional face-to-face ways. These judgements have to be defended on the basis of sound pedagogy.

Challenge Four: Professional Development for TeleTeaching

A difficulty many teachers face in Canadian schools is simply finding the time in their busy days to learn about information and communication technologies. It is impossible for some teachers to do this, let alone reflect on how new technologies can be integrated into their classrooms and their professional lives. There is not only a widespread need for professional development for teleteaching; there is a need for it to be provided on a continuous basis. A second challenge facing many teachers is finding effective ways of integrating information and communication technologies, including the Internet, into teaching and learning. It is not difficult to add information and communication technologies to any classroom but it requires considerable planning to integrate technological developments so that both teaching and learning are enhanced. A third challenge for the professional development of teachers is to be able to justify, on the basis of professional judgements, why the Internet and other technologies should be used in teaching and learning at all.

Conclusion

The introduction of inter-school electronic networks has added a new dimension to rural education in Canada and in other developed countries. In Canada and in many other places, teachers and researchers are seeking appropriate ways of using existing as well as emerging technologies to enhance teaching and learning. The teachers and researchers who are collaborating in the development of new electronic structures for delivering education to dispersed, rural sites in Atlantic Canada are very conscious of being pioneers. Both realize there is a lot to learn to about both teaching and learning in this new environment.

References

Information Highway Advisory Council (1995) *The Challenge of the Information Highway*, Ottawa, Industry Canada

Information Highway Advisory Council (1997) *Preparing Canada for a Digital World*, Ottawa, Industry Canada

Stevens, K.J (1996) Telelearning and New Zealand Schools - Some Implications of the Convergence of Information and Communication Technologies for the Management of Education, *New Zealand Association for Research in Education*, Nelson

Group interaction as a predictor of learning effectiveness in a computer supported collaborative problem solving

Neli Stoyanova
Faculty of Educational Science and Technology, University of Twente
P.O.Box 217
AE 7500 Enschede, The Netherlands.
stoyanovn@edte.utwente.nl

Abstract: The paper presents an experimental validation of learning effectiveness of three different types of group interaction for computer mediated collaborative learning and problem solving. The assumption underlying this research is that the form in which knowledge is shared in collaborative learning is a substantial for cognitive construction and reconstruction. The experiment revealed that the learning effectiveness is influenced significantly by the mode of group interaction that depends on the extend to which students share their learning not only as results but also as a process of knowledge acquisition and creation by a direct interaction.

Theoretical background and research question

Rapidly changing technologies generate new requirements for creating computer environments that support learning in the broad context of global networking communities. Different theoretical perspectives emphasise collaboration as a successful and powerful activity for learning and problem solving.

Collaboration creates an extension of the internal cognition of the personality in outside world (Perkins, 1993). According Salomon (1993) the individuals' and the shared group cognitions interact with one another in a spiral-like fashion whereby individual inputs, through students' collaborative activities, affect the nature of the joint, shared system, which in turn affects their cognitions. It is emphasised that reconstruction of individual cognition requires a profound and mutual understanding of collaborators' perspectives and shared interpretations of the problem. Only the knowledge that is meaningful for individuals could be internalised.

The assumption underlying this research is that the form in which knowledge is shared in collaborative learning is a substantial for cognitive construction and reconstruction. The main research question is: *Is the mode of group interaction a predictor of learning effectiveness in a computer based collaborative problem solving design?*

Collaborative scenarios

Three scenarios of problem solving group interaction have been designed, based on the assumption that knowledge exists in three forms: as individual mental constructs and precepts, as knowledge in action, and as knowledge embodied in artefacts (Hedlund & Nonaka, 1994)

1. *Distributed interaction.* Group members work autonomously and produce intermediate artefacts embodying their knowledge and visions, which are passed to the other members. This circuit is repeated until all group members reach a common vision of the problem. The process of knowledge acquisition, creation and internalisation is individual.
2. *Moderated interaction.* Interaction process is facilitated by a group moderator (the role is taken by one of the group members) adjusting individually produced artefacts until a common group vision is reached. The representations of individual cognitive structures are not directly accessible but group members are involved in the process of negotiation of meanings and ideas that take place between them and the group moderator.
3. *Shared interaction.* Group members interact directly by synchronous activity and common efforts to solve the problem as a group. They share their knowledge in action. Knowledge is communicated in the process of its acquisition and creation and is not mediated by intermediate artefacts. Collaborative actions of students are the individual inputs toward shared cognition.

Experimental validation

The learning effectiveness of the three modes of group interaction was tested experimentally. The experimental design was a random assignment pre-test post test control group. The independent variable was the mode of group interaction with three levels – "Distributed" "Moderated" and "Shared".

The dependent variable was learning effectiveness operationalised as individual learning achievements in terms of: *fluency* (number of concepts representing individual understanding of the problem), *flexibility* (variety of concepts and ideas), *knowledge acquisition* (number of new concepts acquired), *individual-to-group transfer* (individuals' inputs in the group solution), *group-to-individual transfer* (concepts derived from the group solution), *reconfiguration* (changes in the concepts' structure), *retention* (contra indicated by the reduced concepts), and *creativity* (new concepts and ideas generated individually after the collaboration).

Twenty-six students (6 groups) of University of Twente, Faculty of Educational Science and Technology, enrolled in "Linear and Hypermedia" course, were selected as experimental subjects and were randomly assigned to the three collaborative scenarios. The group task was formulated as an open-ended problem. Concept mapping technique was chosen for representation and communication of knowledge because of its effectiveness as a tool for externalisation and representation of cognition. (Stoyanov & Kommers, 1999). Data was analysed applying one-way ANOVA procedure by SPSS 9.0 statistical package.

Results and Discussion

The results are significantly predictive for the learning effectiveness of the three group interaction scenarios. The mode of group interaction influences significantly the knowledge fluency (Sig. = .047), concepts acquisition (Sig. = .045), and group-to-individual transfer (Sig. = .004). On these criteria students in Shared groups scored significantly higher than students in Moderated and Distributed groups.

All three scenarios enabled students to present and incorporate their knowledge in the group process. No significant difference was found on individual-to-group transfer.

Shared mode was highly beneficial for acquiring knowledge both from each other and from taking new perspectives in exploring the problem space. A significant part of the knowledge that was elaborated in group session were incorporated as a meaningful part of students' cognitive structures and transferred to individual cognitions.

Students working in Moderated mode incorporated less new concepts in their personal cognitive structure than students in Shared mode. Only those aspects of the group solution that were developed by the personal participation of a particular student were internalised in his/her cognition.

Regardless that students in Distributed mode had a broad access to all other students' knowledge representation they were not able to gain enough from the externalised experience of the others.

Both the Shared and Moderated mode proved their potential for reconstruction of the individual cognition represented mainly by reshaping of map spatial configuration. Significant interdependence between common group problem solution and the individual outputs was found. Students working within Distributed mode resist on their prior conceptual structure.

No significant difference was found on criteria of knowledge flexibility. The three types of groups were able to explore the problem space from different perspectives and within different conceptual paradigms.

Surprisingly, the individual creativity was not influenced by the mode of group interaction.

Nevertheless no significant difference was found (Sig. = .345), it should be stated that students working in Shared mode showed a lower level of retention of their initial concepts than the students in the other two modes.

In summary, the experiment revealed that the learning effectiveness is influenced significantly by the mode of group interaction. In general, Shared interaction scenario proved to be the most effective in collaborative learning and problem solving. These leads to the conclusion that the learning effectiveness depends on the extend to which students share their learning not only as results but also as a process of knowledge acquisition and creation by a direct interaction.

References

1. Hedlund, G., & Nonaka, I. (1994) A Model of Knowledge Management and the N-Forum Corporation, *Strategic Management Journal, 15,* 73 - 90.
2. Perkins, D. N. (1993). Person-plus: a distributed view of thinking and learning. In G. Salomon (Ed.), *Distributed cognitions.* Cambridge: Cambridge University Press, pp. 88 - 110.
3. Salomon, G. (1993). No distribution without individual cognition: a dynamic interactional view. In G. Salomon (Ed.), *Distributed cognitions.* Cambridge: Cambridge University Press, pp. 111 - 139.
4. Stoyanov, S. & P. Kommers (1999). Agent Support for Problem Solving through Concept Mapping, *Journal of Interactive Learning Research, Vol. 10, No 3/4.*

Re-usability problems in large-scale content management of database driven Web based environments

Allard Strijker
University of Twente
P.O. Box 217
7500 AE Enschede
The Netherlands
strijker@edte.utwente.nl

Abstract: The use of databases involves assigning resources to users with changing access rights. How will the information be presented to the right users? How can resources be reused for different audiences and how should access rights be provided. Who has the right to change, who can read it and who is owner of the objects in a resource base?

Introduction
The faculty of Educational Science and Technology started a faculty wide implementation of Telelearning with the TeleTop project in 1997. The aim of the project was to support teachers and students with a web based database driven environment. Two years later the entire university, including ten faculties, is ready to the implement the Teletop system. How reuse of material should be provided is a point of research because content management can make the use of objects more efficient.

The problem of assigning resources to people
Scaling up a course management system means that more information will be stored. Reusing includes retrieving stored information. Finding relevant material and assigning this material to the right users is a problem because of the large amount of objects and the large scale of users. A second point of attention is the use of access rights. Access rights are used to give users rights to read or change objects. Using databases includes controlled access to different objects for different users.

Objects:
Every object has users that can read or use the object, users who are able to change or create the object and users that can actual delete an object. These rights are set in the access control list and every database uses some sort of access control list to control access objects in a database. These objects can consist of (elements of) learning material, course descriptions, assignments, multimedia fragments, HTML pages or any other type of digital content. Controlling access to information is needed so that copyrights or confidential material can be stored in a protected environment; i.e. an environment that is not accessible for unauthorized users.

Users:
Users are mostly unaware of these access control lists, because software developers make these environments as easy as possible by not showing objects that users are not authorized to see. The problem in most cases is that objects may be accessible for one user, but not for another. Resources available for teachers may not be accessible for students. Assigning students to these resources may result in irrelevant links for the students. This makes reuse for different users and audiences a difficult issue. This problem has not earlier been identified because most web-based environments are still pilots or prototypes. A faculty wide implementation includes a large number of users who can create objects and even more users that should be able to use these objects. Dealing with a large scale of objects and really reusing these in database driven courses is a new development.

Solution for large numbers of objects
Maintaining access control for every single object in a very large resource base is not manageable. Managing many (more than 10.000) users over many (more than 10.000) objects is a realistic example in our situation at the University of Twente. Combining a number of related objects in a course is a solution to make control access rights

manageable. In this way it is possible to assign a set of objects to several predefined user groups comprised of teachers or students. One group can be assigned the role of author and other groups as readers. Copying objects to new courses can involve reuse of objects. This method has been sufficient until now, because in most cases instructors wanted to reuse only the material created by themselves. Reuse as described gives the possibility to make changes to objects for the new audience.

Making objects more flexible

Considering the results of reuse we recently developed a new model for access rights. This model is based on roles that are assigned to user groups. A user group is a list of people who can access the same functionality in a database. So the access control of every object in a course depends on the role a user has. Three roles where identified: Teacher, student and administrator. Using roles makes reuse possible by employing an abstract access level that can be used over courses and provides a consistent control of rights. Objects can be used in every course without changing access control lists of involved courses. The development of a resource browser is in progress. In the first place reuse of objects within a course is being researched, in the second place exchange of objects between courses will be researched.

Challenge, future plans

In the next years reuse of objects at the university level should be supported. Objects should be reused within courses, between courses and faculties. Even different universities should be able to reuse objects in courses. Therefore, interfaces should be developed that support users selecting the right resources. Also, access right models have to be developed. Another objective of our research should be directed at the ownership of objects; i.e. copyrights. Ownership can be seen as part of the access rights involved with objects. Is a user who creates an object the owner and is this user the only one who may reuse or add or edit this object? Who owns such copyrights? All these points need further research. In this respect it is important to note that a number of organizations involving standards for learning technology and related issues are aware of these problems and are trying to find solutions, but until now there is not a standard way to handle large scale resource bases. Examples of these organizations are the Instructional Management Systems project (IMS)[1], the Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE)[2], the IEEE 1484P Learning Technology Systems Architecture (LTSA)[3], Advanced Distributed Learning (ADL)[4] and the Aviation Industry CBT Committee (AICC)[5].

---

[1] IMS: http://www.imsproject.org
[2] ARIADNE: http://ariadne.unil.ch
[3] LTSA: http://www.manta.ieee.org/p1484
[4] ADL: http://www.adlnet.org
[5] AICC: http://www.aicc.org

Computer Support for Unobtrusive Assessment of Conceptual Knowledge as Evidenced in Newsgroup Postings.

Steve Tanimoto*, Adam Carlson*, Earl Hunt*, David Madigan***, Jim Minstrell****

*Department of Computer Science and Engineering, University of Washington
Box 352350, Seattle, WA 98195-2350, USA
**AT&T Research, Shannon Laboratories, 180 Park Avenue Florham Park, NJ 07932-0971, USA
***Talaria, Inc., 705 2nd Avenue, Hoge Bld., Suite 501, Seattle, WA 98104

tanimoto@cs.washington.edu, carlson@cs.washington.edu, ehunt@u.washington.edu, madigan@yahoo.com, jimminstrell@talariainc.com

Abstract: As the Internet brings new means of presenting information to learners, the need for meaningful assessment increases. We describe the design and development of a computer tool to facilitate a particular form of assessment that can be meaningful in online learning contexts. The tool combines a web browser with an annotation facility, a database, and special means for visualizing assessment data captured with the tool.

Introduction:

As educators explore the many possibilities for delivering instruction online via the Internet, they tend to focus primarily upon delivering presentations of information. The forms of presentation include web pages and web sites, text, images, audio clips, video clips, queries to databases, and Java applets that run simulations. In addition to the information itself, the Internet also enables the online gathering and experience of groups of people who might (or might not) be physically distant from one another. The online communities of learners can be formed such that the members are all at a very similar level of expertise in the subject they are studying. What is largely missing from these innovations, however, is a form of educational assessment that is well adapted to the new patterns of learning.

Assessment is sometimes regarded as the unpleasant part of education, in part because traditional testing is sometimes distasteful to students and because assessment is typically considered less important to the presentation of information. However, studies of assessment in support of learning (rather than in support of administration or of college admission, for example) have lead to recommendations for alternative assessment methods such as performance assessment, authentic assessment, portfolio-based assessment, and continuous assessment (see Tanimoto, 1998). These methods offer the possibility to make assessment a more "natural" part of the learning process, and to permit learning to occur with less stress and in ways more in line with workplace goals. Yet these methods are often difficult to implement because they may require more teacher training, more teachers' time spent on assessment, and because their results may seem to be more subjective than the results of standardized tests. We have developed a software tool for assessment to help us explore one approach to assessing online learning. The tool, called INFACT, permits the assessment to be performed unobtrusively in a manner reminiscent of psychologists' observations from behind the glass wall.

Pedagogical Approach

Our approach to assessment takes place within a particular pedagogical methodology. We have applied the methodology in two subject areas: high-school physics and undergraduate statistics. Students in the class are divided into groups of 4-6 students each. An instructional unit lasts one week. On Monday, a problem that requires conceptual thinking is posed by the teacher. Each student in the class is told to make her/his own interpretation of the problem and suggestion for solving it and to write and post a newsgroup entry using a specially modified version of the HyperNews software from the University of Illinois. The posting is due by 12 noon on Tuesday. This initial post is invisible to other students until a virtual curtain is lifted shortly after noon on Tuesday, at which time it becomes visible to the other members of the student's group. The students are then required to respond to each other's postings in an online discussion, and they are told to come up with a group solution by Friday. Over the course of the week, their postings accumulate, creating an archive which feeds our assessment tool, INFACT.

INFACT stands for "Integrated Networked Facet-Based Assessment Capture Tool." It is used by teachers to view and annotate student newsgroup postings in such a way as to build up a database of assessment information that can be used to track student and group progress in understanding the concepts of the instructional unit. INFACT makes use of catalogs of standard misconceptions that students commonly have about a subject. Each misconception is called a facet, and facets are grouped into clusters such that all facets in a cluster represent misconceptions about the same concept. A facet catalog must be compiled in advance of using INFACT for assessment. However, it is possible to refine a facet catalog in the course of assessment. INFACT makes the assumption that facets can be linearly ordered by their "level of expertise" (see Minstrell 1992 and Hunt and Minstrell 1994 for details).

The Design of INFACT

INFACT comprises the following components: an integrated web browser, a database (currently an MSQL database), dialogs for creating and editing assessment items, and a visualization component. The browser component permits the teacher to load and view HyperNews postings in essentially the same form that the students see when they read and post. This component also supports creating selections of text within the document being viewed. The INFACT software determines (insofar as possible given the limitations of available browser software) the start and end positions within the document where the selection occurs. Selections of this form can then be annotated.

Annotations of two types are permitted: facet annotations and free annotations. A facet annotation represents an atomic assessment item, and it consists of the text selection, a reference to the document in which the text occurs, identification of the student who authored the text, identification of the assessor, reference a particular facet for which this text provides evidence, a certainty value given by the assessor, the date of authoring and the date of assessment. A free annotation is simply a comment associated with the selection. The assessor can check a box associated with each annotation to make it visible to the student. The database is used to keep track of the annotations and to make assessment items retrievable by student, by facet cluster, by date, etc. The database also holds the facet catalog. The visualization portion on INFACT permits the user (usually the teacher) to call up assessment data by student, by group, by date, or by facet cluster. The user can also view graphs that help to reveal trends in the data. Two types of graphs supported by INFACT are (a) histograms of facet frequencies, and (b) facet transition diagrams. The latter show how one or more students' misconceptions about a concept change over time.

As a teacher reads student postings with INFACT and makes annotations, s/he can use INFACT to send feedback to the students. INFACT supports two means of feedback: direct email and student-visible annotations. Direct email permits the teacher to send a message to a student in the context of an assessment item. This can be used to get clarification from the student about something not clear from the posting. It can also be used to commend the student or to make a suggestion. However, its main value over email from ordinary mail programs is the automatic association created between the message and the assessment context in which it originates. INFACT makes it possible for the teacher to include a multiple-choice question in the message that when answered online, provides additional evidence in favor of one facet or another within the facet cluster associated with the assessment item. For a screen shot of INFACT, see http://www.cs.washington.edu/research/metip/crlt/infact-1.gif

References

Hunt, E., and Minstrell, J. 1994. A cognitive approach to the teaching of physics. In McGilly, K. (ed.), Classroom Lessons. Cambridge, MA: MIT Press, pp.51-74.

Minstrell, J. 1992. Facets of students' knowledge and relevant instruction. In Duit, R., Goldberg, F., and Niedderer, H. (eds.), Research in Physics Learning: Theoretical Issues and Empirical Studies. Kiel, Germany: Kiel Univ., Insti. for Science Educ.

Scardamalia, M; and Bereiter, C. 1996. Student communities for the advancement of knowledge. CACM, 39, No.~4, pp. 36-37.

Tanimoto, S.~L. 1998. Towards an ontology for alternative assessment in education. Technical Report UW-CSE-98-09-04, Dept of Computer Science and Engineering, Univ. of Wash., Seattle, September 1998.

Acknowledgements: Thanks to J. Phillips and J. Baer for contributions to the visualization code and to J. Ammerlahn for the supporting Perl scripts. Support from NSF Grant CDA-9616532 is gratefully acknowledged.

Evaluation of an ITS for the Passive Voice of the English Language Using the CIAO! Framework

Maria Virvou, Victoria Tsiriga, Dimitris Maras
Department of Informatics,
University of Piraeus,
Piraeus 18534, Greece
E-mail: mvirvou @unipi.gr, vtsir@unipi.gr, eagle@ath.fothnet.gr

Introduction

The primary aim of educational software is to help students learn. Therefore, evaluation of this kind of software is crucial. Its aim is to test the functionality and usability of the design and to identify and rectify any problems (Dix et al. 1993). In particular, formative evaluation is one of the most critical steps in the development of learning materials because it helps the designer improve the cost-effectiveness of the software and this increases the likelihood that the final product will achieve its stated goals (Chou 1999). In this paper, we present and discuss the evaluation of an intelligent tutoring system for the passive voice of the English language using the CIAO! framework (Jones et al. 1999).

The Passive Voice Tutor

The tutoring system that we developed and evaluated is called Passive Voice Tutor (Virvou & Maras 1999a; 1999b). The Passive Voice Tutor complies with the architecture of most ITSs, which consists of the domain knowledge, the student modeller, the advice generator and the user interface (Wenger 1987).

In particular, the domain knowledge of the Passive Voice Tutor comprises knowledge about how to convert a sentence from active to passive voice and vice versa. It also provides the knowledge needed for the dynamic construction of new exercise sentences. Finally, it comprises knowledge about the semantic relation between the words used for the construction of new sentences.

The student modeller checks the student's answer and in case of error, it performs error diagnosis. It contains a bug library of the most common student errors and generic mal-rules that students often apply when they have misconceptions. Another responsibility of the student modeller is to keep a history record concerning each student's progress in learning. This record is used in cases were ambiguity arises, so that the system attributes a particular error to a category of errors that the student seems to be prone to.

The advice generator is responsible for responding in the most appropriate way to a student's error, by informing the user about the cause of the error and by showing to him/her the relevant part of the theory. Finally, the user interface of the Passive Voice Tutor, is a multimedia user interface, which involves animations, sounds and a limited form of natural language so that it can attract the student's interest.

The Evaluation

The CIAO! framework outlines three dimensions to evaluate: (i) context; (ii) interactions; and (iii) attitudes and outcomes. One important aspect of context is the reason why CAL is adopted in the first place, i.e. the underlying rationale for its development and use; different rationales require different evaluation approaches. According to the framework, the reason for looking at students' interactions with the software is in order to understand more about their learning processes; such interactions can provide protocol data for later analysis. Finally, at the "outcomes" stage, information from a variety of sources needs to be used including, pre and post-achievement tests, interviews and questionnaires with students and tutors. The overall emphasis of this framework is on educational issues.

There are many other evaluation techniques, such as the JIGSAW model (Squire & Preece 1996) or the 'set of learning with software heuristics' (Squires & Preece 1999), which also address the problem of integrating both usability and learning issues in the evaluation of educational software. In the JIGSAW model, the evaluation is performed in three levels. In Level 1, the subtasks of the learning and operational tasks are considered independently of each other. As we move from Level 1 to Level 2, integration within the learning and the operational tasks is considered. At Level 3 integration between the learning and operational tasks is considered. On the other hand, the set of 'learning with software' heuristics, are an adaptation of the "usability heuristics" presented in Nielsen (1994), so as to relate them to socio-constructivist criteria for learning. These heuristics include the need to consider appropriate levels of learner control, the need for the prevention of peripheral cognitive errors and the need for strategies for the cognitive error recognition, diagnosis and recovery cycle. The CIAO! framework, seemed to be a more suitable method, in the sense that it also evaluated the students' use of the resource package.

For the evaluation along the dimensions of the CIAO! framework, presented above, we have done the following:

i) **Context**: The underlying rationale for the development and use of the Passive Voice Tutor is to help students during the process of learning. Hence, one of the primary aims of the system is to address individual learners' misconceptions and help them correct their errors. Evaluation in terms of the context has been addressed by questionnaires to human tutors before their students had ever used the system. This was done so that the domain knowledge and student modeller could be evaluated. In particular, tutors were given a set of erroneous answers to questions relating to the domain, which were generated using the system's domain knowledge and bug library. For each question, each tutor had to provide an explanation as to what s/he thought the underlying misconception of the error was. Each human tutor's explanation was compared to the Passive Voice Tutor's explanation. A satisfactory degree of compatibility was found (45%). However, the comparisons also showed that the explanations could be improved at a later version of the Passive Voice Tutor.

ii) **Interactions**: On a second phase, tutors were asked to evaluate the system, after their students had interacted with the Passive Voice Tutor. Protocol data was collected through the individual long term user model of each student. This kind of protocol data was first automatically analysed by the student modeller and resulted in information that concerned the student's individual way of learning. Then, human tutors were also given the same set of students' protocols and were asked to analyse them. Finally the tutors' analysis was compared to the system's analysis. To a large extent, human tutors had similar beliefs to the system's beliefs about the students who took part in this evaluation stage.

iii) **Attitudes and Outcomes**: In the case of the Passive Voice Tutor, at the outcomes stage, questionnaires were given to students and tutors. Students' questions included the following: "Did you consider the system responses to your errors helpful for understanding your mistakes?" Tutors were also asked to evaluate the outcome of the use of the system, after their students had interacted with the Passive Voice Tutor. Therefore, the teachers were asked to provide information about whether the software helped them to understand better the difficulties that their students had in learning the passive voice of the English language. Tutors also seemed quite satisfied by the system's student modelling component. Finally, the progress statistics of each student that had been recorded in his/her long term student model was also used at this stage of the evaluation. The analysis of this kind of data showed that the majority of students (57%) made a progress in their learning, whereas only 43% did not seem to have any progress in their learning of the passive voice. This is an encouraging result in terms of the educational effectiveness of the system.

Conclusions

The CIAO! framework for evaluating educational software has provided insight for several aspects of the software that needed evaluation at several stages; e.g. before any student had interacted with the software and after. In this way, both learning effects and usability issues could be evaluated. The results of the evaluation showed that the Passive Voice Tutor was quite satisfactory but there is scope for improvement in terms of the explanations provided by the system.

References

Chou, C. (1999). Developing CLUE: A Formative Evaluation System for Computer Network Learning Courseware, *Journal of Interactive Learning Research*, 10(2).

Dix, A., Finlay, J., Abowd, G., & Beale, R. (1993). *Human-Computer Interaction*, NY: Prentice-Hall.

Jones, A., Scanlon, E., Tosunoglu, C., Morris, E., Ross, S., Butcher, P. & Greenberg, J. (1999). Contexts for Evaluating Educational Software. *Interacting with Computers*, 11(5), 499-516.

Nielsen, J. (1994). *Usability Inspection Methods*, John Wiley, New York.

Squires, D. & Preece, J. (1996). Usability and Learning: Evaluating the Potential of Educational Software, *Computers and Education*, 27(1), 15-22.

Squires, D. & Preece, J. (1999). Predicting Quality in Educational Software: Evaluating for learning, usability and the synergy between them, *Interacting with Computers*, 11(5), 467-483.

Virvou, M. & Maras, D. (1999a). An intelligent multimedia tutor for English as a second language. *Proceedings of ED-MEDIA, ED-TELECOM 99, World Conference on Education Multimedia and Educational Telecommunications*. Vol. 2, pp. 928-932.

Virvou, M. & Maras, D. (1999b). Error Diagnosis in an English Tutor. *Proceedings of the 8th International Conference on Human-Computer Interaction (HCII 99)*, Munich, Germany, 2, 657-661.

Wenger, E. (1987). Artificial Intelligence and Tutoring Systems. Morgan Kaufman.

Using A Speech-Driven, Anthropomorphic Agent in the Interface of a WWW Educational Application

Maria Virvou, Nikitas Sgouros, Maria Moundridou, Dimitrios Manargias
Department of Informatics, University of Piraeus,
80, Karaoli and Dimitriou St., Piraeus 185 34, Greece
mvirvou@unipi.gr, sgouros@unipi.gr, mariam@unipi.gr

Introduction

Web-based education has the obvious benefit of allowing platform independent access to easily updated teaching material. Recently, a large number of educational applications have been delivered through the World Wide Web. Unfortunately, most of these systems are static, they do not maintain a student model and thus they are unable to provide individualised tutoring. Nonetheless, the future of web-based education seems promising since researchers in the field of Intelligent Tutoring Systems have made quite successful attempts to either move existing ITSs to the WWW or build from scratch web-based ITSs (Eliot et al., 1997; Stern et al., 1997). However, the development of an ITS requires the involvement of a large number of people, including experts of the specific domain, instructors and programmers. A way to overcome these problems may be the development of authoring tools, which will help construct cost-effective and reusable ITSs in various domains. One such authoring tool for ITSs is WEAR (WEb-based authoring tool for Algebra Related domains). WEAR incorporates knowledge about the construction of exercises and a mechanism for student error diagnosis that is applicable to many domains that can be "described" by algebraic equations (Virvou & Moundridou, 1999).

WEAR uses a talking head in its interface with the students. Animated characters have often been used in the interfaces of systems (Rist et al., 1997; Stone & Lester, 1996). Such an interface makes a system more appealing and attractive to the user and if talking about an educational application it may also promote the learning objectives. Walker et al. (1994) investigated subjects' responses to a synthesised talking head displayed on a computer screen in the context of a questionnaire study. Their findings showed that compared to subjects who answered questions presented via text display on a screen, subjects who answered the same questions spoken by a talking head spent more time, made fewer mistakes, and wrote more comments. In this paper we describe how the talking head is used in the whole educational application.

Description of the System and its Interface

WEAR aims to be useful to teachers and students of domains that make use of algebraic equations. Such domains could be chemistry, economics, physics etc. In particular the tool accepts input from a human instructor about a specific equation-related domain (e.g. physics). This input consists of knowledge about variables, units of measure, formulae and their relation. When the human instructor wishes to create exercises s/he is guided by the system through a step by step procedure. At each step of this procedure the instructor specifies values for some parameters needed to construct an exercise. Such parameters could be for example what is given and what is asked in the exercise to be constructed. After the completion of this procedure the tool constructs the full problem text and provides consistency checks that help the instructor verify its completeness and correctness.

WEAR assigns to each student a level of knowledge according to his/her past performance in solving problems with the tool. The tool suggests each student to try the problems corresponding to his/her level of knowledge. When a student attempts to solve an exercise the system provides an environment where the student gives the solution step by step. The system compares the student's solution to its own. The system's solution is generated by the domain knowledge about algebraic equations and about the specific domain in which the exercise belongs (e.g. economics). While the student is in the process of solving the exercise the system monitors his/her actions. If the student makes a mistake, the diagnostic component of the system will attempt to diagnose the cause of it.

When interacting with the students WEAR responds through a talking head, representing in some cases the instructor and in some others a co-student. The talking head component of the system uses speech synthesis to automatically produce speech output from text using MBROLA, a freely available speech synthesiser (http://tcts.fpms.ac.be/synthesis/mbrola.html). The talking head renders the interface quite attractive to students through the sound of speech. Moreover, since WEAR is an authoring tool for ITSs there are a lot messages that are dynamically formed during the execution of the application. Therefore, the authoring tool could not use pre-stored material for the speech feature but rather a speech synthesiser.

In the case when the talking head represents the instructor it guides the student to the environment, recommends what problem to solve next and reads the problem text from the database of the authoring tool. Since WEAR is an authoring tool, new exercises are continuously added to its database. When the student begins to solve the problem, s/he may choose to solve it either with a simulated "co-student" or with the "instructor". These two different choices are only on the level of the user interface. This means that they use the same underlying reasoning abilities from the diagnostic component of WEAR.

If the student selects the mode of the "co-student" then the talking head provides very friendly messages as a peer to the student. This simulated student is responsible for providing positive feedback when the student's actions are correct and for pointing out the student's underlying misconception in case of an erroneous action. The information concerning which actions are considered correct or not and also the messages that the simulated student should say are provided by the diagnostic component of WEAR. The talking head as a simulated student is aimed at increasing the student's attention and possibly collaboration attitude (although in a limited form). Indeed as VanLehn et al. (1994) have pointed out peer learning even in a setting where the other peer is a simulated student may increase students' collaboration skills.

If the student selects the mode of the "instructor" then the talking head provides messages similar to the "co-student" but they are more formal and the diagnosis of misconceptions goes one step further to resolve ambiguities using the long term student model. Indeed, there may be cases where a student's erroneous action may be attributed to more than one misconception. In such cases, the diagnostic component first consults the long term student model and then through the talking face asks the student a question to determine his/her underlying misconception and resolve the ambiguity. The benefit of directly asking the student is twofold: firstly, the system may find out the real reason for the erroneous action and provide appropriate feedback and secondly, the student through explaining why s/he acted in that way gains more knowledge and understanding. It is a common finding in many researches that explaining things either to oneself or to another student helps one's understanding (Webb, 1989; Pressley et al., 1992).

Conclusions

In this paper we described the work in progress of the development of a web-based authoring tool for Intelligent Tutoring Systems. The tool, called WEAR, aims to be used by teachers and students working in domains that make use of algebraic equations. In this paper we focussed on the interface of the ITSs that are generated by WEAR: animated talking heads are used to simulate both the instructor and a co-learner of the student solving a problem. In that way, instruction and feedback are more "human-like" resulting in friendlier and more appealing ITSs. Furthermore, the students interacting with WEAR, may gain better understanding of the domain being taught and also improve their ability to collaborate with others; benefits that arise from the peer learning situation in which the students are involved.

References

Eliot, C., Neiman, D. & Lamar, M. (1997). Medtec: A Web-based intelligent tutor for basic anatomy. *Proceedings of WebNet '97, World Conference of the WWW, Internet and Intranet*, AACE, 161-165.

Pressley, M., Wood, E., Woloshyn, V.E., Martin, V., King, A. & Menke, D. (1992). Encouraging mindful use of prior knowledge: Attempting to construct explanatory answers facilitates learning. *Educational Psychologist*, 27, 91-109.

Rist, T., André, E. & Müller, J. (1997). Adding Animated Presentation Agents to the Interface. *Proceedings of the 1997 International Conference on Intelligent User Interfaces*, Orlando, Florida. 79-86.

Stern, M., Woolf, B.P. & Kurose, J.F. (1997). Intelligence on the Web? *Proceedings of the 8th World Conference on Artificial Intelligence in Education*. Kobe, Japan.

Stone, B.A. & Lester, J.C. (1996). Dynamically sequencing an animated pedagogical agent. *Proceedings of AAAI-96*. Portland, Oregon. Vol 1, 424-431.

VanLehn, K., Ohlsson, S., & Nason, R. (1994). Applications of simulated students: An exploration. *Journal of Artificial Intelligence and Education*, 5(2), 135-175.

Virvou, M. & Moundridou, M. (1999). An authoring tool for Algebra-related domains. *Human-Computer Interaction: Communication, Cooperation, and Application Design, Proceedings of the 8th International Conference on Human-Computer Interaction - HCI International '99*, Mahwah, NJ: Lawrence Erlbaum Associates, Vol. 2, 647-651.

Walker, J.H., Sproull, L. & Subramani, R. (1994). Using a Human Face in an Interface. *Proceedings of Conference on Human Factors in Computing Systems (CHI'94),* 85-91.

Webb, N. (1989). Peer interaction and learning in small groups. *International Journal of Educational Research*, 13, 21-40.

A Domain-Independent Reasoning Mechanism for an ITS Authoring Tool

Maria Virvou
Department of Informatics, University of Piraeus,
80, Karaoli and Dimitriou St., Piraeus 185 34, Greece
mvirvou@unipi.gr

Introduction

Intelligent Tutoring Systems have traditionally been very good at providing dynamic aspects to the educational system's reasoning. This is usually due to the student modelling component that attempts to follow the student's way of learning taking into account possible misconceptions that the student may have. Other important dynamic features of ITSs are due to the advice generator that models the tutoring strategy by which the student is going to be taught the domain.

However, ITSs have often been criticised that they represent immensely complex approaches to building learning environments (Boyle, 1997). A solution to this problem may be authoring tools that provide the facility of building multiple ITSs. In particular, as Murray (1999) points out ITS authoring tools may give the instructional designer a combination of facilities to produce visually appealing, interactive screens and a deep representation of content and pedagogy.

This paper describes an authoring tool for ITSs that incorporates a domain-independent reasoning mechanism. The reasoning mechanism is used for the student modelling and the tutoring strategy of the resulting ITS.

Related Work

The domain-independent reasoning mechanism of the authoring tool described in this paper, is based on an adaptation of a cognitive theory called Human Plausible Reasoning (Collins & Michalski, 1989). Human Plausible Reasoning theory (henceforth referred to as HPR) is a domain-independent theory originally based on a corpus of people's answers to everyday questions. HPR formalises the plausible inferences based on similarities, dissimilarities, generalisations and specialisations that people often use to make plausible guesses about matters that they only know partially. These inferences may lead to either correct or incorrect guesses; in any case these guesses are plausible.

This theory can be used as a domain-independent generator of plausible human errors or as a way of reasoning for open questions. Indeed in previous research we adapted and used HPR in the user modelling component of an intelligent help system for UNIX users (Virvou, 1998; Virvou & DuBoulay, 1999) and in an intelligent learning environment for novice users of a GUI (Virvou & Stavrianou, 1999; Virvou & Kabassi, 2000). In the present research we adapted and used HPR for the student modelling of multiple domains, such as geography, biology etc. and as a tutoring strategy for teaching students how to deal plausibly with open questions. In addition we have provided the facility to human instructors to construct the knowledge - base of the domain to be taught to students.

Operation of the Authoring Tool

The initial input to the authoring tool is a description of factual knowledge of a specific domain given by a human teacher. Then the tool constructs a knowledge base concerning the specific domain in the form of hierarchies, which is compatible with HPR. The human teacher may also construct tests that consist of questions concerning the factual knowledge of the domain.

The resulting ITS may be used by students who can be shown facts from the knowledge base. In addition students may test their knowledge by answering the questions that the human teacher has given. The student modelling component examines the correctness of each student's knowledge and the soundness of the reasoning s/he has used. Information about each student is kept in a long term student model. This kind of information may be used to measure the student's progress and record persistent misconceptions and weaknesses of the particular student.

The tutoring component of the resulting ITS poses questions to the student who is asked to give an answer and an explanation for this answer. For example, in the domain of geography the tutor may pose the question: "Does Italy produce lemons?" Then the student may answer either "Yes" or "No" and give an explanation for his/her answer. An explanation could be "Yes, because I know it does". If the student does not possess the factual knowledge needed for this answer s/he may say: "My guess is yes. I know Spain produces lemons; Spain is similar to Italy in terms of agricultural products. Therefore, Italy probably produces lemons". In this case, both the answer and the reasoning are examined by the ITS. There may be cases where the student's answer may be incorrect but the reasoning reveals that the student has a good knowledge of geography and uses it in a plausible way.

In particular, there may be several cases of combinations in terms of the correctness of the guessed answer and the correctness of the reasoning. One case is both the guessed answer and the reasoning used to be correct. Another case is the guessed answer to be wrong but the reasoning used to be correct. In this case the tutor informs the student about the mistake but admits that the reasoning that the student used was plausible. A third case is the guessed answer to be correct but the reasoning used to be incorrect. In this case the tutor informs the student that the answer was correct by chance. There are also cases where the reasoning used may be correct but the factual knowledge of relevant topics may be incorrect. For example, if the student was asked whether Italy produced coffee and answered "My guess is yes because Spain produces coffee and Spain is similar to Italy in agricultural products". In this example Spain is similar to Italy but it does not produce coffee.

The learning environments that result from this authoring tool are more open than tutoring systems which do not have any reasoning abilities about correct and incorrect knowledge. For example, Ohlsson (1993) suggests the analysis of epistemic activities (arguing, describing, explaining, predicting, etc.) to be more relevant for higher order learning of declarative knowledge than the study of goal-oriented action. In addition, Andriessen & Sandberg (1999) point out that the process of becoming an expert in a certain domain should no longer be solely viewed as the acquisition of a representation of correct knowledge; the knowledge to be acquired should flexibly manage open problems. In this sense the authoring tool provides support in the student's learning of factual knowledge and the reasoning that may manage this knowledge.

Conclusion

In this paper we described the work in progress of an ITS authoring tool that incorporates a domain-independent reasoning mechanism. The reasoning mechanism is based on HPR, which is a cognitive theory about how people make plausible guesses. In this way, the resulting ITSs may provide quite open learning environments for the students to practice their factual knowledge on a certain topic, factual knowledge on possibly relevant topics and the reasoning they use to deal with open problems by combining factual knowledge from relevant topics.

The authoring tool is in the process of being evaluated in the domain of geography and biology.

References

Andriessen, J. & Sandberg, J. (1999). Where is education heading and how about AI? *International Journal of Artificial Intelligence in Education*, 10, 130-150.

Boyle, T. (1997). *Design for Multimedia Learning*. Prentice Hall, 1997.

Collins, A., Michalski R. (1989). The Logic of Plausible Reasoning: A core Theory. *Cognitive Science*. 13, 1-49.

Murray, T. (1999). Authoring Intelligent Tutoring Systems: An analysis of the state of the art. *International Journal of Artificial Intelligence in Education*, 10, 98-129.

Ohlsson, S. (1993). Learning to do and learning to understand: A lesson and a challenge for cognitive modelling. In P. Reimann & H. Spada (eds.) *Learning in Humans and Machines*, Oxford: Pergamon Press, 37-62.

Virvou, M. (1998). RESCUER: Intelligent Help for Plausible User Errors. *Proceedings of ED-MEDIA 1998, World Conference on Educational Multimedia, Hypermedia and Telecommunications*, Freiburg, Germany, vol. 2, 1413-1420.

Virvou, M. & DuBoulay, B. (1999). Human Plausible Reasoning for Intelligent Help. *User Modeling and User Adapted Interaction*, 9, 321-375.

Virvou, M. & Kabassi, K. (2000). An Intelligent Learning Environment for Novice Users of a GUI. To appear in *Proceedings of ITS-2000, 5th International Conference on Intelligent Tutoring Systems*, Montreal, Canada.

Virvou, M. & Stavrianou, A. (1999). User Modelling in a GUI. *Proceedings of HCII 99, 8th International Conference on Human-Computer Interaction*, Munich, Germany, vol. 1, 262-265.

EDIT - A Distributed Web-based Learning Network for Distance Education

Lucian Voinea, Gabriel Dima, Ciprian Cudalbu, Marcel Profirescu
EDIL R&D Centre
University "Politehnica" of Bucharest
Romania
lvoinea@edil.pub.ro, gdima@edil.pub.ro, ccudalbu@edil.pub.ro, profires@edil.pub.ro

Ion Miu
IBM Global Services, Education&Training, Bucharest
Romania
miu_ion_jr@ro.ibm.com

Abstract: This paper reports on the results of the project "Open and Distance Learning Network in Information Technology and Microelectronics - EDIT" run by University "Politehnica" of Bucharest, Technical University of Cluj, Technical University "Gh. Asachi" of Iasi, University of Craiova, Romania and IBM Global Services, Education&Training, La Hulpe, Belgium. The paper focuses on the description of the main objectives, technical infrastructure, course materials, impact/target groups, type of learning environment and further developments. A distributed web-based learning environment has been developed within the EDIT project.

Objectives

The main objective of EDIT Project was to develop the first Romanian academic open and distance education network aimed at training the students and academics from the four partners universities. In the long run the network will extend to link the main technical universities in Romania, including researchers and experts from other institutions. The project is financial supported by the Romanian National Higher Education Funding Council for a period of three years.

The project's specific objectives are: 1) to setup and to develop the technical infrastructure; 2) to design and to implement some good examples of education/training course materials in the field of IT and Microelectronics; 3) to deliver the designed courses to our students/customers; 4) to find the best suited learning environments for a given topic/target group; 5) to support itself through contracts with different customers at the end of the three years period.

The Technical Infrastructure

Because of the unique distance learning environment of the Web and the availability in all Romanian universities the EDIT Project focuses on web-based learning environments.

The Design and Implementation of Course Materials

In 1998, EDIT Distance Learning Network starts to deliver his first course on Modeling and Simulation of Semiconductor Processes and Devices (MSSPD) for the MSc students from Department of Electronics and Telecommunications (Drondoe et al. 1998) using an in-house designed web-based learning environment: EDIT Learning Environment - ELE. Presently, we offer four courses for Department of

Electronics and Telecommunications: Electron, Devices and Circuits, MSSPD, Optimization Methodologies and Particle Simulation in Nanostructures (Drondoe et al. 1999).

Impact/Target Groups

The courses are open for undergraduate and graduate students, academics and researchers that can choose between different level of complexity depending on their previous knowledge and personal goals.

The Type of Learning Environment

Depending on the topic and/or target group the chosen learning environment used for implementation of the course material was either ELE and/or two well-known distance learning commercial products (i.e. LOTUS Learning Space and IBM Distance Learning Space/DLS).

The main features of ELE are (see Zolti et al. 1999): www dedicated arhitecture, distributed way of working both in design and exploitation, high degree of reusability, integrated communication system (e-mail and virtual classrooms), web-based publishing system, web-based voting system and secure web access to the database.

Sustainability

The sustainability of the project is envisaged through contracts with online continuing education courses on demand dedicated to enhancement of adults' knowledge/skills and/or to professional reorientation of the unemployed people. A special attention is also given to distance training of the work-force in the corporate sector.

Conclusions and Further Development

A distributed web-based learning network has been presented. At the basis of this implementation lies WWW dedicated architectures. This has allowed us to reach a high level of reusability and also cost-effectiveness. Currently, there is much work in progress to implement more courses within EDIT Distance Learning Network and to further develop the ELE by establishing some efficient authentication methods that would make awarding certificates more legitimate.

References

Drondoe A., Trasca C., Dima G., Radulescu E., Amza C., Mitrea O., Von Koschembahr C., & Profirescu M.D. (1998). Romanian Open and Distance Education Network. *EDEN'98,* 1998, Bologna-Italy, 198-202.

Drondoe A., Dima G., Profirescu M.D., Trofinenco C., & Amza C. (1999), Design Tools for Microelectronics Through Internet. *The 19th World Conference on Open Learning and Distance Education*, 1999, Vienna-Austria. CD-ROM.

Zolti C.I., Voinea S.L., Dima G., Profirescu M.D., Miu I., & Olteanu G. (1999), A Distributed Approach Towards Designing Intelligent Tutoring Systems for the World Wide Web. *1st International Conference on Enterprise Information Systems (ICEIS'99)*, 1999, Setubal-Portugal. 343-350.

Acknowledgements

The Romanian National Higher Education Funding Council is kindly acknowledged for the financial support of this work.

Design Processes Involved in the Creation of Computer Based Learning Environments: Preliminary Results

Steve Wakeham. M.Ed.*
e-mail: swakeh@po-box.mcgill.ca

Robert J. Bracewell, Ph.D.*
email: ed13@musica.mcgill.ca

* Educational & Counselling Psychology, McGill University

This short paper describes dissertation work in progress investigating the cognitive processes and social practices involved in the creation of computer based learning environments (CBLEs). Unfortunately, knowledge regarding the actual design process is very limited. Formal instructional design prescriptions (Dick & Carey 1985; Gagne Briggs & Wager 1988) and design principles based on cognitive psychology (Duffy & Cunningham 1996; Wasson, 1996) do exist but it is not clear how these prescriptions and design principles are used in 'real life'. Research into the cognitive processes involved in instructional design tasks is limited. Studies have examined such things as the extent and nature of alternative designs and stopping rules (Kerr, 1983), expert-novice differences in problem understanding and problem solution (Rowland, 1992) and, expert-novice differences in declarative and procedural knowledge and representations of design (Perez & Emery, 1995). There are very few studies of the design process involved in the creation of CBLEs. The lack of empirical work regarding the design processes and practices involved in the creation of CBLEs is surprising given the important contributions this type of knowledge could bring to future design activities. Studies of the process could indicate where typical difficulties exist and suggest strategies to overcome them. Additionally, it would be interesting to observe the effect of the application of one of design principles on the actual design process.

Theoretical Perspective

The theoretical perspective adopted in this study combines traditional human problem-solving (Newell & Simon, 1972) perspective with an activity theory (Engstrom, 1989) one. Problem-solving research focuses on the internal mental process involved in problem-solving and has been used to investigate instructional design problem-solving process but it has not been used rigorously to study designers of computer material. On the other hand, activity theory investigates how social systems influence human practice. Activity theory has not been used to study the design processes involved in the creation of computer based material but has been used to study other computer design activities. Research that combines human-problem solving and activity perspectives provides a theoretical perspective that recognizes the cognitive and social dimensions of design activities (Bracewell & Witte 1997; Cobb, 1994; Portes 1996).

Questions and Method

(1) What problem-solving processes are involved in developing computer-based learning environments (human-problem solving perspective)
(2) What social practices are involved in the creation of developing computer-based learning environments (activity theory perspective)

A case study of a design team at a local multimedia development firm was conducted over several weeks. Participants included one subject matter expert, an editors and a graphic artists. Data consists of participant observation field notes collected over several weeks, interviews and think-aloud protocols.

Results

Preliminary results indicate that the problem-solving activity of team members is goal directed and involves establishing numerous local plans and frequent evaluations. It is clear that a concurrent analysis that combines problem-solving and activity theory is a very promising approach. It provides data that allows researchers to analyse and interpret the relationship between internal mental processes and social context.

References

Bracewell, R., & Witte, S. (1997, April). The implications of activity, practice and semiotic theory for the cognitive constructs of writing. Paper presented at the American Educational Research Association, Chicago, IL.

Cobb, P. (1994) Where is the mind? Constructivist and socio-cultural perspectives on mathematical development. Educational researcher 23, 13-20.

Newell, A. & Simon H. (1972). Human Problem Solving. Prentice Hall: Englewood Cliffs, NJ.

Portes, P.R. (1996) Ethnicity and culture in educational psychology. In D. C. Berliner, & R. C. Calfee (Eds.), Handbook of educational psychology (pp. 331-357). NY: MacMillan

Rowland, G. (1992). What do instructional designers actual do. Performance and Improvement Quarterly. 5(6) 63-86

Rowland, G., Lesseur-Parra, M. & Basnet, K. (1994). Educating instructional designers: different methods for different outcomes. Educational Technology July-August 5-11

Wasson, B. Instructional planning and contemporary theories of learning: is this a self-contradiction. (1996) In P. Brna, A. Paiva & J. Self (Eds) European Conference in Artificial Intelligence in Education AIED: Lisbon, Portugal.

Acknowledgements

This project is supported by fellowship funding from (a) Quebec government's FCAR-MÉQ Action ConcertéeBourses d'étude en milieu pratique program, Innovitech Inc., & BGWMultimedia, (b) Social Sciences and Humanities Research Council and McGill's TeleLearning Project. Thanks to Professors Robert Bracewell and Susanne Lajoie for their advice and encouragement.

FM Radio Stations – Broadcasting with the Sun

David Walker
The Commonwealth of Learning
600-1285 West Broadway
Vancouver, British Columbia, Canada
dwalker@col.org

Abstract: This paper describes a case study on the use of community-based low powered FM radio that has been undertaken in Uganda as part of the work of the Commonwealth of Learning. It describes a media solution that employs low-powered FM radio as an effective method of delivering education and information to a rural community. It also describes the inhibitors to proliferation of community radio stations and reflects on the future directions for the use of radio as a delivery system for education.

Introduction

"All available instruments and channels of information, communications, and social action could be used to help convey essential knowledge and inform and educate people on social issues. In addition to the traditional means, libraries, television, radio and other media can be mobilized to realise their potential towards meeting basic education need of all". Final Report World Conference for All: Meeting Basic Learning Needs, Jomtien, Thailand, 1990.

Why Community Radio?

Community radio is an immensely powerful technology for the delivery of education with enormous potential reach globally. Creating opportunities for communities to utilise this delivery system will enable disadvantaged groups to engage in a development agenda, sensitive to their needs and aspirations. In order to serve the underprivileged and rural poor, mass media such as radio must create conditions and mechanisms that provide people with genuine access to useful information. Such mechanisms will offer ways in which people can express their sentiments, opinions, views, dreams and aspirations, their fears and insecurities, their strengths and capabilities, and, of course, their ideas for development.

High illiteracy rates and low levels of schooling among disadvantaged groups, especially women, in many developing countries continues to limit their ability to lift themselves out of poverty. The existing educational system has shown itself to be unable to respond to the massive demand for increased education. This is especially true in many poverty-stricken countries with respect to meeting the massive education needs of the rural poor. Consequently, disadvantaged groups continue to be denied access to information, knowledge, skills and technology transfer.

The answer is to deploy Distance Education techniques and delivery systems such as radio and television bascd at the community level to address directly local issues and needs.

In order to empower disadvantaged groups as equal partners in development, the limitations of formal and non-formal education are now being challenged. Urgent and new ways to achieve mass education, that can be both efficient and effective, are being sought. In this context, radio, an effective telecommunications medium, was proposed at the Jomtien, Thailand UNESCO Education of All conference in 1990 as one massive solution. Radio can cut across geographic and cultural boundaries. Given its availability, accessibility, cost-effectiveness and power, radio represents a practical and creative medium for facilitating mass education in a rural setting. However ten years on since Jomtien, radio still continues to be an underutilized technology in education. This is especially surprising because from a learner's point of view, radio is user friendly, accessible and a well-established medium. From an educational provider's point of view it is easy to set up, produce and broadcast programmes. After almost hundred years of broadcasting history most nations of the world have more than a respectable level of engineering skills and broadcasting talent to apply the technology in education. In the last ten years, radio has been greatly enhanced by the emergence of new technologies, which have opened up new opportunities for a variety of forms of delivery and access for both broadcaster and listener. For example, portable, low cost FM transmitting stations have been developed and digital radio systems that transmit via satellite and/or cellular are being implemented in many parts of the globe. Internet streaming audio software technology has emerged recently to allow a global audience to listen the news from a distant country. And windup and solar radios have been developed thus freeing radios from expensive power sources. COL is addressing the issue of education for all with creative media solutions that fall under the banner of an initiative called The Commonwealth of Learning Media Empowerment (COLME).

COLME – A Template for a Media Projects

COLME is building creative media models for delivery of information and training in the area of non-formal and formal education.

COLME strives to:

- Provide new skills in the use of technology for the disadvantaged
- Provide media models that will stress local participation and transfer of knowledge and skills
- Provide opportunities for disadvantaged groups to participate and benefit from new technology and media based initiatives
- Create a capacity for dialogue among government sectors, institutions and different interest groups
- Create a research base and body of knowledge that can be utilised by Commonwealth governments, organisation and communities as models for media and technology based initiatives.

Media projects in radio stations and projection, video and audio production, and computing solutions have all been part of the work of COLME in the past several years. The focus here is a portable FM radio station that has been used in several developing countries of the Commonwealth such as Uganda, Namibia and South Africa.

Overview of the Station

Radio is a very powerful technology that can allow large sectors of the population to be reached with information, quickly and economically. Due to national broadcast regulations in many countries, community radio stations have not developed. Also the cost of transmitters, infrastructures, and equipment, has placed most potential community broadcasters at a disadvantage, especially those in the remote rural areas. There is a distinct information gap to the rural corners of some countries resulting from the lack of service by national broadcasters who in some cases have weak or non-existent signal coverage. Under COLME, portable FM radio systems have been tested and implemented as part of media project work over the past three years. The station configuration that was first developed has, with input and data gathered from COLME initiatives in the field, have aided the manufacturer in altering the station to address the each community's need. The station configurations range in price from three for five thousand dollars US including all elements, antenna, transmitter, console, mixer, microphones and CD and tape decks (**Figure 1**). The stations can run from 12 V DC or 120/240 AC.

Figure 1 – Pictured is a station in its watertight carrying case (on the consul starting on the left top the gooseneck microphone, below is the mixer, top right are two tape decks, below are two CD decks). The transmitter and power supply, not pictured, are housed under the consul. The consul is removed from the carrying case when in operation (see Figure 4 for operational mode).

Keys Elements to Success

There are number technological factors that are important in the initial needs analysis before a station can be considered. First the physical landscape must be conducive to an FM signal to reach the intended target audience especially if rebroadcast of the origin station signal is not possible due to cost or licensing regulations. If the landscape is mountainous then there will be difficulty in the signal reaching a large radius of users. Secondly, the station target audience must have radios or access to radios. Thirdly, there must a situation where there is a steady flow of content and a regular broadcast schedule.

Fourthly, the station must be targeted to the local users so that they can directly relate to the content, language, and situations discussed.

In the feasibility stage before station implementation certain conditions must exist to improve the element of sustainability. In-country stakeholders are identified for each of the stations. Their role is to insure infrastructure is in place for FM radio and that all licensing and issues pertaining to community broadcasting are dealt with.

Another important factor is that the broadcasts are in languages that are used daily in the local community level. The national or regional stations do not have the capacity to aim linguistically or at the level of information detail for rural community issues. Community-based stations can be effective if well managed in providing information and training directly to the community. In the case of the COLME installed community station in Uganda, it was imperative that the station be able, by law, to rebroadcast Radio Uganda in the event of important political announcements. Therefore, among the technological upgrades in the design of the station, in addition to the interface for telephone calls, extra microphone inputs for group discussions, and a more powerful transmitter, a facility for radio rebroadcast of the national government station, (in Uganda, Radio Uganda) and international broadcasters (such as the BBC) was implemented.

The overriding factor to the success of these stations has been the proper community access and ownership, which was paramount in the initial project design. If the station is or becomes an integral part of the voice of the community and local interest groups have an equal say in the information that is disseminated via the station, then there is a lesser risk of failure in the long-term sustainability of the station. This can be achieved with good station management that works with community leaders and committees consisting of both political and community leaders.

The local stakeholders, with the aid of COLME, will provide on going evaluation of the stations via listener surveys and media expert evaluation. Workshops will be given in production and survey techniques that will aid broadcasters with improving programming to suit the needs of the community. Local broadcasters will be tapped to train in advanced broadcasting techniques and programme development that will improve community radio personnel.

A Solar Station on the Move – A COLME Case Study

Apac, Uganda is located in the northern region of Uganda. This COLME project was a cooperative effort with the Minister of State and Tourism, The Right Hon. Akaki, to work with community leaders to implement an FM radio station in the Apac region. The COLME feasibility study revealed several limitations with the electrical infrastructure, which was not reliable. This was a result of load sharing throughout the country (Apac would not receive power for several days). The power was also not usable for electronic equipment due to the dramatic power fluctuations. Therefore, it was decided that in order to maintain a reliable broadcasting schedule and develop the station as a center point to community activities by different groups, Radio Apac would be operated entirely by solar power. This would free the project from the constraints of electrical situation and the tariffs associated with it. A configuration was determined, in consultation with a solar distributor in Kampala, to allow the station to stay operational during the eighteen-hour broadcast day. Eight solar panels and seven deep cycle batteries were installed at the station, which now provide lighting and all the station power requirements for daily broadcasting (see **Figures 2 to 4**). The lifespan of solar installations is over a decade with low maintenance costs.

A committee was organized and a station manager appointed. This person works directly with the community to develop programming and allow the development of community involvement. The station has a rebroadcast facility incorporated for programmes from the national broadcaster as well as the BBC and WorldSpace. A further radius of listeners will be taken in Spring 2000 with a retransmission unit that will allow the signal to take in other populated areas. It is anticipated that the total potential listening audience will be over one million. A VHF/UHF radio system will also be implemented to act as a community telephone that will interface into the FM radio system. This will allow the broadcasters to out to the community and speak directly to groups live on air thus eliminating the issue of travel to the station by people such as farmers and medical officers. Links have been made to educational programmers in South Africa to supply educational programmes to the station. The station has been used by the government for health related issues and announcements. There is also an element of income generating by the station with the interest of local businesses in advertising their services.

Figure 2 - Receiving the solar panels at the station site

Figure 3 – Installing the panels

Figure 4 – Radio Apac, 92.9 FM on air, powered by the sun

Conclusion

Radio is an effective system for delivery of education to large numbers of people. It facilitates information exchange at the community level, acting as a "community telephone" and can be effective in literacy and formal/non formal education. Analogue systems for radio will be supplanted by digital broadcasting in the coming decade, however digital radio will pose issues including cost of radio receivers and renewal of broadcasting infrastructure. Analogue radio systems, such as the portable solution that COL and others have utilised in community FM radio initiatives, can be effective in delivering education to the masses without the high infrastructure costs associated with radio broadcasting. With community broadcasting not only can broadcasters focus on addressing local needs through their own produced programming, but also have the choice among a tremendous variety of quality educational content that is available via rebroadcast from national and international sources whether it is delivered via satellite or via thc Internet. Rebroadcasting also should be balanced with the needs of the local community and the provision of appropriate and relevant programming content.

There is a marriage between the digital and the FM analogue systems that is taking place. The convergence also includes Internet streamed audio based broadcasters that can effectively be employed by the community FM station in a rebroadcast mode. Will we be able to say in ten years that radio's potential for educational delivery to millions of disadvantaged groups has finally been realised? With the many varied formulas for convergence of digital and analogue technology and the vast selection of content and tools to create original culturally sensitive material for education at the community level, we state clearly - yes. But will the bodies that regulate frequencies for community radio initiatives reform regulations to reflect the current technological developments and pressing need for mass media to meet the goal for education for all in the next ten years? We can only hope. The past ten years and the failure of Jomtien is a heavy burden to bear. The next ten should see the harnessing of radio, analogue, and more so digital, as the powerhouse for delivery of education. Governments should be prepared to adjust broadcasting regulations to adhere to technological developments and realities, and also consider community based mass media delivery as an effective solution for improving a nation's human resource development towards the goal of education for all.

David Walker
Education Specialist (Educational Technology/Media)
The Commonwealth of Learning
1285 West Broadway, Suite 600
Vancouver, British Columbia
Canada, V6H 3X8

Tel: 604 775 8235 Fax: 604 775 8210 WWW: http://www.col.org http://www.col.org/colme
Email: dwalker@col.org

Training Faculty To Use Active and Collaborative Learning And Web-Based Courses In an Integrated Curriculum For The First Two Years Of An Engineering Program Of Study:

John R.Watret, Department of Computing and Mathematics
Watretj@cts.db.erau.edu

David Pedersen, Department of Educational Technology
Pedersd@cts.db.erau.edu

Charles J. Martin, Department of Computing and Mathematics
Martinc@cts.db.erau.edu

Embry-Riddle Aeronautical University
Daytona Beach, Florida 32114-3900

ABSTRACT The authors will describe the programs used in the preparation of faculty who are participating in an Web-based Integrated Curriculum in Engineering (ICE). The programs are a blend of efforts between faculty and the Educational Technology Team.

The ICE program is a comprehensive effort between engineering faculty, humanities faculty, physics and mathematics faculty. The ICE program includes specifically designed sections of the foundation courses required of all engineering students: the calculus sequence, the physics sequence, the humanities sequence, social science, and introductory engineering courses. What differentiates the ICE program from traditional engineering curricula is that all courses incorporate active and collaborative learning and a reliance on computer and web technology. In addition, the ICE program promotes team learning, team design projects, and a well-documented series of assessment practices.

Background of ICE:

The motivation behind this program includes:

- high attrition rates in calculus, physics, and chemistry;
- perceptions of the faculty that these students do not read and write well;
- a lack of comprehension of the building nature of the foundation courses and their relationship to the engineering curriculum;
- the lack of continuous use of common computer technology;
- failure of students to adjust to the university environment,
- and the isolation that many students feel in such programs of study.

The Integrated Curriculum for Engineers was introduced in 1997 to a volunteer group of 65 entering freshmen selected from a pool of 130 initial volunteers. In succeeding years, similar sized classes have volunteered to enter this program.

This paper describes the programs specifically designed by the Educational Technology Team and the programs put together to teach faculty how to use active and cooperative learning in the various courses which are included in ICE.

Description of ICE methodology

Computer and web technology are crucial to the implementation of the ICE program. Students in this program must have laptops for use in each course. Classrooms have been wired so students have access to the campus network and access to the Internet. Common software in use includes Maple, Microsoft Office, Bentley Microstation, and Internet access. All courses are web-based so that students have access to each course in the program, to reference materials, tutorials, reviews for exams, and to each faculty member and to their peers. Forums, emails, chat rooms and links to other sites are all available to every student. Students can plug their laptops into any campus port as well as their dorm room. The authors will discuss examples of daily classroom usage of a web-course and we will comment on the active and collaborative nature of the courses by showing how these are incorporated.

Another crucial component of the ICE program is the use of cooperative and collaborative learning in each course. Thus, in addition to restructuring the content, all courses have been redesigned for an active and collaborative learning environment. Each course assigns team exercises, daily or weekly, which are to be done both in and outside of the classroom. In any of these courses, it is common to ask a team to present their work to their peers at the end of a daily class. In addition, the mathematics faculty designs external team problems that are reported in class about a week later. For each such team problem it is required that the problem be written using a word processor and the report is graded for composition and exposition as well as the mathematics. Class presentations are oral and each team receives a grade based upon accuracy, style and clarity of exposition.

Students in the program are assigned to a team of four. A team is selected based on the class rank condition. A team stays together through all the courses during that semester. The engineering faculty devote the first week of the introductory engineering course to team building skills and continue to monitor the effectiveness of the teams throughout the semester. This engineering course also serves as a student success course based on the University 101 model and include topics such as time management, study skills as well as adjustment and orientation to the university.

Programs of the Educational Technology Team

Most of the faculty who teach at Embry-Riddle use word processing, spreadsheets, and email. A few of the ICE faculty had some acquaintance with use of the web, but none had ever put a course up on the web and many were apprehensive about trying A template was designed specifically for the web-based portion of the ICE program, and faculty members were provided with training on how to develop and post materials in the template.

Because the ICE faculty were technically proficient in specialized areas and working with a web template specific to their program, a customized training program was developed for them by the university Educational Technology Team. A description of the ICE web template and training program and ongoing support for the ICE faculty will be presented in this talk

Programs used to acquaint faculty with Active and Cooperative Learning.

When faculty think of teaching, they think of lecturing - the me- centered model of education. Active learning is participatory - an idea or theme is selected, the students think about it, promote their own understanding, and share it with the class. Collaborative learning is group based - in our case, team-based. It requires the team to work together in and out of class on assignments.

Assessment

Assessment of these training programs include informal and formal components. In this presentation, the authors will comment on each, including what worked and what did not. In addition, we will comment upon some of the measures used by faculty in the ICE program itself. These include attitudinal surveys about use of teams, use of active learning, use of computer technology, use of computer software, use of web-based courses, adjustments to the university, and a variety of other topics. Assessment of use of web-based materials is done by formal assessment at the end of the term. All aspects of assessment will be shared with the audience.

FutureBoard: Supporting Collaborative Learning with Design Activities

Yuhei YAMAUCHI1), Takeshi SUNAGA2), Yumiko NAGAI 2)
Toshiya TAKAHASHI 3), Syunji OGAWA 4) , Isao MATSUI5)

Ibaraki University 1) , Tama Art University 2), Recruit Co.,Ltd 3)
SoftDevice Co.,Ltd 4) , ViewTech Lab Co.,Ltd 5)

yamauchi@mito.ipc.ibaraki.ac.jp 1)

Abstract: The FutureBoard system has been developed to support the collaborative learning process, especially design activities in Project Based Learning.
Two kinds of board system have been created: one is a Personal Board for supporting the personal reflective thinking process based on a wireless note PC, and the other is a Collaboration Board for supporting collaborative learning and the creative process based on a 50 inch monitor with pen input support.

Project Based Learning and Design Activities

In Japan, the national curriculum standards will be changed in 2002, and Project-based learning known as "The period of integrated study" will be introduced to elementary and secondary schools. During the process of project-based learning, design activities such as making books and posters are critical because they give students the chance to reflect on their ideas. Computers have been used for the design activities in project-based learning, however they are limited to student's individual expression when using graphic software and DTP software.
We believe computers can render the process more dynamic when designing activities such as in collaborative design for the social construction of ideas, by many professional designers do.

Design Process of Professional Designers

We have analyzed the design process of professional interface designers (a university professor and two professional designers in a private corporation) in order to clarify points to support the collaborative design process.

1. Using Tracing Paper
All used tracing paper in the collaborative design process. One designer drew an idea on paper, while the other put tracing paper on it, revised and added new ideas to previous ideas.
2. Fast and Interactive Process
This process was fast-paced and interactive. They sketched ideas in a few seconds and talked like a "This is better," pointing the revised idea.
3. Using Personal Spaces
Sometimes, Personal spaces were used such as on a small memo or a corner of the tracing paper to dot down their ideas.

Outline of the FutureBoard System

Following this analysis, we made design policies for the new system that supports the collaborative design process. We named it "FutureBoard".

1. Tracing Paper Function
FutureBoard contains 8 layers of tracing paper wherein the level of transparency can be modified. The lowest layer is called the "Master Layer", a special layer for guiding design activities such as Maps, Axes, Tables, etc.

2. Pen Input and Drawing Tool
A user can employ the pen input (or his/her finger) similar to ordinary paper resulting in the interaction being much quicker. Moreover, the software becomes not just a paint tool but a drawing tool, so that each object drawn can be moved or deleted.
3. Personal Board and Collaboration Board
Two kinds of board system have been developed: one is a Personal Board for supporting the personal reflective thinking process based on a wireless note PC, and the other is a Collaboration Board for supporting collaborative learning and the creative process based on a 50 inch monitor with pen input support.

Personal Board and Collaboration Board

The hardware of the Collaboration Board system (CB) consists of a PC and a 50 inch projection monitor with pen input support and a wireless LAN station.
The software of CB is a simple drawing programme with 7 half transparent layers. The user can control the visible/invisible aspects of the specific layers as well as control the 5 levels of transparency. All operations are assigned to the icons, thereby eliminating the menu bar.
The hardware of the Personal Board (PB) system consists of a pen-based PC and a wireless LAN card.
The software of PB is a subset of the Collaboration Board that has two layers and is optimized for SVGA screen. (The CB is of XGA size)
Initially, students will use the PB, and then send the work to the CB's layer. With the CB, they can lay ideas on the other half of the transparent layers. And CB's data can be downloaded to a PB using the wireless LAN system.

FIGURE 1: Jr.HS students using Personal Board and Collaboration Board

Evaluation

The FutureBoard system was evaluated from November to December of 1999 at Utase Junior High School in Chiba Prefecture, JAPAN. The system was used in project-based learning about "Makuhari Bay Town" where the students live. To meet the goals of the curriculum, Small groups were formed. The students explored and researched many aspects of their town, such as the traffic system and road safety, the soundscape of the town. They reported the result of their research on the Personal Board and transferred the data to the Collaboration Board. Using Collaboration board, They discovered new ideas from the overlapped information and made final presentations to an audience composed of classmates, teachers, municipal officials and parents.
We are now evaluating how these tools supported the collaborative process by protocol analysis and interviewing. The main points of the evaluation center around how 8 half-transparent layers and drawing tools work as a cognitive resource in collaborative process.

Acknowledgements

This research is generously supported by an IPA (IT Promotion Agency, JAPAN) Grant.□We deeply appreciate the cooperation of the students and teachers at Utase Junior High School in furthering our research.

Merging Physical Manipulatives and Digital Interface in Educational Software

Anna Zacchi, Nancy Amato
Dept. of Computer Science
Texas A&M University
USA
{zacchia, amato}@cs.tamu.edu

Abstract: In this paper we describe how elementary school students used physical manipulatives in conjunction with the digital interface of educational software for geometry. The blending of physical manipulatives and digital interface may help them to overcome the limits of the representation and interaction modalities of the digital interface.

Introduction

Our study used SuperTangrams (Sedighian & Westrom 1997), a program developed by the EGEMS group at the University of British Columbia. We introduced manipulatives that students could use while playing with the software. The idea was to use manipulatives in conjunction with the software in order to overcome the representational problems of the interface. Manipulatives allow the students to experience what they are doing on the screen in the real world.

SuperTangrams. SuperTangrams is a computer-based learning environment for two-dimensional transformational geometry. Learning of this mathematical domain is situated in the context of the traditional tangram puzzles game activity. The player is challenged to put together several geometric shapes to fill a given outline. To move the shapes on the screen the student selects and applies to them one of three transformations: translation, rotation, and reflection.

Subjects and Settings. The study involved approximately 180 fifth grade students at a College Station, Texas, elementary school. The task of each student was to play with SuperTangrams to solve the tangram puzzles. The student was free to use the tools that we placed on the side of his computer. Data collection techniques included class observations, video-recordings, scratch paper used, pre-tests and post-tests, questionnaires and log files of computer sessions.

Use of Physical Manipulatives

First set of manipulatives

During a first study session (two weeks), we provided the students with the following manipulatives:
1) a set of tangram plastic shapes, 2) a reflection mirror, 3) a colored grid board with a rotating stick.
The board had two different drawings on it: a line for reflection and a circle divided in 16 sectors of equal size. This is consistent with the software that allows the minimal angle to be $1/16^{th}$ of a circle. A stick is connected to a hub at the center of the circle and can rotate 360°. The idea was that the students would place a shape on the circle and then rotate it by pushing against it with the stick. We intended for them to use the reflection mirror with the line drawn on the grid board to find the reflection line.

Rotation. One common use of the shapes was to put them on the screen and animate them. A video recording shows a girl using them for rotation. She started superimposing one plastic shape on the digital shape on the screen, and then she moved the shape along the arc of rotation trying to move and rotate it at the same time. In this operation she paid attention to the position of the shape on the screen, but not to the orientation, or angle of rotation. The students who used the grid positioned the plastic shape on the circular drawing, trying to position the shape in the same orientation as the one on the screen. Then they would push the shape with the stick until the shape could reach the orientation of the target. They would count the number of sectors the stick moved and move the digital handle accordingly. Some students felt comfortable with the board, while some others preferred to bring the shapes directly to the screen.

Reflection. Students did not use the mirror on the grid board with the plastic shapes as we had expected. Instead, they placed the mirror directly on the screen and looked for the reflected image of the digital shape. The first operation involved was to position the mirror until they could see the reflected image superimposed on the target. Once the position was found, they had to play with the digital handles to position the reflection line along the position found for the mirror.

New Manipulatives

The use the students made of the manipulatives surprised us, since they preferred to use them on the screen, merging the physical operations with the digital ones. Thus, for the second session, with a second group of students, we modified the manipulatives to make it easier for the students to use them on the screen. We eliminated the grid board and built a rotation tool consisting of two popsicle sticks joined together at one end in such a way that they could rotate, and placed some sticky paste on the other ends. The popsicle stick had more success than the grid. The students would stick the chosen shape at the end of one stick, and position the two overlying sticks directly on the digital radius of rotation, with the plastic shape matching the digital shape. Then they would rotate the stick holding the shape and keep the empty stick in the initial position. When the plastic shape reached the target, the opening of the two popsicle sticks represented the sought after angle. In this case they could hold the right "angle" in their hand. Finally, they would recreate the digital angle playing with handles, holding the physical one as a model.

Student reactions

The second set of tools had more success than the first. It was more natural for the children to bring the tools to the screen, and they could physically experiment with the transformations. In the questionnaires we asked children if it was good to have manipulatives, and if they helped them learn. Here are some of the answers:

> *"They helped because they were 3D;" "they helped you to learn the movement;" "all tools because they helped you think ahead;" "you need some reference to look at;" "because it is important to have stuff you can work with in your hand;" "it helps understand."*

Conclusions And Future Work

Software running on a computer is something abstract: when the student drags a handle with the mouse something happens on the screen. In educational software for geometry it is important that the student learns to relate what happens on the screen to the real word. Our preliminary findings indicate that physical manipulatives can be a valuable addition to educational software. We noticed how the use of manipulatives helped students overcome limits of the representation and of the types of interaction allowed by the interface. For example, additional information on the screen whose purpose was to help the students, such as additional lines, actually confused them, causing them to miss important concepts. Using a physical representation of those concepts, such as an angle between two popsicle sticks joined together, helped them to focus on the main aspects of the transformation without being lost in representation details. During our study we collected log files and data relative to pre-test and post-test. The statistical analysis of this data will determine the effect on learning of the different tools.

References

Sedighian K. & Westrom M. (1997). Direct Object Manipulation vs. Direct Concept Manipulation: Effect of Interface Style on Reflection and Domain Learning. *HCI'97 Conference on People and Computers XII, Bristol, UK*. 337-357.

Acknowledgements

We thank M. Klave and EGEMS for their support, and C. Melick and L. Stewart for their help with the experiment.

CORPORATE DEMO PAPERS

Public broadcasting archives and documents used for educational purposes

Pierre C. Bélanger
Société Radio-Canada
1400, boul. René-Lévesque Est, 8e étage
Montréal (Québec), H2L 2M2
pierre_c_belanger@radio-canada.ca

Carole Poirier
Société Radio-Canada
1400, boul. René-Lévesque Est, 8e étage
Montréal (Québec), H2L 2M2
carole_poirier@radio-canada.ca

Contemporary education needs to be connected to the very world it purports to study. In this context, media archives and documents are value-added material that can support both traditional pedagogical practices and media literacy related activities. Public broadcasting archives and related documents can play an edifying role in offering various sources through which to grasp a host of current and historical issues. Recognizing the educational value of its media assets, Radio-Canada is working with schools, colleges, and universities in exploring a variety of pedagogical scenarios in which media content can complement traditional study material. This presentation will illustrate how Canada's public broadcaster can, by means of forging partnerships with various organizations (multimedia, cultural, or educational), and repurposing of media archives, play an active role in the development of educational Web content as part of a constructionist approach to learning.

Learning Code

Suzanne Rhodes, Human Code, USA

Who We Are

The Learning CodeTM development team extends beyond the walls of our studios to include the clients we work with and the learners we work for as well as a passionate and compassionate team of education specialists which includes the following professionals:

- Educators
- Interaction Specialists
- Producers
- Artists
- Technologists

What We Do

At Human Code, our mission is to humanize technology to fundamentally transform the way people learn, work and play. Human Code's Learning Technology Group meets this challenge by designing spectacular learning environments.

Our approach affords the Learning Technology Group with the discipline to manage the complexity of tasks that characterize each design stage, as well as the flexibility to provide appropriate consideration to the six interrelated components that define each of our spectacular learning environments. These components include:

- Setting
- Community
- Content
- Pedagogy
- Tools and Technologies
- Assessment

How We Do It

Derived from years of best practices and research in the field of learning technologies, our Learning CodeTM approach to educational environment design is an iterative process that motivates our team of specialists through the following comprehensive design stages:

- Envision
- Design
- Produce
- Implement
- Integrated, On-going Reflection

Who Benefits?

Targeted learners

Learning Code TM engages the learner in an experience that is personal, relevant and meaningful. Our environments engender a love of learning, content mastery, higher-order thinking, and inspire life-long learning.

Clients and Educational Partners

Learning Code's collaborative nature transforms clients into development associates. Skillfully managed projects, delivered on-time and on-budget meet the needs, goals, and expectations of our client partners.

Human Code

Each project affords our company teams with heightened knowledge, skills, and abilities that inform future designs and techniques. The result is continually evolving processes, products, and services.

About Human Code

Human Code is a leading developer of interactive experiences for e-commerce, games, learning systems and marketing communications. The company's approach combines creativity, consulting and technology to create user-centered solutions that change the way people learn, work and play. Human Code's creativity and client-service focus are maintained through the company's Studio Network, which includes Austin Studios, Presage Studios in San Rafael, CA, Human Code Japan in Tokyo, and Human Code Shanghai. The company was founded by industrial designers in Austin, Texas in 1993, and received venture investments from Austin Ventures and Applied Technology in 1995 and 1999. Additional information on Human Code can be found at www.humancode.com.

Human Code's Learning Technologies Group is emerging as a market leader in creating spectacular learning environments. From a statewide initiative in Idaho to programs that provide entry-level technology workers with training in hard and soft skills, Human Code is becoming known as a true total solutions provider for educational technologies.

Teaching and learning in a virtual campus: The model of the Universitat Oberta de Catalunya

Albert Sangrà
e-Education Laboratory
Universitat Oberta de Catalunya
asangra@campus.uoc.es

Lourdes Guardia
Head of Instructional Design Unit
Universitat Oberta de Catalunya
lguardia@campus.uoc.es

By combining the latest technologies with both a solid pedagogical foundation and continuous evaluation, the Universitat Oberta de Catalunya has built a Virtual Campus: an electronic communications environment that provides the means to effectively support the tutoring of students, and the provision of university resources and social activities.

It has presently a total of 13.000 registered students. Eight main degree programs are offered, as well as Master programs, postgraduate courses and a wide offer of continuous education programs.

The organization is also working on the *Metacampus*, which mission is to demonstrate the global, virtual co-operation of universities; a concept known as the flexible university which is achieved by interconnecting the partners virtual services and infrastructures.

It will be able to capture, register, invoice, teach, assess and accredit courses and provide all the administrative services in a global scale, using the Internet as the only medium to support all these educational processes.

Deploying Web-Based Assessments

Eric Shepherd

Learn the principles of creating and administering Web-based tests and assessments using Question Mark™ Perception™ software. Find out how to use Perception's authoring wizard to create questions in a variety of formats: multiple choice, multiple response, hot spot, text, numeric, selection, and matrix questions as well as explanation screens that can include text, graphics, and multimedia. Participants will also learn how to create multiple question banks from which to assemble tests, surveys, and questionnaires. Other topics include how to set up interactive feedback, create adaptive tests, analyze test results, and create reports. . Example questions will be presented from various applications including competency testing, employee recruitment, customer satisfaction questionnaires, study aids, diagnostic tests, skills assessments, product knowledge exams, course evaluations, and certifications. The presentation will cover such issues as test security, linking with learning management systems, and the use of Perception Secure Browser for high-stakes tests.

CORPORATE SHOWCASE PAPERS

The LearningStation.com

The LearningStation.com is dedicated to providing a realistic and cost-effective way to manage technology and make it available to the teachers, students, and administrators who will transform the educational process to meet the expectations of the information economy.

The LearningStation.com is the leading and largest Application Service Provider (ASP) and portal in the educational market, providing online access to educational content, tools, and applications, on a subscription basis. With The LearningStation.com, a managed and maintained library of applications is made available to PCs, Macintosh systems, and thin-client devices across the school's network and over the Internet. The LearningStation.com Chief of Innovation and Co-Founder Jim Pennington states, *"Schools are extremely excited to hear that they can get out of the software management business, and focus on using software rather than delivering it," says Pennington, "and the fact that they can make good use of their installed base of cross-platform computers has a significant impact on their ability to make technology accessible to more students and teachers."*

The Education Market Opportunity

Technology is now accepted as an integral part of education in Canada. As awareness of the importance of preparing students for the information age grows, school boards are turning an increasing amount of attention to this process. Educational spending now accounts for 8% of Canada's budget, and technology is fast becoming a priority, including significant investment in hardware, software, and cabling. In the 1997 - 1998 school year, $230 million was invested in bringing computer technology into Canadian classrooms.

Despite a high level of spending, most schools are equipped with a collection of computers ranging from Apple II to x386 to Pentium-based computers. This presents an implementation nightmare. It is currently impossible for schools to incorporate new software applications into their curriculum without consistently upgrading their hardware, a situation which is neither desirable nor cost-efficient. Regular overhauls of computer equipment is financially impossible for schools with limited budgets. This issue is probably the single largest barrier to institutional technology integration.

The Learningstation.com presents a solution to this problem. It has the potential to completely reorganize instructional computing as we know it. It would allow schools to run brand new applications, as well as provide web access and e-mail, while removing the financial burden of having to constantly upgrade hardware. It would also allow schools to use equipment donated through programs such as the Computers for Schools Program, which provides schools with recycled business and government computers.

What is thin-client computing?

Citrix Systems, the world leader in server-based computing, reports over 2,000,000 ports in place supporting over 10,000,000 users today. The idea behind the thin client is simple: concentrate computing power, storage, applications, and data on "servers" (powerful computers) and provide users with a simple "client" computer that is easy to install and maintenance-free. Users connect to The LearningStation.com servers over the Internet to process applications, access files, print, and perform all other services available to ordinary computers. Since the applications and data are kept on a server, only keystrokes, mouse clicks and screen updates travel the network, so just a fraction of the normal bandwidth is required to run applications. Thin-client delivery has the flexibility to support any device—from full-featured computers like PCs, Macintosh systems, and UNIX workstations, to Windows-based terminals and hand-held information appliances.

How do schools benefit from using an Application Service Provider (ASP)?

- **Reliability and Ease of Use**

ASPs allows teachers and students to spend more time working on technology projects such as accessing information on the Internet and using educational software—rather than spending class time fixing and upgrading PCs or adjusting software programs to suit each individual workstation. Users simply log on and access their applications and data.

- **Simplified, Centralized Management**

The LearningStation.com's servers are managed by skilled network administrators, removing this responsibility from educators. Updates and additions are made only once at the server and are immediately available to all users.

- **Lower Cost of Technology**

Zona Research, a technology research firm, estimates that organizations will save 54-57% of their systems administration costs over a period of 5 years with a thin-client computing approach. Using the services of an ASP further reduces costs by eliminating software upgrades and inefficient purchasing volumes.

- **Security**

Vital data and applications may be kept on The LearningStation.com servers creating a higher level of security. Sensitive applications and data are made available to authorized users only via password protection. Data is effectively secured and backed-up in one central location either on a local customer server or at The LearningStation.com.

- **Universal Access**

Since applications and data are stored on the server, access is available to students and faculty from any machine at any location and at any time via an Internet connection and the desktop appearance is always consistent.

Strategic Alliances

The LearningStation.com has created a network of strategic partners supporting thin-client delivery of applications to the education market. The LearningStation.com is continually looking for new strategic partners to enhance it's offering to education customers.

Software Publishers and Online Content—The LearningStation.com has strategic agreements to offer products from:

- Microsoft
- The Learning Company
- Sunburst Communications
- Saratoga Group
- Infonautics
- Schepp-Turner Productions
- CBT Training
- Lotus
- Learning Outfitters
- Steck Vaughn
- MediaSeek
- Webivore
- Fog Cutter
- SkillsBank
- And many others

Technology Partners—The LearningStation.com has strategic agreements with:

- Citrix
- Sun Microsystems
- Empower Corporation
- MCNC
- Wyse Technology
- Computer Network Power
- Boundless Technologies
- Boca Research
- OZ New Media

Server Access Accounts

The LearningStation.com customers use Server Access Accounts (SAA) that allow access to the LearningStation.com server farm via the Internet. Users have access to a basic package of applications and services that include:

- Reference.Center, a customized version of Infonautic's Electronic Library
- Adventure Online, real world-based core learning materials
- Star Office Suite, an online suite of productivity tools
- Facilitator, conferencing tools for collaborative learning
- Internet filtering and virus protection utilities

Additional products and services can be added as desired including:

- Microsoft Office or Works
- SkillsBank or Cornerstone basic skills software
- Classroom Planner, a comprehensive teacher productivity tool
- Webivore, a directory of educationally reviewed web content
- Explorasource, a curriculum correlation tool for teachers.
- Many, many more

Schools require a Local Area Network (LAN) to provide users access to The LearningStation.com. A T-1 line, or a fast broadband connection like high speed cable modems, is recommended for school site access, while an individual account can gain access over a modem. SAA's are for concurrent usage, so schools only need to purchase as many accounts as they will use at one time. Access is 24 hours a day, seven days a week, allowing teachers, students and parents to gain access from home and after hours as well.

Total Cost of Ownership

Typically, educational technology purchase decisions are made on the basis of acquisition cost and compatibility. As technology usage becomes more pervasive, educators will need to pay more attention to the Total Cost of Ownership (TCO) which includes support and maintenance costs, reliability, and lifecycle replacement costs. And in these areas, thin clients continue to out perform new PCs in cost effectiveness by a wide margin.

Zona Research, a technology research firm, estimates that organizations will save 54-57% of their systems administration costs over a period of 5 years with a thin-client computing approach. And this cost savings is in addition to the lower cost thin-client devices and ability to leverage your current computing infrastructure—hardware, applications, networks and training—to extend the reach of your thin-client network.

A study by the Gartner Group released in June 1999 estimated that thin-client applications require 80 percent less management than traditional PC deployment (Computer Reseller News Online, 6/1/99).

Here are some details of the Gartner Group Study for annual PC cost of ownership:

- Actual cost of the PC Three-year depreciation $677
- Non-Labor Expenses Software, network connectivity, etc. $1677
- Technical Support Service, Maintenance, Help desk $1089
- Network Capital Cabling, Servers, etc. $585
- Network Support Management, virus control, etc. $544
- End User Admin Backups, upgrades, productivity loss $981 from downtime, etc.

Total Cost of Ownership $6507

Thin-Client Computing Cost Savings

While schools typically cannot provide the type of support that is described above, the information serves to illustrate the cost savings that thin client computing provides. In fact, the lack of resources available to support PCs makes an even stronger case for thin-client devices in education. The cost savings of thin-client computing in education are just starting to be quantified:

- Thin client devices can have an effective life of 5 - 10 years
- Your current PC's can be easily utilized as Thin client devices
- Software is a fixed annual expense without hidden version upgrade expenses
- Network support can be provided centrally on servers instead of desktops
- End users have a common, easy-to-learn desktop environment
- Downtime loss from viruses, hardware failures and vandalism are all but eliminated
- Universal access enhances productivity and leverages the technology to more users

SPECIAL INTEREST GROUPS

Campus Notebook Computer Programmes

Craig Blurton, University of Hong Kong, China

Notebook computer programmes are proliferating as many universities move from "corporate" ownership of computing resources to individual ownership. Benefits of such programmes have been widely touted by universities and commercial notebook computer vendors including enhancement of universities marketing position, decreased IT expenses because of cost-sharing between institutions and students, extended learning opportunities, and enhanced IT skills.

But how each individual programme is implemented is highly contextualized on local goals, needs, and circumstances. This special interest group meeting will give representatives from tertiary institutions an opportunity to interact, share success stories, identify common concerns, and perhaps develop collaborative efforts around the issues of "assured access" and "mobile computing."

Issues that may be discussed include:

* Planning and implementing such programmes.
* Multiple or single vendor solutions
* Cost-effectiveness
* Bridging the gap between academia and business
* Managing vendor relationships
* Equity of implementation
* Staff support and development
* Barriers to success
* Programme evaluation

Providing Quality Distance Education in an Outcomes-Oriented Program

Dr. Ginny Engman
Fort Lewis College
52 Hesperus Hall
Durango, Colorado 81301..
engman_v@FORTLEWIS.EDU

Abstract: Providing on-line programs for pre-service teachers has presented many issues. Assessing the effectiveness of one's teaching in the classroom is difficult under the best of circumstances; doing so through distance education is even more challenging. The program at Fort Lewis College has addressed these issues and, while resolving many of them, has developed some concerns that require further study.

Quality Distance Education in an Outcomes-Oriented Program

The development of an on-line program in elementary and early childhood licensure has raised many issues. It has also caused some dissension among the faculty. The program consists of all courses in the traditional program being offered through Top Class and Web CT. Currently two faculty (of the 10 full-time faculty) have been responsible for the majority of the program delivery. There has been an increase in the number of students who have opted for this avenue since its inception three years ago. Students are admitted to the program in the same way that students are admitted to the on-campus program: minimum gpa of 2.5, proof of having worked with children, pass a state basic skills test, pass and oral exam, and adequate ACT/SAT score.

Causes For Concern

There are three major causes for concern. First, after an initial orientation meeting on campus, the faculty have little or no face-to-face contact with the students. They must rely on the written evaluations and comments of the public school teachers with whom the students are placed. Historically, these assessments have been somewhat skewed toward the positive. In fact, the teachers are willing to be more objective if they do not have to put their observation in writing. However, for legal purposes we need to keep a "paper trail". The problem arises when we face a disconnect between what the teachers are writing and the actual effectiveness of the student (teacher candidate). It comes to a head at the student teaching experience—after the student has finished all course work and pre-student teaching practica. The dilemma we face is that the students are out of our service are (hence, the term distance education) so that it is not possible for our faculty to observe and evaluate them on-site. when predicted teacher How do we balance this with our commitment to preparing qualified, caring and competent teachers?

Second, besides the teacher education courses, there is a need for courses outside the department to be delivered on-line. There are auxiliary courses in Exercise Science, Art and Music that our students need as part of their licensure program. Additionally, if the are seeking a degree in Arts and Sciences, they will need to take classes in they major. There has been much resistance on the part of faculty to develop an electronic delivery of their courses. How can we break through the barrier that keeps faculty from taking a risk in the area of distance education?

Third, and lastly, until recently, the upper level administration has been reluctant (not necessarily resistant) to invest significantly in distance education. There is a skepticism about the ability to have high quality and require high standards in an electronically delivered program. How can we educate decision-makers so that we can get their buy-in for distance education?

How to Prepare Teachers for Integrating Multimedia and Technology into K-12 Classrooms

Barbara G. Foster, Ed.D. – Spalding University: Louisville, KY USA bfoster@spalding.edu

Abstract: To meet the needs of diverse learners, teachers must be able to integrate multimedia and technology into K-12 classrooms. Participants will walk away from this session with practical assignments and constructivist activities to enhance professional productivity and support instruction, successful assessment strategies that promote positive attitudes for facilitating the lifelong learning of various technologies by teachers and students, and samples of student work. Topics will include: knowledge of basic multimedia terminology, applications, and technologies; development of basic skills in operating multimedia hardware to support instruction and learning; development of basic skills in using and integrating the Internet and multimedia applications into the curriculum to meet the needs of learners at different age levels and in different subject areas; experience in making presentations using multimedia technologies; experience in designing and planning instruction that integrates multimedia technologies into the curriculum; and awareness of the copyright laws as they relate to educational technology.

Educational Technology and Context: an exploration of values, roles, and concerns from Lecturers, tutors and instructors.

Alison Hudson
Learning and Teaching Institute,
Sheffield Hallam University
Adsetts Centre, Howard Street
Sheffield, UK, S1 1WB
a.r.hudson@shu.ac.uk

John Steel
Learning and Teaching Institute
Sheffield Hallam University
Adsetts Centre, Howard Stree
Sheffield,UK, S1 1WB
j.a.steel@shu.ac.uk

Introduction

Educational and instructional technologies are increasingly becoming part of learning and teaching in higher education institutions. There is no doubt therefore that the adoption of such technologies in this context impacts upon many areas of university life. It could be argued however, that in addition to significant benefits to the institution and its students, the increasing use of educational technologies raise a number problematic issues and areas of uncertainty.

This special interest discussion therefore seeks to get to grips with a number of key issues around the role of educational technology in the learning and teaching equation from the perspective of the lecturer/tutor/instructor. It is considered therefore that by generating discussion around a number of important areas of interest to educational practitioners, some improved awareness of obstacles as well as examples of best practice can be made. From this starting point, greater understanding and progression may be encouraged or developed.

Applications and categorization of software-based scaffolding

Koos Winnips, University of Twente, Netherlands; Catherine McLoughlin, University of New England, Australia

The increasing popularity of computer-based learning environments, combined with a need for time-flexible and self-reliant learning, has caused an increase in the demand for scaffolding embedded in instructional software environments (see for example Acovelli & Gamble, 1997; Guzdial & Kehoe, 1998; Tabak & Reiser, 1997; Rada & Yazdani, 1998). The aim of software-based scaffolding is to provide some of the same kinds of support a teacher could provide in a classroom setting, but now in a computer-based learning environment. In this setting it is assumed that face-to-face contact between student and teacher is reduced or impossible. Software scaffolding can be defined by the following three characteristics (Guzdial, 1995, Zhao, 1997, Winnips, 1998):

- Modeling: the desired behavior is modeled by providing a kind of structure, communicating what is desired, or presentation of an expert model.
- Support is given to the learner so that the learner can perform a task independently.
- Fading takes place so that students become self-reliant.

While many applications and examples of software scaffolding are now known, a categorization of these examples has not emerged yet. Applications of scaffolding can be categorized according to who regulates the scaffolding (teacher, peer-student, computer, self), technology used, pedagogy used, or according to its intended learning outcome. An example of a categorization, based on types of support given is found below:

- Providing examples: ideally these examples should not only focus on products, but also on a process. Providing examples links to the concept of modeling as Bandura (1965) described it, where a teacher would serve as a role model.
- Helping students, by giving away (physical) parts of the solution. This can serve to help students with a solution, or the help may just serve to support students on very time-consuming tasks that are not absolutely necessary for learning (Acovelli & Gamble, 1997).
- Providing a model for design, or a structure to design in. For example providing design guidelines (Collis & Winnips, 1998).
- Cueing/hinting: helping students with a solution by providing a hint or cue to a possible path of the solution (Acovelli & Gamble, 1997).
- Coaching comments (Jonassen, 1998). These comments are intended for motivation, providing feedback and advice on performance, and provoking reflection.
- Asking questions, pointing out weaknesses, asking for a motivation, in order to enhance reflection.
- Metacognitive support: stating why the above types of support are given, in order to model the type of metacognition that experts would use.
- Providing a timeline, with fixed dates and goals built in. This structure could be present, to help students appearring to be very goal directed to build in multiple evaluation moments into the actual experience of studying.

Aim of this SIG discussion is to reach consensus about a number of categories for scaffolding and to construct guidelines about the relationship of learning outcomes to particular forms of scaffolding. This in order to provide structure for future research and to be able to better link previous experiences in software scaffolding to future experiments.

References

Acovelli, M., & Gamble, M. (1997). A coaching agent for learners using multimedia simulations. *Educational Technology, 37*(2), 44-48.

Bandura, A. (1965). Influence of model's reinforcement contingencies on the acquisition of imitative responses. *Journal of Personality and Social Psychology, 1*, 589-95.

Collis, B., & Winnips, J. C. (1998, June). *Design guidelines for teaching about design guidelines for educational WWW sites.* Paper presented at EDMEDIA/ED-TELECOM 1998. Freiburg, Germany.

Guzdial, M. (1995, April). *Role of artifacts in programming and physics learning with Emile.* Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco). [WWW document] URL http://www.cc.gatech.edu/gvu/edtech/AERAartifacts.html

Guzdial, M. and C. Kehoe (1998). Apprenticeship-based learning environments: A principled approach to providing software-realized scaffolding through hypermedia. *Journal of Educational Multimedia and Hypermedia, 9* (3/4), 289-336.

Jonassen, D. H. (1998). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), Instructional theories and models (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.

Rada, R., & Yazdani, M. (1998). Artificial intelligence and education [Special issue]. *Interactive Learning Environments, 6*(1/2).

Tabak, I., & Reiser, B. (1997). *Complementary roles of software-based scaffolding and teacher-student interactions in inquiry learning.* Paper presented at the conference: CSCL '97: Computer Support for Collaborative Learning, Toronto.

Winnips, J. C. (1998). *Scaffolding the Development of Skills in the Design Process for Educational Media through Hyperlinked Units of Learning Material (ULMs).* Internal document, Universiteit Twente, Faculty of Educational Science and Technology, University of Twente, Enschede. [WWW document] URL http://scaffolding.edte.utwente.nl/

Zhao, R. (1997, April). *Implementing scaffolding in computer tutors.* Paper presented at the Annual Meeting of the American Educational Research Association (April, 1997) Chicago, IL. [WWW document] URL http://lpsl1.coe.uga.edu:80/zhaopage/interest.html

TUTORIAL PAPERS

EDMEDIA2000 TUTORIAL

PLANNING ONLINE COURSES and LEARNING RESOURCES

Andrew Litchfield
Lecturer in Learning and Teaching
Centre for Professional Development
Macquarie University
SYDNEY NSW 2109

Tel: +61 2 9850 9780
Email: andrew.litchfield@mq.edu.au

Session Number: 5553
Maximum Participants: 20
Duration: 3 hours

WORKSHOP OBJECTIVES

By the completion of the workshop participants should be able to;

1. understand the processes, phases and activities involved in planning online courses and learning resources
2. develop a persuasive proposal for project funding including concept, rationale, team formation, learner profile, timeline and budget
3. locate potential sources of project funding
4. understand the pedagogic principles of designing online courses and learning resources
5. identify project learning and teaching strategies
6. develop the content for online courses and learning resources
7. understand the legal issues involved with the design of online courses and learning resources

INTENDED AUDIENCE/EXPERTISE LEVEL

This tutorial is for faculty and staff developers who want to fund, design, develop, implement and evaluate online courses and multiple media learning resources. The tutorial is set at an introductory and moderate level.

ABSTRACT

In this tutorial we discuss and commence the crucial planning tasks required to successfully fund, design, develop, implement and evaluate online courses and learning resources. The tutorial will be of most benefit to participants who come with a specific project idea they want to develop further.

We discuss a learner-centred project framework that consists of proposal, media production and educational design processes, phases and activities. You will use the framework to start developing a persuasive proposal including the project concept, rationale, objectives, team formation and learner profile. You then use the framework to develop sound project timelines and a justifiable budget. Potential sources of project funding are identified.

Design principles for online courses and learning resources are discussed based on the instructional design process, Bigg's concept of 'alignment', and Laurillard's 'conversational model' of the learning and teaching process. You will commence identifying your project's learning and teaching strategies. We discuss methods of developing the content for your project and the relevant legal issues.

TUTORIAL OUTLINE

1. Introduction - participant's projects
2. Learner-centered project proposal, media production & educational design processes, phases and activities
3. *Activity #1: Develop project concept, rationale, objectives, team and learner profile*
4. Timelines for online educational projects
5. *Activity #2: Develop project timeline*
6. Budgeting for online educational projects
7. *Activity #3: Develop project budget*
8. Funding sources
9. Design principles for online courses and learning resources
10. *Activity #4: Identify project learning and teaching strategies*
11. Developing educational content

12. Relevant legal issues

13. Plenary Discussion

14. Conclusion and tutorial evaluation

PRESENTER'S QUALIFICATIONS & EXPERIENCE:

Andrew Litchfield lectures in Learning and Teaching at the Centre for Professional Development, Macquarie University. He is responsible for supporting Macquarie University staff in course design, the use of educational technology, and the planning, design and management of teaching innovations and learning resources. His academic experience also includes lectureships in Media Communications and in Educational Technology.

Andrew's media company, Positive Image, has produced numerous large-scale educational media projects. He has extensive project management and media design experience and has produced four award-winning projects funded by the Australian Government as 'Projects of National Significance'.

POSTER / DEMO PAPERS

Research & evaluation of online systems for teaching & learning

Anne A'Herran, James Cook University, Australia

Piecemeal adoption of methods of online educational delivery can duplicate effort and waste an institution's resources. Early enthusiasm for online delivery of courses soon fades without strategic initiatives on the institution's part. In August 1999 a Web Educational Development Advisor was appointed at JCU to research and evaluate systems for online teaching and learning, with a view to integrating the selected system university wide. That research and evaluation is the subject of this paper.

The relationship between learners' personality types to their performance in computer-mediated distance education

Justin Ahn, Fairfield University, USA; MiLee Ahn, Hanyang University, South Korea

Many distance education programs tend to be focused on programs rather than on individuals and their characteristics with the goal of improving the learners' performance. More research into the effects of distance education should be oriented toward the individual learners. Little is known about the personal factors that promote or inhibit success in distance education environments. This study examined the relationship between learners' personality types and their performance in computer-mediated distance education. This study found that Perceiving types posted fewer but longer messages, Judging types posted more but shorter messages, Feeling types perceived that they had gained knowledge more than other types, and Sensing types were less satisfied with the CMC experience. There were no significant relationships between personality types to grades, level of small group collaboration, and level of leadership influence. Students indicated that the leadership changed from topic to topic and learning in CMC can be achieved without a leader. They used others' frequency and quality of postings, writing skills, and feedback to postings as a factor in determining the leadership.

Tutoring Skills for Instructors in Distance Delivery

Mohamed Ally, Athabasca University, Canada

The growth in use of the Internet and other telecommunications technologies in education is changing the role of the instructor from that of a provider of information to that of a tutor. This new role of the instructor requires different skills to work with students in a virtual and distributed environment. This session will present the tutoring skills that are required by tutors to function in a distance delivery mode.

Development of an Introductory Financial Accounting Text in Print-based and Electronic Multimedia Environments

David Annand, School of Business, Athabasca University, Canada

Athabasca University is Canada's largest distance-based, open university. Students presently registering in the University's introductory financial accounting course are provided with a paper-based textbook, solutions manual, study guide, and assignment manual. These materials are all developed and printed in-house. The 800-page textbook was recently converted to on-screen presentation format. The amount of material was significantly reduced by moving discussion cases to an on-line instructors' manual. The material was edited for on-screen use by altering backgrounds, screen breaks, and page size. The files were then converted into Authorware Professional®. Information presentation was streamlined and interactive elements were incorporated. Feedback for selected text problems was inserted at appropriate points. Audio/visual segments, two computer simulations, and navigation and index systems were developed. The final product will be packaged on a CD-ROM, included with each print-based course package sent to students, and incorporated into the University's Virtual Teaching and Learning (ViTAL) electronic environment.

The Biotechnology Project: A Case Study on Integrating the Use of The Internet for Research and On-Line Communication in a Brazilian School

Cristiana Assumpção, Columbia University, USA

This project was developed in a model private school in Brazil, Colégio Bandeirantes, having the reputation for its high academic level and vision for the future. Using an advanced topic in Biology, students were challenged to go beyond normal academic activities, acquiring skills to integrate technology and become lifelong learners. They have had the opportunity to interact with researchers in the field of Biotechnology, as well as with peers in New York. Students have learned to use the Internet as a research tool as well as a place for collaboration and content building. This is a study of the role of technology in empowering students to become active learners and researchers, as well as adaptation to these new methods of communication. Interesting patterns have emerged on how students communicate online versus face to face. The study continues on how to create pedagogically sound best practices for technology integration.

Utilization of BBS for ESL class

Hideyuki Baba, Keio Gijuku Girls High School, Japan

We introduced the usage of a BBS system into ESL learning to enhance English reading and writing competence of our high school students. The BBS system can enable our students to learn English in a totally relaxed and comfortable way. They are expected to find an English file by using a Web browzer and write down their reaction on a page designed in the BBS. Students are also expected to name the URL on the top of the reaction writing so that we can easily trace back what kind of file our students have read and what kind of viewpoint they have taken. The BBS system itself is not so complicated. The program was originally created by a Japanese college student and made to adapt our learning goals later. The good points of this system is (1) it is quite easy to grasp the several stages of developing process of our studets' English learning only by giving a look at the writing page, (2) students can read and write English in a non-stressed way, (3) the English the sudents are likely to write is not so intimate or personal, which is one of the disadvantages of "pen-pal, or mail-pal" type of writing, (4) anyone concerned can write comments to the writings so that a kind of dialogue is possible among the people inside the system.

The eMINTS Project: Enhancing Missouri's Instructional Networked Teaching Strategies -- Promising Developments and Projected Outcomes

Adam Bickford, OSEDA/University of Missouri Extension, USA; Bill Elder, OSEDA/University of Missouri Extension, USA; Barbara Hammer, OSEDA/University of Missouri Extension, USA; Patrick McGinty, OSEDA/University of Missouri Extension, USA; Priscilla McKinley, OSEDA/University of Missouri Extension, USA; Susan Mitchell, OSEDA/University of Missouri Extension, USA

The eMINTS Project is an ongoing cooperative initiative between the Missouri Department of Elementary and Secondary Education (MoDESE), the Missouri Research and Education Network (MOREnet) and 98 elementary classrooms in 44 school districts. eMINTS classrooms are provided with an extensive technological infrastructure: high-speed internet connectivity, enough student computers to provide one computer for every two students, a high capacity teacher workstation with video conferencing capabilities, and a computer projector and a Smart Board. In addition to the computing infrastructure, participating teachers receive extensive training in constructivist, inquiry-based teaching methods which are supported by the University of Missouri College of Education, which provides full-time assistance in locating and using on-line instructional resources. Results from the first wave of this project, the MINTs Project, have demonstrated that well trained teachers working in technologically rich classrooms, can focus student interest and improve student scores on measures of academic achievement.

LEZI: a Tool for Easy Development of Interactive Video for Education

Mario A. Bochicchio, University of Lecce, Italy; Roberto Paiano, University of Lecce, Italy; Paolo Paolini, Politecnico di Milano, Italy; Elisabetta Andreassi, University of Lecce, Italy; Tiziana Montanaro, University of Lecce, Italy

The design and implementation of complex multimedia application is an extensive effort, requiring time, technical skills and sizable budgets. In few cases, therefore, in educational environment it's possible to realize complete hypermedia applications. It's true, nevertheless, that within several academic institutions there is the capability of developing high quality educational content, traditionally delivered as paper, while it could be more efficiently delivered in multimedia format. Our Laboratory is devoted to development of Multimedia applications, some of them concerning educational subjects in collaboration with several professors from the Humanities. Many of them asked for developing their own "cultural" application, but may be they don't have the budget, human resources or technical skills to carry on the job. With this requirements in mind we conceived LEZI, a tool that requires a minimal computer expertise in order to develop in a quick manner educational multimedia application based on interactive video and electronic documents.

New Views on Community and Collaboration: Building and Sharing Dynamic Worlds in Cyberspace

Paula Bonta, LCSI, Canada; Richard Borovoy, MIT Media Lab, USA; Susan Einhorn, Consultant, Canada; Brian Silverman, MIT Media Lab, USA

Abstract: The Internet has the potential to provide an unprecedented dynamic, interactive learning environment - one in which students from around the globe can collaborate in the construction of exciting new worlds. Despite the Internet's capabilities, there is a lack of applications geared towards fulfilling this need. This poster session will present a prototype, the Kids Internet Construction Kit (KICK), that allows K-12 students to create and share dynamic worlds on the Internet.

Reeves Ten-Dimensional Model: Application for the Design and Development of Web-Based Learning Scenario on Learning Theories

Caroline Brassard, Universite du Quebec a Chicoutimi, Canada; Jacqueline Bourdeau, Universite du Quebec a Chicoutimi, Canada; Pauline Minier, Universite du Quebec a Chicoutimi, Canada

This poster presentation covers the design and development of a media-based learning scenario and Web environment with a view to implementing a pedagogical design that integrates new technologies. The scenario responds to concerns regarding pedagogical innovation in "Teachers Training". It tries to facilitate the development of the skills required within the larger framework of courses where theoretical content is high and cooperative learning methods must be supported. The focus was therefore placed on the ability to "make links" and on the socio-constructivist approach. The results showed the importance of design, the need for cognitive strategies, the inherent pedagogical value of cooperative learning and developing the ability to "make links". The creation of links can go beyond the context to encompass any training session that contains a wide range of theories and a broad body of knowledge. It appears that the need for a design that produces the most appropriate overall educational formula may lead to proven pedagogical effectiveness.

The Creative Network:the development of a collaborative learning community for mature professionals

Helen Brown, University of Central England, Birmingham Institute of Art and Design, England

The hypothesis underlying the formation of the Creative Network is that a radical approach to Continuing Professional Development in the U.K. is needed to prepare those employed in the Creative Industries for:

1. the portfolio career
2. short term contracts
3. rapidly changing technologies/materials
4. structural changes in the companies, flatter hierarchies, featuring multi-skilling and cross functional teams
5. e-business (e-commerce and e-volution)

The Creative Network web site is the gateway to a learning community. There is no standard course or assessment. Instead the Creative Network tutors work with each individual learner or company to analyse their development needs and structure a training plan. The Creative Network aims to facilitate deep learning based upon a spirit of facilitation which helps learners to contextualise new learning and construct personal relevance and meaning.

Breathing New Life Into The Classroom

Lawrence Bundy, Nebraska Department of Education, USA

Two Nebraska projects, funded by grants from the United States Department of Education, will work together to prepare teachers to use technology in the classroom. The Connections Project, a five-year Education Technology Innovation Challenge grant, works with in-service teachers. Introductory, intensive five-day summer workshops focus on classroom uses of technology, brain-compatible teaching strategies, life skills, multiple learning styles, and integrated curriculum models. On-going staff development follows the workshops at local sites throughout the academic year. The teachers create curriculum units incorporating the strategies they have learned and post them on the project Web site—http://ois.unomaha.edu/connections. They also create CD-ROMs of the workshop presentations, which will be distributed to over 6,000 teachers. The Catalyst Project, a three-year Preparing Tomorrow's Teachers to use Technology (PTTT) grant, involves seventeen higher education institutions that are engaged in active systemic changes to prepare pre-service teachers to use educational technology. The two projects will work together to identify and develop a cadre of K-12 teachers who are leaders in the use of educational technology. This cadre will act as resources in the higher education classroom and as cooperating teachers for teacher education programs.

Improving Collaboration in Face-to-Face Groups using Technology

Robert W. Cavenagh, Jr., Dickinson College, USA

Abstract: Face-to-face collaborative work is an essential tenet of much contemporary teaching, especially within constructivist models. The practical use of technology by small intact groups has received relatively little research attention. Observation of learners in existing settings suggests that commonplace computing facilities may limit effective collaborative work by more than two individuals. The design of facilities and strategies specifically for collaboration has been demonstrated to improve the effectiveness of such work. This PosterDemo reviews applicable research, presents design and cost criteria for and photographic examples of purpose-built facilities, and delineates pedagogic strategies found useful, including both assignment and assessment strategies. It summarizes findings and future topics to explore. It also simulates the look and feel of one such collaborative facility.

Educational Applications of Hypervideo

Teresa Chambel, University of Lisbon, Portuga

Video clips can greatly enhance the authenticity of a computer based learning environment. Something constructivists have been strongly arguing for. Broadcast television does not afford composition or the time to reflect. But, television and video, when properly constructed, can be a powerful tool for reflection. If the user can select what is to be seen and control the pace of the material, and it is easy to go back and forth, to stop, to make annotations, to compare and to relate to other materials. Effective reflection requires some structure and organization, the main issues in hypermedia. Hypervideo refers to the integration of video in truly hypermedia documents, taking into account its spatial and temporal dimensions, and defining the semantic and mechanisms to link and navigate video and other media. In this presentation, different mechanisms for the integration and navigation of video in educational applications are demonstrated. These were developed using HTIMEL, an extension to HTML and existing Web tools, being developed and used in the Unibase project on distance learning.

Collaboration between T&T3 Project Team and ETU/CeLTS at HKIEd in Promoting Teaching Skills and IT for HE

Thomas YH Chan, Lingnan University, Hong Kong, China; Julianne WY Wong, Hong Kong Institute of Education, Hong Kong, China; Elson Szeto, Hong Kong Institute of Education, Hong Kong, China

We are presenting the fruit of our collaboration in the context of the T&T Project --- a publicly-funded inter-institutional collaborative initiative for all academic and professional staff in Hong Kong's HE institutions. Project mission is to pull together human and instructional resources from all institutions in a collaborative effort in promoting, fostering and advancing quality teaching and learning. We are going to share with conference participants the following:

- Designing and conducting sessions on IT in teaching and learning for academic and professional staff from all tertiary institutions in Hong Kong, in particular on:
- formatting and layout of text
- digital graphics
- perfecting presentation skills
- other digital media for enhancing teaching and learning
- Designing and producing for colleagues' use self-instructional multimedia packages for enabling IT self-sufficiency (in CD-ROM format)
- Initiating audio and video streaming for the "T&T Project Website" and related on-line multimedia packages

Teaching Symbol Recognition with Interactive Java GUI

Li Chao, University of Houston-Victoria, USA

Abstract: The ease of learning Java, its reliability, and its portability make this programming language more and more popular among students and faculty. It has gained much attention through its power of multithreading, networking, and computer graphics. As an assistant in teaching computer vision such as symbol recognition, Java has the flexibility needed to develop classroom demonstrations which are accessible through Internet. The objective of this paper is to present an interactive Java based GUI to assist the teaching of symbol recognition.

Kabisa: A computer-based training program for diagnostic reasoning in tropical medicine

Geraldine Clarebout, Univerisity of Leuven, Belgium; Jan Elen, University of Leuven, Belgium; Joost Lowyck, Univerisity of Leuven, Belgium; Jef Van den Ende, Institute of Tropical Medicine, Belgium; Stefano Laganà, Italy

A shift took place in educational goals from knowing everything in a certain domain, to knowing how to deal with complex problems. The reasoning process has become more important than the amount of information to memorize. In medical education the same evolution took place. A computer-based training program that is developed to guide and help to develop diagnostic reasoning skills in tropical medicine is KABISA. In this poster, the program will be presented and all its functionalities, as well as a user-test that was performed. This test was done to identify whether KABISA really contributes to the development of reasoning skills in tropical medicine. The main aim of this test is to determine what has to be changed to the program to provide students with an efficient learning environment to learn diagnostic reasoning and to optimize the program. Use was made of a thinking aloud method and log file analysis.

WEB-LIT: Web-Based Support for Learning Theory and Instructional Design

Ken Clinkenbeard, University of Bergen, Norway; J. Michael Spector, University of Bergen, Norway

The primary objectives of our project include creating an open and flexible web site to host materials on learning theory and instructional design. We will find and evaluate existing web-based materials on these topics which reflect a wide variety of perspectives, applications and lessons learned and organize the site so that materials can be posted and easily accessed. Interactivity also plays a key role. Opportunities are provided for users to comment on existing materials and/or submit new materials. Our goal is not to create an online course in the area of instructional design of learning theory, but to augment the design of these courses by offering support resources. A secondary goal of this site is to create a web-based set of resources that can provide a source of evaluation data on the use of web-based materials in graduate education.

Realism and Credibility in a Simulation-Based Virtual Physics Laboratory (VPLab): An Empirical Study

Marc Couture, Télé-université, Canada; Alexandre Francis, Université de Montréal, Canada

Realism and effectiveness of computer simulation-based learning or training environments have been examined in several studies. It was shown that under certain conditions, simulations can be as efficient as real experiments, and that increased realism may result in gains in 'practical appreciation'. However, few have investigated the relationship between realism and credibility, or between credibility and effectiveness. The VPLab is a simulation-based learning environment featuring many characteristics and constraints normally associated with real experiments. These include uncertainty in measurement, random fluctuation of parameters, and limitations in user control over the simulation. This approach distinguishes the VPLab from most existing simulation-based laboratories. We will present first results of an experimentation with first-year university science students, in which we sought to identify the factors, most notably those associated with our approach of realism, that may enhance the credibility of such an environment and/or its perceived relevance as a tool for learning laboratory skills as well as science concepts.

A Web-based Tutorial on Optical Communications

Ignacio de Miguel, University of Valladolid, Spain; Carlos Jesus Fuertes, University of Valladolid, Spain; Abel Prieto, University of Valladolid, Spain; Patricia Fernandez, University of Valladolid, Spain; Miguel Lopez, University of Valladolid, Spain; Fernando Gonzalez, University of Valladolid, Spain; Juan Carlos Aguado, University of Valladolid, Spain; Ruben M. Lorenzo, University of Valladolid, Spain; Evaristo J. Abril, University of Valladolid, Spain

We are developing a tutorial on optical communications in order to increase the interest of the students in this area and to clear up some concepts. The tutorial is divided into four didactical units: Propagation of Signals; Components and Devices; Optical Communication Systems; and Optical Communication Networks. Within each unit, basic information is provided as well as simulators and animations. The students can also perform self-evaluations to check their progress. The self-evaluations are randomly generated from the contents of a database according to the students' preferences (topics, difficulty and kind of items: questions and/or short problems). The tutorial is being developed at http://pesquera.tel.uva.es/tutorial. The utilization of web technologies allows the students to access the tutorial from their homes, and we hope it will facilitate the collaboration with other groups working in these topics. This work is partially supported by Consejeria de Educacion y Cultura (Junta de Castilla y Leon).

Posting Visual Cues on Threaded-Message Boards in Science Curricula: Enhancing Transfer of Theory Knowledge to Clinical Practice

Gregory A. DeBourgh, University of San Francisco, USA

Results of a pilot study (16 baccalaureate nursing students) suggest posting thematic, integrated photographs, graphic, and text data on asynchronous, threaded-message boards facilitates transfer of theory knowledge to clinical practice and supports the acquisition of skills in clinical reasoning (pattern recognition, critical analysis, problem solving, and identification of therapeutic interventions). Visual cues provide powerful representations of reality that enable students to recognize manifestations and patterns of clinical pathologies. Text-based learning prompts stimulate reflective thinking and collaborative problem solving. Used synergistically, they create clinical context, authentic complexity, and scaffold learning. Provided both words and pictures during instruction, learners encode information in such a manner that recall is facilitated and transfer of knowledge enhanced. Students report on-line interaction results in the positive experience of belonging to a professional community during learning, affords support and opportunities for collaboration, and increases access to the instructor to clarify "accuracy of learning" and provide feedback. Using visually-enriched on-line conferencing is an enjoyable, convenient, and satisfying way to amplify and enhance learning, and "brings the course content alive".

The «BacVert» or «Blue Box» - A Knowledge Recycling Bin for Students

Céline Desjardins, Centre de recherche LICEF, Canada; Éfoé Wallace, Centre de recherche LICEF, Canada; Claude Ricciardi-Rigault, Centre de recherche LICEF, Canada

While it has become common to provide students with a list of documents to peruse on the Internet, information gathering, net-surfing and annotation all have an exploratory, individual and work-in-progress quality. Sharing insights gained through these activities, especially in distance education, is complicated and requires highly structured settings. The INF9002 «BacVert» web-based dispositif at Télé-université supports such sharing. The natural language parsing performed by Nomino provides flexible automatic structuration, both of the core Internet material proposed by the teacher to which the students gradually add their findings, and of the comments about these documents produced by the students. By allowing a group of students to constitute an evolutive information base, to comment on it and to compare notes, the INF9002 «BacVert» constitutes a step towards tackling the complexity and heterogeneity of the information environment, while supporting exchanges among peers about the material at hand.

Building Global Information Communities: the University of Iowa Center for Electronic Resources in African Studies (CERAS)

Barbara Dewey, University of Iowa Libraries, USA

This poster session provides a case study of the issues and lessons learned regarding development of the University of Iowa's Center for Electronic Resources in African Studies (CERAS) (http://sdrc.lib.uiowa.edu/ceras/). The Center is a "virtual" space for creating, disseminating, and accessing scholarly electronic resources in text, multimedia, and interactive format, and a "virtual" place for further development of electronic resources (textual and multimedia-based) pertaining to Africa created by scholars from the United States as well as from Africa and other parts of the world (http://sdrc.lib.uiowa.edu/ceras/). CERAS is part of the University Libraries' Scholarly Digital Resources Center supporting students and faculty engaged in African Studies research and teaching at the University of Iowa, and scholars nationally and internationally. CERAS is also a venue for U.S. and African scholars for creating and disseminating African Studies scholarship and information resources in electronic format. Several CERAS initiatives have focused on image creation, particularly in the field of African art, a strength at the University of Iowa. CERAS will serve as a venue for digitizing projects related to Africana scholarship (i.e. museum collections, selected non-copyrighted collections, archival materials, and documents). Other goals include bringing high quality African Studies scholarly electronic collections and web sites currently in existence into a user-friendly digital library web page; providing a venue for "publishing" original materials, including pre-prints, (articles, books, conference proceedings) as well as creating significant thematic textual and multimedia collections of materials in electronic format; and developing an electronic international community of Africana scholars where dialogue about issues, research, and projects can take place. This latter feature is intended to provide a broader opportunity for Africana scholars to post drafts of research papers and projects for critique and discussion by other Africanists from around the world. The University of Iowa Libraries is seeking collaborative projects and partnerships with institutions and Africana scholars from around the world.

Introducing a Distance Learning version of a Postgraduate Program on Networking in Argentina

Dean Javier Díaz, University of La Plata, Argentine; Maria Alejandra Osorio, University of La Plata, Argentine; Ana Paola Amadeo, University of La Plata, Argentine

The great popularity of the Internet and the widespread use of the World Wide Web are promoting a new methodology for distance learning. The main advantage of the Internet based courses is possibility to promote a bi-directional communication between the students and the professor and to highly, motivate the student due to an adequate feedback. This poster describe the introduction of Internet tools (such as www, e-mail, IRC, FTP, mailing list) in the distance learning postgraduate program of the 'Magister de Redes' (http://www.linti.unlp.edu.ar/master) of the UNLP . The ongoing experience was successful due to certain facts that are stated in the poster which also mentions some drawbacks and the strategy for overcoming them. The distance-learning version of the program started in 1998 as way to reduce the obstacles for he students (professionals from the engineering and the computer science field in the networking area), mainly the traveling expenses and the time it takes due the large geography of our country and the long distances.

The Bones Of The Skull: Creating Anatomical Models With Quicktime Vr

Marilyn Dispensa, The University of Iowa, USA; Jim Duncan, The University of Iowa, USA; Jerry Moon, The University of Iowa, USA

This electronic demonstration will provide an overview of QuickTime Virtual Reality (QTVR) and its utility in the development of virtual anatomical models which can be used alone or integrated into computer-based-learning (CBL) software. The Bones of the Skull: A 3-D Learning Tool is a CD-ROM-based module designed to help college-level anatomy students learn the bones and important landmarks of the skull. The software has two main features: 1. A collection of Quicktime VR movies that allow the user to rotate and view the skull and its bones in three dimensions. 2. An interactive "textbook" that contains high quality 2-D images, descriptive text and many embedded activities to encourage interaction with the content. This presentation will demonstrate the product and provide an overview of QuickTime VR, including technical requirements and hardware/software costs. The Bones of the Skull won the 1999 Sandoz/Slice of Life Student Software Award.

The impact of establishing a virtual university: a case study at NUST

Nomusa Dlodlo, National University of Science and Technology, Zimbabwe

The purpose of establishing any university is to cater for the educational needs of the surrounding community. In developing countries universities fail to cope with large numbers of applicants. The reason is that the number of universities in such countries is limited due partly to historical circumstances and partly due to financial constraints. The exercise of building brick and mortar universities and acquiring skilled staff to run them is expensive.

A Distributed Maritime Simulation Training Environment based on HLA

Mirko Dobermann, Computer Graphics Center ZGDV, Germany; Harro Kucharzewski, MarineSoft GmbH, Germany

A new approach for advanced training systems is the integration of computer simulation into such applications, allowing students to experiment in complex scenarios. The presentation introduces a distributed simulation-based training scenario , generated in a distributed environment, which that offers extended functionality for interaction and demonstration within a maritime training scenarioapplication. The main objectives of the solution are threefold: to set up and establish a distributed simulation-based training environment, to provide real-time interaction functionality during run-time, as well asand to integrate already available simulators that are currently on the market. The infrastructure for this simulation is based on HLA/RTI, while which already offers functionality to couple embedded applications with networked simulation applications. The Computer Graphics Center in Rostock (ZGDV) currently focuses on maritime scenarios related to competency training for crews aboard and ashore. The development of the simulation environment is part of a research project in collaboration with regional enterprises in the Maritime sector.

Human Anatomy Predissection Lecture-On-Demand at The National University of Singapore

Gilles Doiron, National University of Singapore, Singapore

The NUS Integrated Virtual Learning Environment (IVLE) was developed so that staff and students could use this information technology infrastructure to communicate, exchange documents and information, discuss, chat, and access custom learning materials and course related web sites. IVLE also enabled the university to consider new pedagogical approaches, which would utilise its campus-wide broadband access to meet specific teaching and learning needs. A "lecture-on-demand" (LoD) delivery was seen as a viable tool that would allow students to take more responsibility for their learning and enable them to have greater control over their time schedule. With the collaboration of the Faculty of Medicine, the Center for Instructional Technology and the Centre for Development of Teaching & Learning, a prototype anatomy pre-dissection LoD, "The Abdominal Wall & Inguinal Canal", was produced. This paper examines the design and development issues addressed in building the prototype. Field test data on the technical reliability, and ratings, and comments from student feedback are presented.

ExploraGraph and CINEMA

Aude Dufresne, Univ. of Montreal, Canada; Claire Isabelle, Univ. of Moncton, Canada; Roger Nkambou, Univ.of Montreal, Canada; Yan Laporte, Univ. of Montreal, Canada; Frank Ferront, Univ. of Montreal, Canada

The ExploraGraph interface was designed to facilitate interaction in the context of distant learning. It was developed as an alternative to simple web interaction, in order to increase flexibility, visibility, and structure in the learning environment. It may be used as a front end to existing courses on the web and to support learner in them. The ExploraGraph Navigator makes it possible to navigate through conceptual graphs with automatic arrangement of elements, zoom and "fish eye" effects. Each node of the graph may have a description attached to it and may give direct access to an application, a document or an Internet site. Graphic structures may thus be used to represent the organization of tools, activities, concepts or documents. The Navigator offers each user a tool to specify his goals and the system can support him, using multiple modalities: Hypertext, graphical cues, Ms Agents avatars, voice, visual demonstrations and force feedback guiding.

Future Special Education Teachers' Abilities to Integrate New Technology Into Teaching Reading Comprehension

Catherine Dumoulin, Universite du Quebec a Chicoutimi, Canada; Jacqueline Bourdeau, Universite du Quebec a Chicoutimi, Canada

This study questions future teachers' abilities to integrate new technology into their teaching. A pedagogical scenario based on a cognitive approach was proposed to graduating students of the bachelor of Special Education program in order to teach Grade 3 students with reading comprehension difficulties. This pedagogical scenario integrated new technology via the "Village Prologue", a computerized environment. Future teachers were found to organize pedagogical activities, create learning situations suitable for teaching reading comprehension, help motivate children to read, and finally, guide children in their learning processes within the computerized environment. Furthermore, the pedagogical scenario helped in motivating future teachers to include new technology in their future teaching. The computerized environment also permitted the future teachers to adapt their teaching to the specific needs of children with reading comprehension difficulties.

School Festival on the Internet - Project-based and cooperative learning -

Hironori Egi, Keio University, JAPAN; Yoshitomo Tsutsui, Kamogata High school, JAPAN; Yuuki Nishimura, Keio University, JAPAN; Keiichirou Ishibashi, Keio University, JAPAN

We report a case of project-based and cooperative learning activities, School Festival on the Internet, Okayama 1999 (SF99) in Japan. Three public high schools in Okayama, Keio University and Kurashiki University of Science and the Arts participated in SF99. The goal of SF99 was to put the school festivals held at each of the high school on the web so that the students efforts could be widely appreciated. School festivals are considered as an educational event in Japan, and we implemented SF99 as a project-based and cooperative activity. The festival provides students with opportunities to present achievements of their research or their other interests. Video streams and online communication through a Bulletin Board System (BBS) were the main applications used to achieve the end. SF99 is one of the few examples were extra-curricular activities such as school festivals were digitalized. Information-based learning and extra-curricular activity have similar goals. We also analyzed the achievements of SF99 and discussed the educational effect of information-based learning using the Internet.

The ParlEuNet-project: Problems with the validation of socio-constructivist design principles in ecological settings

Jan Elen, University of Leuven, Belgium; Geraldine Clarebout, University of Leuven, Belgium

Instructional design aims at generating indications about optimal relationships between learner-related and instruction-related variables in view of the attainment of instructional and/or learning goals. In this poster, a study is presented in which it was started from socio-constructivist view on learning and instruction to identify a number of design principles. These principles were used to design and develop a concrete and innovative rich technological leaning environment, the ParlEuNet learning environment. The main features of the this environment can be described as follows:

- A variety of technologies
- A problem-based learning environment where use is made of ill-structured tasks
- International collaboration

It was hypothesized that such an environment would have an influence on certain learning environment. In this poster the environment and the results of the research will be presented, which indicate that there is an influence of the learning environment, however in a different direction than was expected.

Examining Medical Students' Attitudes and Learning Experiences in BioWorld

Sonia Faremo, McGill University, Canada; Susanne Lajoie, McGill University, Canada; David Fleiszer, Faculty of Medicine, McGill University, Canada

This poster presents BioWorld (Lajoie et al., 1998), a computer-based learning environment (CBLE) that engages learners in realistic problem solving as they attempt to diagnose medical cases. Its design is consistent with both problem-based learning (PBL) and cognitive principles of instruction. Solving a BioWorld case involves interpreting case history information, ordering diagnostic tests, developing diagnostic hypotheses, and reflecting on one's own performance. As part of a larger study, the data for this poster consisted of measures of the attitudes and learning experiences of medical students using BioWorld. The experimental procedure involved having medical students individually diagnose a set of BioWorld cases and complete a questionnaire concerning their experiences. Students rated several aspects of the system (level of interest, difficulty, utility of learning activities, etc.). The results have implications for the design of CBLEs for complex domains. They also suggest that BioWorld is an effective learning environment.

CyberARTS: A Integrated Arts Curriculum

Tito Faria, Don Mills Collegiate Insititute, Canada; Sholom Eisenstat, Don Mills Collegiate Institute, Canada

The CyberARTS program is offered at a number of school sites in Toronto. CyberARTS uses a constructivist methodology to deliver visual integrated arts, media communication, computer technology and now Gr. 9 Geography credits. Students have constant access to labs of Macs and PCs and a range of peripherals. Teams of teachers work collaboratively creating and delivering the curriculum. Senior students complete the program with a co-op experience. Their placements include: Alias Wavefront, Web Feat, Apple, Microsoft, the Design Exchange and Nelvana. Our partners include: Waterloo University, Apple, Kodak, Rogers Cable and SoftImage. Our senior class was involved in designing and producing the first edition of "RE: DESIGN", a web "zine" about design for teachers and students by students. www.dxnet.net. Currently a number of senior co-op students have placements at the Design Exchange where they are working on the website for Toronto's Olympic bid. Our program has won an Apple School of Distinction Award and some of its teachers have won a 1999 Prime Minister's Award for Achievement. We will focus on:

- problem oriented curriculum projects and units
- subject integration and authentic learning assessment techniques
- real-world connections and business partners

Managing Electronic Resources - Auto-registration for Distance Learning

Richard Fasse, Rochester Institute of Technology, US; Damon Betlow, Rochester Institute of Technology, US; Randy Overbeck, Rochester Institute of Technology, US

Electronic resources used in distance learning are often restricted to registered students through login ids and passwords. As electronic resources proliferate, so do the problems with managing these accounts for both students and administrators. One option is a form of auto-registration with "course keys" that allows users to select their own login id and password, but restricts registration to only those who received the "course key" in a handout or email.

Interactive Training Materials for Early Childhood Educators: Cases, Tools, and Reflection

Gail Fitzgerald, University of Missouri-Columbia, USA; Louis Semrau, Arkansas State University, USA

Materials to assist early childhood educators in working with young children with behavioral problems are currently in high demand. Multimedia programs offer an effective method for providing instruction based on authentic cases for developing necessary knowledge and skills. In the multimedia program, "Trisha," users can seek professional knowledge from an information database, watch Trisha in multiple settings, interview her teachers and other care providers, read case records, listen to expert commentators discuss theoretical approaches and care recommendations, and carry out a series of real-world activities related to Trisha's needs. Following problem-solving activities, users engage in a series of reflective prompts to review their decisions based on best practices. The program contains electronic performance support tools that can be used within the program as well as in actual job situations. "Trisha" is designed for implementation with workers in childcare settings and preservice courses. Additional information is available at http://www.coe.missouri.edu/~vrcbd/.

Integrating computer ethics into the computer science and computer engineering curricula

John Fodor, Educational Media Resources, Inc., USA

This demonstration will show how to integrate computer ethics into the computer science and computer engineering curricula by using the interactive CD-ROM Understanding Computer Ethics. (UCE was made possible by grants from the National Science Foundation and has won AXIEM, Communicator and International CINDY Awards.) We will discuss such topics as computer privacy, computer security, ownership of intellectual property, software piracy, hacking and professional responsibility. We will examine ways of developing skills, sensitivities, and understandings to "human value" issues and problems raised by computing and information technologies, including ways to elicit more reflective performance understandings. We will analyze four ways specific ways of integrating computer ethics into the computer science and computer engineering curricula:

1) as a stand-alone class,
2) incorporating computer ethics into existing cs & ce classes,
3) as part of a capstone senior project, and
4) as an independent study class.

Development and Implementation of Computerized Instructional Materials: The Mismatch Between Formal and Informal Technology Support Structures in a Medical College

Cynthia Frank, The University of Arizona, U.S.A.

This study focused on the development and implementation of instructional computer materials in the everyday teaching environment of a southwestern U.S. medical college. What happened between the time an instructor voluntarily decided to implement computer technologies in a course and the time a student could actually use the technologies? The existence of formal technology support structures led to the assumption that instructors would utilize professional help. This turned out not to be the case. The majority of instructors used informal support structures to develop and implement their materials. Much of the work was done by students who had no training in instructional design, multimedia programming, or graphic design. This preliminary finding indicates a fundamental mismatch between the type of support professors selected and the type of support offered by the institution.

Putting Curriculum in Control: Interactive Courseware Development with the TechDisc Instructional Design Template

Traig Friedrich, Sencore, Inc., United States; Bill Wann, Sencore, Inc., United States; Karen Korth, University of South Dakota, United States; Mike Hoadley, University of South Dakota, United States; Dan Eastmond, University of South Dakota, United States

The Technology for Training and Development division at the University of South Dakota has joined forces with Sencore, Inc., a multimedia application provider, in the development of an innovative multimedia authoring tool. Designed specifically to apply recognized instructional design techniques to "drag-and-drop" multimedia development, this tool puts interactive courseware authoring into the hands of the classroom educator. This approach to multimedia application development benefits everyone involved in K-12 education by enhancing the classroom teacher's control of course curriculum and specific course content. During this demonstration of the TechDisc Instructional Design Template, participants are welcome to engage in open discussions of the tool, trends in multimedia project authoring, and other issues surrounding interactive courseware development.

Using Virtual Reality to Assist Air Travelers With Disabilities

Clark Germann, Metropolitan State College of Denver, USA; Jane Broida, Metropolitan State College of Denver, USA

Getting to the airport, checking our luggage, going through security, boarding the plane--these are all tasks most of us take for granted each time we fly. But to persons with physical disabilities who use a wheel chair, the above tasks can be difficult and intimidating. No two airports are exactly the same, and procedures for air travelers with disabilities differ with each air carrier. To help ease the anxiety, faculty and students at Metropolitan State College of Denver have used computer technology to duplicate one major airport into virtual reality. Now, future air travelers can preview the experience first on the computer prior to going to the airport in person. With 135,000 people in wheelchairs in Colorado alone, provision of resources for air travel is especially pertinent. Survey research and anecdotal evidence has shown that these virtual representations can be helpful in reducing anxiety in persons with disabilities by providing a preview of a location prior to visiting it in person.

Gender and Race: The Accuracy of Internet Clip Art

Carol Gilley, University of Arkansas, USA; Elaine Terrell, University of Arkansas, USA

Abstract: Computers are being used to create various print media as well as multimedia. Some questions are being raised in developing these media materials. Is there a supply of free clip art on the Internet that represents the real world? Do viewers see themselves in clip art used in print and computer-based multimedia? This study explores the issues of equity and stereotyping with regard to the images in free Internet clip art by investigating the following two hypothesis. 1) There is no significant difference between the proportion of men, women, boys, and girls represented in free Internet clip art and the proportion of men, women, boys, and girls in the general population. 2) There is no significant difference between the proportion of White, Blacks, and other minorities represented in free Internet clip art and the proportion of White, Blacks, and other minorities in the general population.

How To Be Innovative Designing Educational And Interactive Environments For Children

Gloria Elena Gomez Escobar, University of Los Andes, Colombia

LUDOMATICA PROJECT looks to effectively attend children's educational needs. It seeks to help them to creatively think and act, validating their rights to high-quality education and to actively participate as social change agents. This validation is accomplished through innovations in formal, non-formal and informal education, using Information and Telecommunication Technologies within a non-conventional pedagogical. We want to develop the intellectual potential and cognitive abilities of children who live in high-risk situations, taking advantage of their adverse learning to stimulate creative potentials, communicative resources and have them discover their own adventurous spirit and creative capabilities. The interactive game THE FANTASTIC CITY is one of the environments created for these purposes. This is a digital multimedia microworld that motivates and develops children's fantasy and creativity by means of enigmas and puzzles, seeking to generate cognitive and affective imbalances. This interactive environment leads children to action. It promotes curiosity and experiential learning; it allows speculating, discovering, learning from mistakes; and it stimulates the desire to learn.

Teaching Dynamics of Dairy Herd Health and Management

Claudia Haferkamp-Wise, Cornell University, USA; Heather G. Allore, Cornell University, USA; Yrjo T. Grohn, Cornell University, USA; Lorin D. Warnick, Cornell University, USA

Cornell University offers "Dynamics of Dairy Herd Health and Management" (http://courseinfo.cit.cornell.edu/courses/vetmed745) - a newly designed web-based distribution course to its on-campus veterinary students and to students at 9 off-campus test sites within the United States and abroad. This course uses a computer-based instructional delivery system (DairySim) to teach basic concepts of epidemiology and economics of dairy cattle disorders, experimental design, and statistics. The courseware provides two simulation models - SIMHEALTH and SIMMAST - with an interactive user-friendly interface and output analysis - thus making research tools accessible to a broader audience. DairySim and its accompanying user guides are available on-line. Lectures can be attended in person on-campus or viewed via the internet. Students can print handouts for use in computer laboratory sessions, take on-line quizzes and download homework assignments. Completed assignments are handed in by uploading the documents. Instructor-student and student-student communication for off-campus students takes place via email and an on-line discussion board.

A Comprehensive Model for Improving Technology in Teacher Education

Robert (Bob) Hannafin, College of William and Mary, US; Robert (Bob) Hanny, College of William and Mary, US.

This paper identifies the professional development model developed at the College of William and Mary to close the gaps between its strategic vision for the teacher education program and its capacity. The College's vision is to produce teachers who seamlessly integrate technology by designing and assessing authentic student-centered learning activities. Three areas were identified as requiring parallel effort: faculty development, institutional development, and clinical faculty/PDS development. Goals were established that addressed capacity shortfall and advance the program to the point where significant innovation could occur. Both our students and faculty needed to master both basic technology skills and the subtler art of practicing creative integration strategies. It also required placing our students with teachers who are competent technology users and encouraging in technologically-adequate classrooms. Institutional changes were necessary on two fronts: upgrading the technology available in School classrooms, and instituting incentives to entice faculty to use and integrate technology.

Web-Based Tools For Courses On Transport Phenomena

Bernardo Hernandez-Morales, Universidad Nacional Autonoma de Mexico, Mexico; Rafael Fernandez-Flores, Universidad Nacional Autonoma de Mexico, Mexico; Jorge Tellez-Martinez, Universidad Nacional Autonoma de Mexico, Mexico

Even though multimedia applications have been extensively used in many courses, the field of transport phenomena has received comparatively less attention. Thus, we are developing interactive tools, to be accessed through Internet, to solve problems observed when traditional teaching techniques are used. The material consists of modules to solve typical problems in transport phenomena. Each module is a Webpage that includes the theoretical background (with hyperlinks to all course material) and an interactive worksheet to solve a particular problem. The worksheets are built with Java applets (JDK 1.1. compatible) and may may be used in any of three modes: example mode (fixed set of values), training mode (variable set of values), and exploration mode (range of values of a key independent variable). Thus, unlike problems found in traditional textbooks, the student may explore a range of values for key independent variables to establish its influence on the dependent variables.

Shaknoma: A collaborative tool for shared knowledge management

Oriel Herrera, Pontificia Universidad Catolica de Chile, Chile; Sergio Ochoa, Pontificia Universidad Catolica de Chile, Chile; Vidal Rodriguez, Pontificia Universidad Catolica de Chile, Chile; David Fuller, Pontificia Universidad Catolica de Chile, Chile

Nowadays, the amount of scientific knowledge produced is overwhelming and it is clear that it will grow even more. Shaknoma (Shared Knowledge Manager) is a tool useful to make available and share the people's individual knowledge. The activities carried out on this tool respond to a model that ensure the input, validation, use and evolution of the knowledge. The process is implemented through four major components: the shared repository, the management model (see Herrera et al. 2000), the representation language of the knowledge, and the collaborative environment. The knowledge management model provides decision-making mechanisms, which mainly includes discussion and voting activities. As a way of structuring and graphic representation, Shaknoma uses a language based on conceptual maps (Novak 1984). The information repository does not store only knowledge, but also the information of its use and evolution.

Teachers and Computer Technology Training

David Hofmeister, Central Missouri State University, USA; Gerry Peterson, Central Missouri State University, USA

The poster session provides an overview of the processes and materials used to advance the integration of computer technology into student learning in K-12 schools.

Results and conclusions from a Learning Software Design Competition

Brad Hokanson, University Of Minnesota, USA; Simon Hooper, University Of Minnesota, USA; Paul Bernhardt, University Of Minneosta, USA

The University of Minnesota's Design Institute is sponsoring a competition to recognize the design of innovative educational software. The competition was open to professional and not-for-profit educational software designers in such areas as higher education, K-12 education and commercial training. Prizes will be given in each category, and entries for the competitions were due February 15, 2000. Winners of the competition were announced April 10, 2000. One of the competition's goals is to establish a bank of exemplary educational software that can be examined by designers and students of educational software design. To facilitate this goal, winning designs (and others selected for inclusion) will be compiled and made available to the public. We will present the results of the competition in a workshop format at ED-MEDIA 2000. The intended audience is educators and practitioners in the field of educational technology.

Constructive Hypertext for Learning

Hsi-chi Huang, The Ohio State University, USA

This study focuses on teachers as designers using constructive hypertext and teachers' perspectives on the use of the World Wide Web in educational contexts and its implications. Constructive hypertext encourages the participants not only to be users of hypertext, but also to be designers of hypertext. The study describes the participants' experiences as designers and their thoughts on designing hypertext for learning. In designing Web-based hypertext learning environments, educators can make use of the Web from three approaches: the Web as a resource for information, the Web as a medium of expression-representation, and the Web as a space for dialogue. The distribution perspective takes advantage of the Web as an information network. The expression-representation perspective uses the Web as a space for publishing, and expressing ideas and creativity. The Web as a space for dialogue has the capacity to encourage and embrace different voices. To participate in the dialogue is to create voices. The dialogue space provides possibilities for students to converse and exchange learning experiences.

Internet Infrastructure with ATM for Small Countries; Case Studies

Necdet ICIL, Eastern Mediterranean University, TURKIYE

Rapid development on communication technologies, become easy to support QoS (Quality of Services) application on Internet. As a case study, North Cyprus which is a small country with 5 small cities, develop a project to connect all cities with ATM BackBone. The purposes of the project is to connect all the local government offices to the cities node and to use all multimedia and information facilities on the BackBone. All governmental documentation will be send electronically between the offices. Virtual meeting will be possible by using video conferencing facilities. Also all schools will connect to the Ministry of Education to use educational facilities which are prepared by the trainers.

NACSIS-ILL Distance Training System in IDLE Distance Learning Project

Tomo'o Inoue, National Institute of Informatics, Japan; Haruki Ueno, National Institute of Informatics, Japan

We have started the distance learning project named IDLE (Integrated Distance Learning Environment) in 1998. The primary motivation of beginning the project is to meet the social needs. There are not many practical and sustainable DL systems in Japan, while on the other hand DL is already recognized as a natural form of getting education in the US. Current core product of IDLE is NACSIS-ILL Distance Training System, a WWW based system for training NACSIS-ILL operators. NACSIS-ILL is a system that our institute offers to nearly 700 university libraries to support exchange of information for the inter-library loan service. Our institute also offers NACSIS-ILL Training Courses to train the staff in the inter-library loan sections of the participating libraries. We have put emphasis on its practicality in the project and applied DL to the training course. The system will be in actual use this year.

Linking Active Learning to Web-based Instruction: Students Teaching Students through Multimedia Productions

James S. Javenkoski, Department of Food Science and Human Nutrition, University of Illinois at Urbana-Champaign, USA; Elizabeth F. Reutter, Department of Food Science and Human Nutrition, University of Illinois at Urbana-Champaign, USA; James E. Painter, Department of Food Science and Human Nutrition, University of Illinois at Urbana-Champaign, USA

Instructors (academic teachers and corporate trainers) recognize the value of video as an educational medium. Video provides learners (students and trainees) with opportunities to observe phenomenological examples that reinforce the concepts that are verbally described during classroom and laboratory sessions and on-the-job-training. Until recently, educational video production was a multi-step, multi-component process requiring at the minimum a camera or VCR, a computer (with a high speed processor, very large hard drive, and video editing and processing software installed), and a high speed serial I/O connection to transfer the video data between hardware devices. The new Apple© iMac™ DV desktop computer and iMovie™ software offer a simple, accessible, and affordable solution to instructors who wish to create continuous media (audio and video) for use in their courses. Our demonstration will showcase the QuickTime streaming videos produced in UIUC's FSHN 199: Business Etiquette and Protocol and FSHN 355: Fine Dining Management courses.

Using Tailored, Interactive Soap Operas for Breast Cancer Education of High-Risk Hispanic Women

Maria Jibaja, Baylor College of Medicine, USA; Paul Kingery, Hamilton Fish Institute, USA; Nancy Neff, Baylor College of Medicine, USA; Quentin Smith, Baylor College of Medicine, USA; Jennifer Bowman, USA; J. David Holcomb, USA

While Hispanic women have lower rates of breast cancer than other groups, among women from all ethnic groups, they are the least likely to undergo screening exams. This study evaluated a culturally sensitive and linguistically appropriate tailored computer-based educational program on breast cancer early detection aimed at high-risk Hispanic women. Spanish-speaking Hispanic women from an inner-city community health clinic were recruited and randomly assigned to either a computer intervention with an interactive soap-opera format ($n=118$) or a comparison group ($n=60$). True-false pre- and post-tests were used to identify any change in breast cancer related knowledge/beliefs. Both younger (18-40 y.o.) and older (41-65 y.o.) women in the intervention group increased significantly their knowledge/beliefs as compared to the younger and older women in the comparison group ($p<.05$). Computer-based tailored and interactive soap operas that are linguistically and culturally appropriate are effective in increasing breast cancer screening knowledge/beliefs in high-risk Spanish-speaking Hispanic women.

webStract - a Distributed Tool for Collaborative, Project-driven Learning on the Internet

Werner B. Joerg, NetEssence / U of Alberta, USA

webStract is a combined software tool that supports the construction and delivery of Internet based courseware. It embodies a project-driven paradigm - a problem based learning approach guided by the needs of student projects. It allows content providers to make effective use of the vast knowledge source of the World Wide Web and to present the students with qualified material in a structured manner. It takes advantage also of the interaction capabilities of the Internet, to enable focused synchronous and asynchronous communication among distributed teams and team members. Following a brief introduction of the motivation and the learning paradigm, our presentation centers on the three principal areas of service covered by webStract: knowledge qualification and structuring tools for the content provider, collaboration and management tools for the teams, and knowledge management tools for the individual student. webStract is currently being used in experimental courses. We'll report feedback from those experiments.

Digital Learning System: Web's Cool

Myunghee Kang, Ewha Womans University, Korea

Web's Cool (can also be pronounced Web School) program with SRL(Self-Regulated Learning) principles, PBL(Problem Based Learning) approaches and Keller's ARCS model for motivation has been designed by the author and developed by Samsung Electronics Company in Korea. Now, all the contents and study modules are completed in CD-ROM and the total service including Q&A and real tutorial help is now available on the UNITEL web service.

Learning Amidst A Sea Of Information In The New Millennium

Dan Kauwell, University of Illinois, Urbana-Champaign, USA; Jim Levin, University of Illinois, Urbana-Champaign, USA; Daniel Schiff, University of Illinois, Urbana-Champaign, USA; Young-Jin Lee, University of Illinois, Urbana-Champaign, USA

Visualization can improve our ability to access information and construct knowledge. Information visualization is particularly well suited for the location and analysis of information found on the Internet and, for the construction of knowledge from that information. Our research has led us to develop VisIT, a tool for the visualization of Internet based information and the analysis of that information. Instead of lengthy lists of search results, the user is presented with a graphical, spatial representation of the search space. Now the user can "see" the hits returned by the search engine as well as other pages from the same site. When any of the pages are clicked, the appropriate page is displayed in the browser window. Furthermore, VisIT facilitates the knowledge construction process by allowing its graphical displays to be edited, saved and re-opened later.

An@tomedia: A New Approach TO Medical Education Developments In Anatomy

David M. Kennedy, Monash University, Australia; Norm Eizenberg, The University of Melbourne, Australia; Chris Briggs, The University of Melbourne, Australia; Ivica Grkovic, The University of Melbourne, Australia; Priscilla Barker, The University of Melbourne, Australia

Evaluations have indicated that students find An@tomedia very engaging (Kennedy, Eizenberg, & Kennedy, In this volume). An@tomedia supports students actively in their learning tasks, fostering a deeper understanding of human structure, with a stronger basis for clinical diagnosis and procedures. The new medical course has focused less on traditional teaching, instead emphasising on focussed dissection, problem-based and self-directed learning. An@tomedia provides multiple perspectives of the human body. Each module is independent and of equal importance. The modules are:

1. Back,
2. Abdomen,
3. Thorax,
4. Neck,
5. Upper Limb,
6. Lower Limb,
7. Head, and
8. Pelvis.

The first 3 of the 8 modules, the Back, Abdomen, and Thorax have been completed, each organised into 4 major perspectives.

1. 'Dissection' includes practical (including emergency) procedures.
2. 'Imaging' incorporates sectional and endoscopic anatomy.
3. 'Regions' incorporates surface and functional anatomy.
4. 'Systems' incorporates conceptual and clinical anatomy.

References

Kennedy, D. M., Eizenberg, N. & Kennedy, G. (In this volume). An evaluation of interactive multimedia designed to support problem-based learning in medicine. In ED-MEDIA & ED-TELECOM 2000, Proceedings of the 12th World Conference on Educational Multimedia and Hypermedia & World Conference on Educational Telecommunications. Montreal, Canada: Association for the Advancement of Computing in Education.

Offering Online Degree Programs: A Case Study Issues, Challenges, Successes, and Lessons Learned

Gerard Kickul, University of St. Francis, USA; Laurel Jeris, University of St. Francis, USA; Michael LaRocco, University of St. Francis, USA

Offering degree programs online offers an attractive option in the higher education environment. As schools confront this opportunity, familiar issues of quality, access, participation, retention, and assessment take on new meaning. Online delivery systems parallel traditional classrooms, including discussion and assignment areas, chat rooms, and online assessments. After experiencing high student dropout rates the University focused on several solutions to reduce its student dropout rate. These included online support systems with a centralized approach to addressing faculty and student technical concerns, complaints, and requests for assistance. A new assessment procedure consists of a two-phase process, a pre-course assessment and a more traditional assessment occurring during the final three weeks of the course. Finally, feedback from faculty on the various instructional design challenges including learning curve, time commitment, recommended class size, ethical issues, adaptability of subject matter content, and practical suggestions for reconceptualizing syllabi and assignments for online learning will be included.

Developing a Distance Education Infrastructure

Gerard Kickul, University of St. Francis, USA; Mark Snodgrass, University of St. Francis, USA

Development of distance learning infrastructure is a multifaceted project, from the desktop to the far reaches of the Internet. Attention must be focused on the outgoing data and information, as well as, incoming data and information. There are four basic areas of concern when designing an infrastructure to facilitate Internet distance education solutions: hardware, software, support, and security. Providing the proper hardware to developers and support personnel is crucial in creating a productive and efficient work environment. Reliable and efficient Internet access is essential, with 24-hour availability and minimal down time. Software components for development and support are key ingredients to success. From a student and faculty standpoint, the course software must be user friendly with a high degree of stability. Support must be considered from both a human and a technological standpoint. Essential to any online endeavor is secure access and distance learning demands the highest levels of security.

Content Management for Web Based Learning

Thomas Kleinberger, TECMATH AG, Germany; Paul Müller, University of Kaiserslautern, Germany

With the help of the newest information and communication technology all the needs of modern educational systems can be met for the first time in one tool: the computer. Computer based solutions provide the technological support necessary for the whole teaching and learning process. The greatest advantage of this tool is the possible combination of all its usable instruments, their flexibility and configurability. With new technologies and new media types it will be possible to support all kinds of training, self-study and continuing education. It is clear that these new methods and technologies require new methods and solutions for the tasks content creation, delivery and archiving. Especially the use of new media sets high requirements on these tasks. This article describes how content management systems, a technology already used in other kinds of business, can support these tasks in web based teaching and learning. A definition of content management is made and refined for the area of web based learning. The main building blocks and features of content management systems are described and the improvements for web based learning are highlighted.

Computer-Mediated Communication for Distance Education: Developing and Teaching a Second Language Course in Academic Reading

Esther Klein-Wohl, Open University of Israel, Israel

The Open University of Israel is searching for ways to improve its distance education methods. Taking advantage of the flexibility of computer-mediated communication (CMC), we will describe the application of CMC to academic reading. We chose e-mail support, which allows students to work on texts, and to receive feedback and help when needed. Reading - a mode of language use, and distance education - a mode of language instruction, feature striking parallels: the reader (in "real life") and the learner (when learning to read) each functions in isolation when interacting with a text. Discourse is enacted at a distance, a disassociated first person (the author or the instructor) is actively present, and no reciprocity is manifest, within the interactive context. Therefore, reading instruction and distance education seem very well-suited. Because CMC is particularly learner-centered, it seemed appropriate to adopt this more motivating medium of instruction to our traditional reading program.

The Major Promise of Distance Education Is On Campus

W. R. (Bill) Klemm, Texas A&M University, USA

Distance Education (DE) is reforming on-campus instruction. DE's impact extends beyond the mere use of technology to put more razzle-dazzle into classroom presentations and beyond the advantages of assisted learning via computer simulations, drills, and animations. DE should force teachers to re-examine teaching philosophies, style, and tactics. Distance Education shows that learning need not depend on classroom lecturing. Indeed, we should now re-consider the whole purpose of the classroom environment. DE prompts us to re-examine accrediting criteria of "contact hours" and "credit hours." Teachers, now freed from the lecturing straight-jacket, can explore creative ways to show students how to find, comprehend, manage, integrate, and apply information. DE reveals the value and need in teaching for more interpersonal communication, between teachers and students and among students. I see a revival of interest among teachers in group work. Specific strategies for this new kind of classroom teaching are illustrated in the poster.

Interactive Ophthalmic Pathology Tutor

Gordon K. Klintworth, Duke University Medical Center, USA; Anthony N. Benson, Duke University Medical Center, USA; Ann L. Bushyhead, Duke University Medical Center, USA

A CD-ROM interactive, instructional course on ophthalmic pathology and relevant anatomy with hundreds of high quality images has been developed for users with different knowledge backgrounds.

Cognitive Idea Processor --- Modified Mandal-Art

Kagemasa Kozuki, Konami Co, Japan; Atsushi Tsubokura, Osaka Electro Communiation Univ., Japan; Shogo Harima, Osaka Electro Communiation Univ., Japan; Noboru Ashida, Osaka Electro Communiation Univ., Japan; Katsuhide Tsushima, Osaka Electro Communiation Univ., Japan

The new idea processor called modified Mandal-Art which can assist a user in his associative thinking between given item have been developed in which a user can communicate with the system using eye movement , finger-hand motion and voice. A user of this idea processor is forced to associate by seeing only nine items on the matrix called Mandala on CRT at a time. We have measured this information retrieve behavior from item pool of our testee putting on eye mark recorder and data gloves. Human associative thinking in his problem solving is accelerated by using this cognitive idea processor. This type of idea processor may brings us innovation of educational style on the computer by using the student model which take account the real time associative behavior of a learner.

Dilemma of Inquiry and Reflection Through and With Technology: New Directions for Research in Post-Secondary Teaching

Olga Kritskaya, Michigan State University, USA; Tony Clay. Michigan State University, USA

The study explored the issues of pedagogy for teaching reflective inquiry in the undergraduate program in Educational Psychology. The analysis focused on the role of the learners' imagination and the use of instructional hyper-media texts in construction of meanings associated with the course content. Particular attention was paid to the development of student design ideas that they use for the arrangement of images, which reflect, as a special form of narrative, on their understanding of the disciplinary concepts, personalities and life experiences. The data illuminate the instructional conditions when the student's act of arranging information becomes an act of insight. The computer-based student projects (Teacher's Portfolio, Multi-Media Gallery), along with the instructional hyper-media texts, reveal a critical instructional shift in the pedagogy of teaching reflective thinking-from structure to process, from enforcing students' competence to engaging them into performance-that fosters a deeper understanding of the dialectics of socio-cultural processes.

Assessing and Training Admunct Faculty with Technology: Enhancing their Classroom Learning

Karen Krupar, Metropolitan State College of Denver, USA

Increasing numbers of adjunct faulty at all major institutions of higher education has made it imperative that institutions examine the technology competencies of this large contingent of faculty who now instruct 40% of the courses on the undergraduate level. Very little effort is being made to provide development or training for these faculty in technology applications that would keep their students current in the rapidly altering global world of the 21st centuty. Metropolitan State College of Denver reviewed their 650 adjunct faulty and found many interesting factors that will be reported during this poster session. It is evident that adjunct faculty need assistance in both learning specific technology programs and in applying the technology into their coursework.

Design an Enhanced Virtual Experiment Environment Using Science Process Skills on WWW

Li-Ping Kuo, Chung Yuan Christian University, Taiwan, R.O.C; Da-Xian Dong, Chung Yuan Christian University, Taiwan, R.O.C; Chang-Kai Hsu, Chung Yuan Christian University, Taiwan, R.O.C; Jia-Sheng Heh, Chung Yuan Christian University, Taiwan, R.O.C

This paper proposes a methodology of applying a proper distance learning system following Seven Steps of Problem Solving and Science Process Skills. To complete this process of distance learning, this paper also suggests some tools for student undergoing all the process needed in the problem solving. Virtual Experiment Environment and Experiment Record are presented for some new notions in this paper. In Virtual Experiment Environment, Visual Lab is a new idea to operate experiment in Internet and show the reality of experiment. Experiment Record solves the difficult of implementing sheet and chart in HTML document. An environment for teacher design Science Process Skills is also presented in this paper.

Analysis of messages on the Only One Earth Club; TV-based collaborative learning site on the Internet

Haruo Kurokami, Kanazawa University, Japan; Tatsuya Horita, Toyama University, Japan; Yuhei Yamauchi, Ibaraki University, Japan

Messages sent to our BBS for collaborative learning can be classified to 10 categories. Each of these categories has some types of interactions among participants and site-staffs. The types of interactions are promotion of in-depth learning, discussion, and question & answers.

Aged and Disability Care training: A CD-ROM based project

Mark Laidler, RMIT UNIVERSITY, Australia

This demonstration has been developed to highlight one solution for delivering high quality work-based training in a multimedia environment.

Civilization in the 21st Century

David F. Lancy, Utah State University, USA; David DeBry, Utah State University, USA; Megan Andrew-Hobbs, Utah State University, USA

We will report on the evolution of an on-line course. The Civilization/Humanities course had its origins in the reform of the university's General Education curriculum in 1994-95. It was one of several classes created to replace existing requirements. The reform effort was designed to create interdisciplinary classes that would put the emphasis on universal aspects of inquiry rather than the narrow focus of typical introductory classes. Other expected features of these new courses were an emphasis on writing and the integration of technology. The initial Civilization/Humanities class met these criteria and was, by several measures, quite successful. In developing his version of the class, Dr. Lancy digitized his very large slide library and students were thus able to more readily access the collection for study and review. Another milestone occurred in 1998 when the library adopted an Electronic Reserve policy. Forced to incorporate this system into his class, Lancy went further and adopted many of the built-in features of ERes" such as the "Bulletin Board." Civilization/ Humanities was moving towards the new millennium as it were. It became clear in the second year of implementing the new Gen Ed program (referred to as University Studies) that not enough faculty were signing on to teach the new courses. A bottleneck emerged which provided further incentives to adapt the few classes that had been developed to meet the new criteria for delivery to a larger audience. The most recent stage in this evolutionary process we will report on is the transformation of the Civilization course from a (primarily) classroom to (primarily) on-line delivery. In concluding we will generalize about this evolutionary process from cases gathered across the curriculum on our campus.

Wired for Learning

Donna Landin, West Virginia Deaprtment of Education, United States; Roberta Taylor, IBM, United States; Lynn Blaney, Wheeling Park High School, United States; Susan Alkire, Romney Junior HIgh School, United States

The Reinventing Education project was established under a $2 million dollar grant from IBM to the West Virginia Department of Education. Its purpose is to define and validate criteria for creating instructional plans that use the power of the Internet to address the West Virginia Instructional Goals and Objectives and improve student achievement and learning. A Criteria for Excellence was created, then employed by a group of pilot teachers to develop lesson plans that would be peer reviewed, validated by field testing, observed during classroom implementation, and repeatedly revised. The resulting lesson plans have resulted in significant learning improvement and have been placed in the Best Practices database and shared with all teachers in West Virginia. Instructional plans have been developed for K-12 classrooms in the areas of math, language arts, social studies and science by teams of teachers, pre-service teachers and college instructors. On line professional development facilitates implementation of the instructional-collaborative environment.

Redesigning An Individualized Paper-Based Course

Stéphane Lavoie, SOFAD, Canada; Jo-Ann Stanton, SOFAD, Canada

Web-based courses that are an adaptation of a paper-based version rarely take full advantage of the Internet and related technologies. Taking this into account, we developed a successful interactive web version of a French grammar course. This poster session will show how "Du français sans fautes" was reengineered to avoid the pitfalls of shovelware using an Oracle database created with Visual Basic applications. We will offer an insight into the most challenging aspect of the process: the development of interactive exercices. We will focus on how we worked around technical constraints in order to maintain our pedagogical goals. More than 1500 students have enrolled in the course since it went online in September 1998. You may access "Du français sans fautes" at http://www.dfsf.com.

Team-paced versus Self-paced: The Effects of Educational Game Design on Collaboration, Learning and Attitude towards Information Technology

Edith Law, University of British Columbia, Canada; Maria Klawe, University of British Columbia, Canada; Cristina Conati, University of British Columbia, Canada; John Meech, National Research Council, Canada

Avalanche is a multi-player game where players must cooperate to achieve a common goal. Using Avalanche, a pilot study was conducted to investigate (a) the effects of cooperative (team-paced) and independent (self-paced) learning on communication patterns, performance, learning and attitude of the players, and (b) whether there exists any gender differences in how boys and girls interact with the computer and their teammates in a cooperative gaming environment. 16 elementary school children, in same-gender groups of four, played Avalanche for two-hour sessions. Results suggest that although team-paced learning foster a positive, cooperative team dynamics, self-paced learning has a more significant effect on learning itself. In addition, boys and girls react to the two versions of the game differently. In particular, the self-paced female group demonstrates more cooperative and help seeking/giving behavior than the team-paced female group, while the reverse was observed among the boys.

Assured Quality Strategies in Web-based Accredited Programs

Judy Lee, University of Central Florida, USA

Distance learning poses a challenge to voluntary accreditation. Quality assurance in emerging technology mediated distance learning is a central issue for accredited programs. The Council for Higher Education Accreditation report (CHEA, 1998) defines "quality assurance" as the means by which the institutions or providers set their accredited programs goals and measure results against those goals in distance learning. Regional and specialized accrediting organizations are currently engaged in assuring quality in distance learning as part of their ongoing review of institutions and programs. "Distance learning is seen by many as transformative vehicle for increasing the pace of change and reform in higher education. For these and other reasons, analysis of quality assurance is an essential topic for national, state and institutional policy development (CHEA, 1998)." Areas of interest regarding Quality Assurance Strategies include course and program concerns and needs, faculty and student concerns and needs, technical needs, and administrative support.

Reference

Council for Higher Education Accreditation (1998, April) . Assuring quality in distance learning . Washington, DC: The Institute for Higher Education Policy

Training Students to Be Self-Learners in Educational Hypermedia and Technology Courses

Amy S. C. Leh, California State University San Bernardino, USA;

Modern technology is changing our education paradigm. Due to technology advancement, instructors can no longer play the role of "information-giver", rather have to become a facilitator. Facing tremendous amount of technology information, students in Educational Technology need to feel comfortable of learning technologies by themselves. The presenter employed a variety of instructional strategies in her graduate courses to train her students to be technology self-learners. In the courses, her students searched for Internet tools useful for instruction, selected computer applications that they would like to study, learned the selected tools in a team, and trained other class members the use of the tools they learned. In this poster session, the author will present teaching strategies, instructional activities, and course assignments that are related to the training. She will also report students' feedback on this kind of training.

Effective Use of Client-Server Software and Teaching Strategies in Online Courses

Amy S. C. Leh, California State University San Bernardino, USA; Laura Howzell Young, California State University San Bernardino, USA

In the field of education, many professors are incorporating online teaching into traditional courses. What is the impact? The authors received a university internal grant to convert two education courses—an instructional technology course and a course in adolescent development—to include online components. They report the benefits and challenges of using WebCT (course tools) with a variety of teaching methodologies. The poster session reflects results of a pre- and post- survey used in both courses to determine teacher attitudes toward online coursework. Students in both courses appreciated the flexible schedule of online work and time saved by not having to commute. The majority of teachers in both classes had not previously taken online courses; many liked the threaded group discussions and online testing, but a few who did not believe at the outset that on-line teaching is beneficial continued to reject it. For most of the participants, technology improved learning and achievement.

Stepnet: quality newspapers and web-based learning in the Netherlands

Jan Lepeltak, Meulenhoff Educatief, The Netherlands

Stepnet is a web-based newspaper-project in the Netherlands. Due to some educational reforms students in the upper grades of the Dutch secondary schools are to study partly individually, which implies that teachers are obliged to provide them with proper assignments. The results of these are part of the students' final examination. The use of ICT should also be part of their activities and a relation with daily (world-) news-events is strongly recommended. In order to facilitate the above aproach for teachers and students, PCM, a Dutch publishing company consisting of newspaper and educational publishing houses, developed a web-site. This site contains a D-base filled with assignments related to the contents of two daily national quality newspapers. Every three weeks during the annual schoolterm a special magazine is published. Schools will pay a fee and will receive a licence in return, which entitles all participating students and teachers to receive a copy of this magazine called the "@krant", as well as access to the assignment D-base and the @krant D-base containing the newspaper articles. In addition, teachers will receive a half a day on-the-job training about working with Stepnet.

Custom-Authored Hypermedia Exercises for Use in College Classrooms

Amy Lobben, Central Michigan University, USA

Continuously improving technology now allows educators new opportunities to move beyond traditional lecture style methods to create custom-authored multimedia, hypermedia, and animation presentations for use in classroom demonstrations or as computer-run student exercises. The development of new software programs and faster, more powerful computers, is beginning to change the creation process of dynamic presentations (multimedia, hypermedia, and animation). The once time consuming, programming intensive, and complicated methods of authoring such presentations have become manageable tasks through the use of improving computer programs, many of which are easy to learn and use. A series of computer-administered lessons have been created using Macromedia Director and Freehand. Each interactive lesson is designed to explain a specific topic and includes animation, graphics, photographs, quizzes, while maintaining stringent design guidelines. Applications such as these could have profound effects in large college classrooms, where traditional lecture-style approaches limit the individual, active learning by students.

Groupware Tools: Web File System Allows Students to Access Information Anywhere, Anytime

Tyrone Lobo, SiteScape, Inc., Canada

This poster/demo is based on SiteScape's Web File System and will explore how the Web File System allows users to securely store and manage large volumes of information entirely over the Web, giving students the freedom to access information from any industry-standard web browser.

A Web-based Hypermedia Pedagogical Course

Alla N. Makarova, St-Petersburg State Pedagogical Univeristy, Russia

The success of any hypermedia distance-learning course strongly depends on its psychological and pedagogical aspects. A study was made of the practical realization of some common pedagogical/psychological criteria in a Web-based hypermedia course. As a result of this study a template was developed which includes these criteria. This template may be included as a building block for many different hypermedia courses devoted to a particular subject. Some open problems with the template are discussed and analyzed.

Info Pursuits

Kerrie Manning, Leichhardt High School, Australia; Rosemary Ward, UTS, Australia; Tony Ward, Award Consulting Enterprises, Australia

Info Pursuits is an interactive CD-ROM game designed to teach and practice Library Information Skills. Students will answer Trivial Pursuits style questions and will be offered Information/Research Skills hints and suggestions as part of the feedback. These will include such things as techniques for finding resources, using encyclopaedias, dictionaries, non-print resources, Internet, statistical resources, telephone books, indexes, directories, interviews etc. Positive experience in using these resources may stimulate students to use them again in a different research task. The same skills are practiced many times with different resources and in different contexts, to facilitate transfer. The questions will be arranged in teaching area groups, to be used by teachers in ordinary lessons within the standard curriculum, or as extension work within standard curriculum areas. Many questions will practise general skills, but each curriculum area will provide experience with subject-specific resources.

Content Area Integration: A Step Toward Emiratisation

Reo H. McBride, Dubai Women's College, United Arab Emirates; Michael Ford, Dubai Women's College, United Arab Emirates; David Thomson, Dubai Women's College, United Arab Emirates; Raymond Yarsley, Dubai Women's College, United Arab Emirates; Laila Hawker, Dubai Women's College, United Arab Emirates

The Higher Colleges of Technology (HCT) is dedicated to the delivery of technical and professional programs of the highest quality to the citizens of the United Arab Emirates (U.A.E.). This is the goal of "Emiratisation": an affirmative action policy of employing nationals in larger numbers in the workforce, which is currently dominated by ex-patriot workers. The authors of this article state that the most effective way to better prepare our students in fulfilling their roles in the task of emiratisation, is to integrate the skills taught in English, Math and Basic Computing in the classroom, and NOT teach them as completely separate entities. In essence, integrating the skills taught in English, Math and Basic Computing develops in students greater linguistic abilities, technical skills, intellectual capacities, and leadership potential. This study describes efforts made toward accomplishing such a daunting yet absolutely necessary task for college students in the U.A.E.

High Tech Classrooms-Going The Distance with Distance Education

Patricia McNames, Indiana University Southeast, USA

The rapidly evolving paradigm of interactive distance education is changing the learning environment on and off campuses and schools nationwide. Educators are suddenly surrounded by not only the opportunities of distance education, but also by its demands. Thus, when educators begin using these boundary-spanning technologies to enhance the learning process, it does dramatically require teachers and students to change what they do. The purpose of this paper and poster/demo is to serve as a resource for educators who may be considering incorporating distance education approaches into their courses. In cyberspace, time and place are fourth dimensional. The four dimensions that will be discussed in this presentation are 1) defining the appropriate distance education system, 2) designing the interactive course, 3) developing a virtual learning community, and 4) dealing with technical difficulties.

An on-line introduction to quantitative methods

Moira McPherson, Lakehead University, Canada; William Montelpare, Lakehead University, Canada

This poster/demo describes the development, implementation, and evaluation of an "on-line" introduction to an undergraduate course in quantitative methods. The virtual curriculum modules developed for the course provided a forum in which information, knowledge, expertise, and questions could be explored and updated throughout the course. Working asynchronously, the user completed six assignments. Questions which arose during the user's session were passed to "experts" that provided feedback, electronically. The "question - feedback" loop was a dynamic component of the organizational structure and used different modes of communication, including e-mail, electronic conference rooms, bulletin boards, and on-line help pages. The assignments were submitted electronically to teaching assistants who evaluated the submissions and provided feedback directly to the users. The inclusion of direct feedback communication between experts and users reduced the impersonal characteristics that might arise within an asynchronous learning-environment.

Principles Of Cognitive Evaluation For An Educational CD-ROM For History

Christina Metaxaki-Kossionides, University of Thrace, Greece; Elevtheria Gonida, University of Thrace, Greece; Stavroula Lialiou, University of Athens, Greece; Georgios Kouroupetroglou, University of Athens, Greece

The evaluation of CD-ROMs and multimedia products used in educational environments ,is a major topic. One of the erasing problems is the formation of a set of pedagogical principles or concepts and their technological implementation. We present the formation of a set of cognitive principles. Those are included in the set of evaluation , concerning a CD-ROM developed by us. The topic was a history lesson about the Homer period. We have selected two types of principles which , together with the ones for software development, should form the set for the formative evaluation. The one sub - set included the pedagogical requirements for the lesson of history. The other sub - set included the principles delivered by the cognitive scientists. These last ones were developed for the specific topic. They mainly refer to the nature and processes of learning and instruction. The set of the cognitive requirements were added explicitly as fields for a database for software evaluation.

Authoring Multimedia, Designing Animations for Physics Education

Donald J. Metz, University of Winnipeg, Canada

Computer animations used in high school physics instruction are demonstrated. The programs are written using Asymetrix Multimedia Toolbook and are designed to address the specific needs of the students and their learning environment.

Dynamic Communication Layer Between Virtual Laboratory and Intelligent Agents

Kaufmann Meudja, UniversitT de Sherbrooke, Canada; Roger Nkambou, UniversitT de Sherbrooke, Canada

In the last few Years, virtual laboratory has become an important part in online courses. Some of those virtual labs involve intelligent behaviour. However, this intelligent behaviour is usually hard-coded in the virtual lab and therefore, limit the possibility of using reusable intelligent agents that are completely separate from the virtual lab and which can control most users actions in the virtual laboratory environment. We propose a way to separate intelligent behaviour from the virtual lab by the implementation of a communication layer between the virtual laboratory and intelligent learning agents.

Design, Delivery, and Evaluation of Online Courses: A Primer

Jerold Miller, United States International University, USA

Online learning environments can be highly interactive and student-centered. Incorporating the contributions and experiences of each member of a learning community into the coursework encourages students to contribute more of themselves to the course and allows them to learn more from their teachers and peers. Creation of functional online learning environments is contingent upon the effective design, delivery, and evaluation of online courses. This session will address the design of online courses and adaptation of traditional courses to the online delivery mode. Participants will understand appropriate online delivery methods, explore teacher-centered vs. student-centered learning, understand effective strategies for communication online, know how to adapt content and curriculum for online teaching, discover new assessment strategies for distance learning, and learn how to create an online community of learners.

Discovering xyAlgebra: Intelligent Interactive Internet Instruction

John Miller, The City College of CUNY, USA

Abstract: Passive activities such as watching presentations, listening to explanations of general principles and watching experts solve sample problems are helpful, but peripheral, to the mathematical learning process. For students the indispensable step is solving problems for themselves. Yet most commercial mathematics software still concentrates on presentations and sample problems, while sending students off line to do practice problems on paper without interactive support. Answers are either multiple choice or limited to a single simplified final step. Early Internet courses are even less interactive. In contrast, students using xyAlgebra can enter each step of each problem solution. They enjoy intelligent support at every step as xyAlgebra's suggested solution strategy changes in response to their steps in simplifying expressions, solving equations and even in setting up and solving verbal problems. The next version of xyAlgebra will support instruction over the Internet, yet the entire package can be downloaded without cost at math0.sci.ccny.cuny.edu/xyalgebra.

Problem-based Learning and Flash 4.0: An Experiment in Science Education

Leslie Miller, Rice University, USA; Janice Mayes, Rice University, USA; Donna Smith, Rice University, USA

How does one design learning resources that will reach large audiences, capture the imagination, and compete with the game environments that are popular among of middle school students? The Reconstructors is a new episodic adventure series, designed for the Web, with a substantive educational message. See http://reconstructors.rice.edu where a student enters a futuristic world in which he or she assumes the role of a "reconstructor." In the interactive mystery format, a student learns science and history relevant to the discovery and use of opiates. Over the course of four episodes or missions, students "solve the problem." The concepts of neurotransmission, the neurobiology underlying drug addiction, drug tolerance, and analgesia, as well as the history of opium use are presented.

On-Line Education Using Video Broadcasting Delivered from Perth Campus, Algonquin College

Maike Luiken Miller, Algonquin College, Canada; Dave Osborne, Algonquin College, Canada; Ian McCormick, Algonquin College, Canada

As part of the LCN (Lanark Communications Network) TAP project, Algonquin College at Perth Campus engaged in a video broadcast/conferencing pilot to deliver a course, "The History and Philosophy of Architectural Conservation" (ARC9001), simultaneously in 2 modes: lectures with electronic slides and traditional black board work and, in parallel, video broadcasts (IN@SEC VP Broadcaster) with e-mail feedback. This pilot demonstrated successfully that on-line co-delivery allows to teach students simultaneously at different locations employing video, audio and text via a network using relatively inexpensive broadcasting/conferencing software with minimal set-up requirements at the clients' site. Course delivery improved. Students enjoyed the choice of delivery modes to suit their learning styles. Professor appreciated more time for interacting with the students. Re-broadcasting at a later time possible. The delivery model - independent of the specific broadcasting tool - provides a means to reach remote connected students everywhere - be it rural or elsewhere around the world.

TLC : Teachers' And Learners' Collaborascope – A Platform For Analysing And Evaluating Online Education

Michelle Montgomery Masters, University of Glasgow, UK; Stewart Macneill, University of Glasgow, UK; Prof Malcolm Atkinson, University of Glasgow, UK

Millions is being spent on installing networks, computers and assembling distance learning material and ICT (information and communications technology) software. Yet the network technology is not being used to assemble databases which researchers, managers and politicians can "data mine" to guide their investment. In the TLC project we are pioneering techniques for assembling and querying educational data. Our goal is to initiate research into the best methods of rapidly assessing the effectiveness of resources deployed and then interpreting the data to improve our educational performance. We are not trying to reinvent the wheel and produce yet another online learning environment like WebCT or Virtual-U. Instead we are building tools which will work in collaboration with these existing learning environments and provide teachers and students with valuable information about the usage of their learning environment. The TLC project aims to utilise the emerging standards such as those from the IMS project.

The Third Dimension For World Of Knowledge: An Acceptable Way To Get In

Mikhail Morozov, Mari State Thechnical University, Russia; Aleksander Markov, Mari State Thechnical University, Russia

Educational CD-ROMs should be as interesting and attractive for children as computer games. The approach offered by the authors allows to reduce the existing gap between multimedia for education and for entertainment. It is achieved due to the unusual design of 3D interface and by using a special technique of development. As a general metaphor for organisation of multimedia environment the metaphor of theatre with all appropriate attributes was

chosen: the stage with visual educational content, side- scenes, a curtain, etc. For presentation of educational material in addition to traditional multimedia components, the new integrated forms are used. Because of complexity and richness of information of the CD-ROM model, its realization is based on graph of program transitions and application of script paradigm, which is accepted for the description of structure of the educational and navigating information. These solutions can be recommended for creation of a new generation of "three-dimensional" educational multimedia CD-ROMs.

Using a Web Site to Increase Student Motivation to Write and Enhance the Reading/Writing Relationship

Susan Nelson, Elm Street Elementary School, USA; Harrison Yang, State University of New York at Oswego, USA

This action research project is an example of how Internet technology is being used in an elementary classroom as a means to increase student achievement. The project explores the relationship between writing and reading and its affects on early literacy development. It also explores the concept of motivating students to write by publishing student work for real life audiences. The project uses the current technology of an Internet web site as a source for publishing student writing. It explores the effects that this type of publication has on student attitude, motivation to write, and literacy development.

TELSI, Web-Based Software For Collaborative Learning

Graciela Nielsen, Norwegian State Center for Adult Education, Norway; Boo Hever, Majornas Vuxengymnasium, Sweden; Aase Steinmetz, Undervisningsministerium, Denmark

The TELSI software has been developed with the support of the European Union under the SIMULAB-project. SIMULAB is a concept for Web-based collaborative tasks. TELSI has been created to cater for the needs of this type of activity, and is a flexible and user-friendly environment.

Development of Speech Input System for Web-based Courseware

Ryuichi Nisimura, Nara Institute of Science and Technology , Japan; Shoji Kajita, Nagoya University, Japan; Kazuya Takeda, Nagoya University, Japan; Fumitada Itakura, Nagoya University, Japan

We proposes WebSPEAC(Web SPEech Acquisition for Courseware) System that provides a speech-input function for Web-based online education system. WebSPEAC has the following three features; (1) easy to maintain the system by the use of a simple speech input program in Web browsers, while the other speech processing are performed on the Web server, (2) a natural interactivity between Web server and users by using the server push techonology, (3) a simple installation and no needs of external programs on client machines. To show the effectiveness, an Web-based speech analysis system, a speech recognition system and a student identification system are developed as the examples of WebSPEAC System. By using the speech analysis system, it is clarified that WebSPEAC System can significantly reduce task steps, error steps and elasped time for speech-input task, compared with the conventional method (file upload).

The Instructional Portal Project

Kevin Oliver, Virginia Tech, USA

The Instructional Portal is a clearinghouse of information, resources, tools, and services at Virginia Tech, designed to facilitate practical instructional design among faculty. Faculty can increasingly adopt and easily utilize educational technologies in their courses. While some faculty use technology to modify and improve teaching and learning practices, too many rely on tools to simply make their existing teaching practices more efficient. The portal is designed to help faculty integrate technology more effectively by applying three instructional design components. The analysis component outlines strategies and instruments to account for environmental and learner characteristics, and provides information about structuring course content. The strategy component describes instructional methods and models that utilize technology effectively, and provides teaching modules covering popular web-based instruction and interface design issues. The evaluation component describes evaluation methods and models and provides tools to help faculty revise and improve their technology innovations. Visit the portal at: http://www.edtech.vt.edu/edtech/portal/index.html

Integrating and Adapting Multimedia Resources

Mary Panko, UNITEC Institute of Technology, New Zealand

In UNITEC students enrolled on an Automotive Trades course have access to a series of 32 CDX disks, entitled The Automotive Trainee Series that provides them with a learning resource in addition to their basic theoretical and practical teaching. This study attempted to:

- discover what beneficial learning effects the students perceived as being currently provided by the multimedia component;
- examine the extent to which the tutors integrated and adapted the multimedia material as part of their teaching; and

- compare patterns of current disk utilization with those of the previous year.

Results showed that although both staff and students thought the multimedia material valuable, its overall utilization by students had diminished over time. The reason for this appears to be the lack of integration of the resource by tutors into their teaching. Furthermore, tutors had generally not adapted the material for their own needs although where workbooks had been provided, this seemed to increase the students' satisfaction.

DISCETECH-BIMBOTECH: An Experimental Project For Introducing Innovative Technology Within The Italian School System

Paolo Paolini, Politecnico di Milano, Italy; Pierluigi Della Vigna, Politecnico di Milano, Italy; Francesca Collina, Politecnico di Milano, Italy; Paolo Magatti, Politecnico di Milano, Italy; Silvia Moiola, Politecnico di Milano, Italy

Since 1996 Politecnico di Milano has launched a program for experimenting, within the Italian school system, the use of advanced technology for teaching and learning. Two projects (in Como and Lecce) have involved more than 700 teachers and more than 8.000 pupils, being the largest of this kind in Italy, both in High Schools (Discetech project) and grammar schools (Bimbotech). The project emphasizes the role of the teachers, who are trained on multimedia and Internet technology first. Secondly they are "guided" and assisted in shaping up specific activities with usage of either multimedia CD-ROM's or Internet Sites. A large collection of CD-ROM's has been created and several hundreds educational Websites, on different subjects, have been classified. The project has been very successful with the teachers (many of them have never used advanced technology before) and the pupils, the learning and the interest of which has been evaluated as sharply improved.

Learning Experiences in New Learning Environments

Heli Pekkala, University of Jyvaskyla, Finland

One of the outcomes of a departmental action research project at our language centre is a modernised Learning Centre, where students and staff of the university have access to learning materials in over 30 languages. The philosophy and pedagogical framework underlying the operations of the centre is to support and encourage students in developing their learning skills and self-directiveness for continuous language learning and for making effective use of new learning environments . This poster presents the Learning Centre (interactive studios, writing studio, multimedia studio etc.) and reports student experiences of learning a new language independently. One part of this learner training course Learning to Learn Languages was a self-access project during which students were requested to reflect upon the kinds of qualities and procedures that self-directed language learning requires from a learner. They also evaluated what areas of language were possible to access without external structuring and teaching.

Microsoft Office as a Learning and Teaching Tool

Craig Place, Acadia University, Canada; Michael Shaw, Acadia University, Canada

Many useful features in popular software applications often go unnoticed by many users. Often thought of as a business application, Microsoft Office is one such suite of applications that is often overlooked as a tool for use in the teaching and learning environment at most grades, and at the university and college level. With just Word, Excel and PowerPoint, MS Office can be used as a tool to develop the basic understanding and expertise for a number of other applications including photo-editors, drawing and animation programs, multimedia authoring and web-development tools. Used as a stepping stone to more advanced applications in this way, the interface of each of these 3 applications can be simplified to be useful at a number of different grade levels, or levels of expertise. Using a combination of examples and hands-on exercises the workshop will illustrate to the participants how MS Office can be used to easily and effectively create multimedia hyper-documents, dynamic learning-objects, student review exercises and interactive non-linear presentations. Specific examples will be the use of PowerPoint as a concept-mapping tool and as a multimedia authoring and animation tool. Using Excel to assist in language learning and create dynamic graphs for interactive what-if scenarios, and using Word to develop hypermedia templates and collaborative writing documents. Several examples of the usefulness and creation of macros will also be shown.

Students' expectations and perceptions of efficacy for self-regulated learning in mediated learning environments: Partial results of an evaluation

Laura Helena Porras, Universidad de las Americas, Puebla, Mexico

This paper discusses partial results of an evaluation applied to an educational teleconferencing system in a Mexican higher-education institution. Courses offered through the system are based on a pedagogical model, which emphasizes the active role of the learner as responsible of her own learning. Therefore, perceptions of the self, and self-regulatory processes become key components in this learning environment. Conclusions here presented correspond only to: (i) students' expectancies, (ii) perceptions of efficacy for self-regulated learning, and perceptions of the course, and of the teacher and learner's work. Results indicate students' expectancies focus on "learning more than in face-to face situations", followed by "using technology", and "having freedom and initiative". Perceptions of efficacy for self-regulated learning were high overall. Nevertheless, analyses of individual items identify specific areas of improvement. Qualitative data on perceptions of the course, and teacher's and learner's work suggest that these courses are more demanding than the face-to-face ones they are taking. Students' responses include attitudinal and cognitive adjustments needed for these learning environments. These results have led to improvements, which are presently being applied.

An Online Model For Precalculus

Hari Pulapaka, Valdosta State University, USA; Denise Reid, Valdosta State University, USA

Some of the greatest challenges to designing and delivering a completely online mathematics course are effective and efficient uses of the leading technologies that are available for this purpose. The authors have just completed designing the first version of a precalculus course that is being delivered through a combination of synchronous and asynchronous environments. Precalculus was chosen over other mathematics courses for several reasons. The course has been planned as a model online course for any mathematics course (especially at the early levels). Future versions of this course and related courses will undoubtedly incorporate additional technologies and components in an effort to improve student learning, interactivity, and end-user feasibility. Future plans for the course include development and refeinement of the unfinished sections of the course and tighter integration with graphing calculator and/or mathematical software.

IMAGUS: An Environment To Design Video Applications For Digital Libraries

Andre Luis Alice Raabe, Pontificia Universidade Catolica do Rio Grande do Sul, Brasil; Lucia Maria Martins Giraffa, Pontificia Universidade Catolica do Rio Grande do Sul, Brasil

This poster presents the description of the IMAGUS environment. IMAGUS has tools to built video applications supported by Internet. This environment has being developed in order to contribute for the construction of the PUCRS digital library collection.

Art, Poetry, and Instructional Media

Thomas Reinartz, Rosemount High School, USA; Brad Hokanson, University of Minnesota, USA

In many high school English courses, students are trained to seek out proper form and work toward clarity in their writing assignments. They are taught to write using complete sentences and complete thoughts, fix their punctuation and grammar, and strive for polish in all written work. That is what English is all about. On one level, we can be pleased with their concern. However, this quest for excellence and perfection seems to interfere with the poetry writing process. Many successful poems lack complete sentences, defy traditional uses of punctuation, and contain word combinations that require readers to make inferential connections, often sacrificing the writing clarity that English teachers work so hard teach. We have taught them to be concise, clear, and correct in all writing endeavors, which in most cases, is sound advice. Writing poetry, however, demands skills that require us to play with words and dwell in areas where word juxtapositions and combinations are limited only by one's imagination. The many choices in this "zone" of possibility are frighteningly endless, so it is no wonder students resist entering. They may get lost. To help foster an awareness about word choice and imagery, we developed an interactive program to generate "found" poetry with student input and used it in a twelve week American literature class taught by T. J. Reinartz, one of the authors. The program evolved from discussion between the authors regarding the use of computers to inspire poetry writing. A multi modal qualitative research study was undertaken involving classroom observation, video taping, survey questions and analysis of poetry segments. The findings of that research and analysis will be presented, with broader observations of the use of computers 'in the service' of poetry, and their appropriate use in the high school classroom.

Students as Producers: Changing the Way we Teach and Learn

Gail Ring, University of Florida, USA; Sebastian Foti, University of Florida, USA; Melissa McCallister, University of Florida, USA; Tamara Pearson, University of Florida, USA; Ebraheem Alkazeemi, University of Florida, USA

Educational technology courses at the University of Florida are modeling the concept of students as producers. Through student-based projects such as an online support center, educational software, student portfolios, and documentary-type CD-roms our students are producing educational products. These 'real' activities are improving our courses as students learn by doing, thereby creating a constructivist learning environment. Relevant, contextual projects such as these provide students with an increased sense of empowerment and ownership. In our presentation we will share how the traditional roles of instructor and learner may no longer appropriate.

The GPB project; A successful PHD seminar using Videoconference in real time and a list to communicatebetween the classes

Claire Roberge, University of Quebec in Montreal, Canada

This winter 2000, a seminar was offered at the PHD level in the departement of Communication at the University of Québec in Montréal.Three teachers participated, one from Montréal, one from Paris and one from Grenoble. Seven sessions were offered in videoconference to all students enrolled. A website and a list were added tools offered to the students to communicate between the sessions. The sessions in videoconference were in real time.

Teachers and students made presentations and periods of questions were planned at the end of each of those presentations.The experience which will be renewed next winter was a success. Technology was used wisely, the teachers made sure the environment available enhance the learning process of their students.The differences in cultural habitus and in the uses of technology were taken in consideration.An evaluation was made taking seriously all factors.

Multimedia Training , Virtual Instrumentation and Remote Laboratory a New Approach to the Electronic Courseware

Nicoletta Sala, Academy of arch. University of Italian Switzerland, Switzerland

This work describes a project developed at the Department of Electronic Politecnico of Torino in the field of multimedia technologies in educational process. The goal was to allow the students to carry out a pre-training activity outside the laboratory and possibly at home; each student could thus individually adequate the learning rate to his own capabilities. After this pre-training phase, students who enter the laboratory require reduced assistance and less time to complete the training activity. This approach can reduce the qualified assistance that is not easily found. For this reason several hypermedia mod-ules have been developed (using Multimedia Toolbook) to assist the students to acquire the fundamentals of the basic electronic instrumentation. The subjects developed are:

- fundamentals of the analog and digital oscilloscope, which includes practical exercises;
- fundamentals of the analog and digital voltmeters and their operating theory;
- the IEEE488 standard interface for programmable instrumentation;
- the logic analyzer;
- the spectrum analyzer.

Virtual instruments are implemented in order to allow simple simulations of the real instruments during the self-training phase A client-server system has been designed in order to allow the students to operate on a remote laboratory for experimental training. The idea is to design a laboratory that is simultaneously and remotely accessible to several students, who concurrently share the same instrumentation, but not necessarily the same experiment. The instrumentation and the other hardware resources are accessible in a sort of time sharing process, which is managed by a server and transparent to the user. The virtual laboratory architecture is composed of two kinds of subsystems: the measurement Server and the measurement clients.

Strategies for Teaching and Learning: Lessons Gained from an Ethnography of Graduate Classes in an Interactive Distance Learning Studio

Lorraine C. Schmertzing, University of West Florida, USA; Richard W. Schmertzing, Valdosta State University, USA

This poster session is based on data collected during a one-year ethnographic case study of graduate education classes during the inaugural year of a 2-way audio/2-way video interactive distance learning classroom at a regional university in the southern United States. Cultural anthropology and symbolic interactionism acted as guide to uncover and describe the processes through which adult learners transformed traditional classroom culture as they implicitly redefined that culture during their initial exposure to a specific distance learning environment. This poster session addresses the often un-addressed complexities inherent in re-defining ones learning environment so that effective learning can occur and offers strategies for teaching and learning based on these complexities. Strategies include ideas for the first night of class, cultural awareness activities, feedback forums, and rules of engagement.

Use of Telecommunications Technology in Radiation Accident Simulation

Domenic Screnci, Boston University School of Medicine, USA; Kirsten Levy, Boston University School of Medicine, USA; Erwin Hirsch, Boston University School of Medicine, USA; Richard Aghababian, University of Massachusetts Medical School, USA; Tracey Russo, Boston University School of Medicine, USA

Radiation accidents are rare but increasing in frequency. Partners in a regional project are providing training on radiation accident preparedness in Eastern Europe and the New Independent States. Recently, the partners devised a radiation accident exercise to simulate radiation exposure and test inter-regional cooperation among eight nations. A variety of multimedia, communication and distance learning technologies was used to execute the exercise. This poster describes:

- Objectives
- Design
- Procedures
- Communication Plan
- Educational Technologies

The exercise demonstrates a live response to a simulated radiation accident; the ability to exchange information among peers, request resources and notify appropriate agencies; and the use of communication technologies to debrief the experience. Also demonstrated is the use of distance learning technology to cultivate regional harmonization of response in a field in which preparedness is essential but practical exercises lacking.

Teaching data analysis using thin client technology for remote access

Robert Seidman, San Diego State University, USA; K. Michael Peddecord, San Diego State University, USA

This poster describes implementation and outcomes of using thin client technology to provide remote access in a data analysis course. All software applications run on the course server, so no downloading of data or software is required. Results from statistical analyses are transmitted to students' client machines. Students were able to launch applications and complete assignments from any location that had Internet access. In addition to 7/24 access, students were able to use software they did not own and large data files they did not have on their own computers. While they generally expressed satisfaction with this remote access capability, drawbacks included initial programming time and cost of the server software, lack of familiarity with operating in a networked environment, frustration with server-side disconnects or ISP interruptions, and occasional inability to print at home because the server software does not include all old printer drivers.

Multimedia Guide to Fractal Geometry

Vladimir Shlyk, Belarusian State Pedagogical University, Belarus

Fractal geometry has changed our view of natural processes and geometric forms. The Guide is a software kit supporting a university course on this science. It contains an introductory electronic textbook, annotated list of publications, favorite Internet links and provides facilities to run programs. One program of the project visualizes the mechanism of birth of classical and IFS fractals. A student can grow fractals by himself and explore their features by trying different generators and mappings. Another program demonstrates connection between the Mandelbrot and Julia sets. It throws a bridge from fractal geometry to nonlinear dynamics and chaos theory by showing different variants of behaviour inherent in underlying quadratic process. Having advantages over analogous programs, it is already being used at several universities. To create the most complete educational software on fractal geometry we would be pleased to collaborate with other specialists and enthusiasts.

Project-Based Learning + Multimedia: Adding Value to Students' Education

Michael Simkins, Silicon Valley Network, USA; William R. Penuel, SRI International, USA

"Does technology really make a difference in student learning?" Definitely, according to the Challenge 2000 Multimedia Project, one of the original Technology Innovation Challenge Grants funded by the U.S. Department of Education. The Project has demonstrated significant educational results when technology investment includes teacher training, technical support staffing, and curriculum materials development. In a five-year evaluation of the $6.2 million project in California's Silicon Valley, SRI evaluators found that technology-using students surpassed their non-technology-using peers in developing some of the most critical skills for the new economy of the 21st century. These skill advantages included better communication, teamwork and problem-solving. Researchers also found important positive changes in teachers classroom practices that support a constructivist approach to learning. In addition, these same students equaled their non-technology-using peers in learning the basic skills measured in standardized tests. In short, students in technology-using classes not only "got the basics," they got more.

The Search for the Skunk Ape: An Information Literacy WebQuest

Charlotte Slater, The Walden Institute, USA; Pamela Sawallis, Florida Gulf Coast University, USA

A web-based instructional resource for distance and on-campus learners uses elements of goal based scenarios (Schank, 1994) and WebQuests (Dodge, 1997) to provide a "fun," story-based environment for learning information literacy skills. This project represents a partnership between instructional technology and library services at a state university.

Online Learning in a 3-D Robotics Workshop: The NASA ROVer Ranch

Stephanie Smith, NASA/LinCom, USA

The ROVer Ranch is an online environment based on NASA's mission as it relates to robotics engineering. Students are situated where they learn about robots and then build and run simulated robots in a 3-D virtual world. The robotics workshop has all the components to build a "soft" version of a robot and the tools needed to instruct the robot to complete its mission. Student engineers or teams select a mission, review the mission goals then design a robot with the appropriate attributes (power source, navigation planning, tools, etc.) based on the mission objectives. Once the robot is constructed, students plan a navigation path and then place the robot in the simulation to execute the mission. This simplified design and programming exercise is an interactive method to learn science and math skills both individually and in a team setting as students share their experience in journals and team message boards.

OATS: Operational Amplifier Tutorial Simulation; a dynamic presentation

Sarah Sniderman, Concordia University, Canada; Gary Boyd, Concordia University, Canada; Geza Joos, Concordia University, Canada

Abstract: Operational Amplifiers are among the most important components used in analog electronic devices. They are complex and initially counter-intuitive in behaviour. Electrical engineering and electrotechnology students frequently need special tutorial help to understand them and configure them to work properly in various circuits. The main advantage of simulation programs for higher education in technical fields is that, when carefully designed, they can promote higher level instructional goals of prime meta-cognitive value, especially those involving the autonomous active construction and exploration of knowledge at a pace appropriate for the learners. Note, however, that such free exploration of knowledge at a responsive pace is not a quality inherent in multimedia instruction. High-level interactivity involves more than guided clicking through branched instruction. A truer understanding requires a learning environment which accommodates the testing, falsifying, validating, and elaboration of understandings.

The Munchhausen-Trick: Learning Internet by Internet

Ralph Sontag, TU Chemnitz, Germany; Dietrich Thie, TU Chemnitz, Germany

The Chemnitz University of Technology is the first one in Germany, which is able to offer an internet-based study about information and communication technology. The participants of the courses are able to collect fundamental and applicable knowledge about internet-related technologies using it - a problem comparable to the baron of Munchhausen, which drags himself at his tuft out of a marsh. After two introducing lessons the communication between learners and teachers is stricly internet-based. Stepwise the students are qualified to understand and maintain complex situations in management of ip-networks and servers. The knowledge can be proofed in a remote managed, but actually existing laboratory. Moreover we had to consider the very heterogenous working times of our participants. We prefer asynchronous communication with short turn-around-times in conjunction with online-tools like "virtual seminars", tests or experiments. The consequently platform-independent project uses open protocols and standardized document formats like HTML or XML.

In defence of 'shovelware': A powerful tool in staff development for online teaching and learning

Heather Sparrow, Edith Cowen University, Australia; Jan Herrington, Edith Cowen University, Australia; Tony Herrington, Edith Cowen University, Australia

A significant challenge for universities creating effective online learning environments is educating and empowering teaching staff. Those who are not confident using technology are frequently unconvinced about the benefits and are concerned that it will force unwanted changes on their current practices. This poster outlines a project which introduced a large number of variously experienced academic staff to online teaching, whilst maintaining or enhancing effective learning. The project included the simple conversion of print-based external units to an online mode, as one of several strategies of development. Whilst this process is often referred to derogatively as shovelware, some of the positive and immediate outcomes achieved will be described, and challenges will be made to extremely negative attitudes towards such conversions.

An Evaluation of Video Compression Schemes for Teleteaching Applications

Ognjen Stanovcic, Open Systems AG Zurich, Switzerland; Thomas Walter, Swiss Federal Institute of Technology Zurich, Switzerland; Bernhard Plattner, Swiss Federal Institute of Technology Zurich, Switzerland

Synchronous, interactive teleteaching is demanding with respect to required network bandwidth and short end-to-end delays. An uncompressed digital video, e.g., requires a data rate of 261 MBit/s. Video compression is a method to reduce required network bandwidth. Efficient video compression is almost lossless with respect to perceived video quality at the receiving site, but it is time intensive. In support of interactivity, however, response times must be short to allow participants to audio-visually communicate like being in the same room. This implies that the end-to-end communication delay should be less than 150 ms. This requirement puts a hard constraint on video compression since compression time is only one factor that adds to the overall end-to-end delay. We present a framework for the evaluation of video compression schemes. We define evaluation criteria such as compression delay and compression efficiency. The video compression schemes evaluated are Motion JPEG, MPEG, H.261 and H.263.

Multibook: making web based learning resources personal

Achim Steinacker, TU Darmstadt, Germany; Cornelia Seeberg, GMD IPSi, Germany; Ralf Steinmetz, GMD IPSI, Germany

Considering the amount of knowledge accumulated on the Web, the discussion of an effective use of the web resources becomes urgent. The main question is how to find the relevant information . In our web based teaching

system Multibook we use modularized learning content stored in a knowledge base and describe these modules such that the combination of modules can be matched to the users preferences, represented in a user profile. In this demo we will show our knowledge base containing both the actual multimedia learning resource and the metadata in form of a terminological ontology, attributes for the resources and relations between the resources. Then we sketch the user profile and finally we show how these components are matched together

Math and Science Curriculum Revision: A Collaborative Approach to Improving Preservice Teachers' Use of Technology Knowledge and Instructional Skills.

David Stokes, Westminster College, USA; Carolyn Jenkins, Westminster College, USA; Lorel Huhnke, Westminster College, USA; Gothard Grey, Westminster College, USA; Cheryl Manning, Bryant Intermediate School, USA

Reports on a Preparing Tomorrow's Teachers to use Technology Capacity Grant project, a consortium comprising Bryant Intermediate School, and Westminster College, both of Salt Lake City, Utah. The consortium participants engaged in collaborative curriculum development to provide preservice teachers greater exposure to the instructional uses of technology in education. Skills in the application of communication, presentations, and CLE technologies were explored. Teaching units integrating sound curriculum with technologies including: video-microscopes, CBL probes, graphing calculators, Excell, PowerPoint, various software programs, and the Internet were developed. Outcomes suggest improved teaching with technology skills, better real-world collaborative inquiry, greater focus upon multiple learning styles; and gains in extending the power of scientific inquiry into mathematical and scientific reasoning.

Integrating pedagogy, content and technology into your curriculum

David Stokes, Westminster College, USA; Wanda Carrasquillo-Gomez, Westminster College, USA

Perhaps there are fewer more daunting tasks to teacher educators than to find the time, means, and information to begin to more fully integrate technology as an instructional and learning tool into their courses. Over the past year the authors conducted a thorough curricular revision of technology courses offered in the Master of Education program at Westminster College in Salt Lake City. Courses were redesigned focusing curriculum upon technology as a communication rather than a presentation medium. Outcomes suggest this approach is beneficial to generating increased understanding of the role technology can play in teaching and learning, and in strengthening key linkages between constructivist theory and teaching practice.

SMILE Maker - An Intelligent Learning Environment for Problem Solving

Svetoslav Stoyanov, University of Twente, The Netherlands

This poster introduces SMILE Maker - a web-based tool supporting ill-structured problem solving activities of students involved in problem-based learning. SMILE Maker stands for Solution, Mapping, Intelligent Learning Environment. It is both a problem solving and a learning tool. As a problem solving tool it proposes a method for creative problem solving based on the synergy of some mapping approaches like concept mapping, mind mapping, cognitive mapping, flowscapping, and process mapping, and a systematic creative problem solving methodology. The method facilitates elicitation of tacit knowledge, an effective organization of the explicit knowledge, and avoidance of some negative individual problem solving syndromes like analysis-paralysis, functional fixedness, premature judgment, and etc. As a learning method it provides an individualized learning environment for studying and applying this method. It adapts learning to four personal constructs such as learning styles, problem solving styles, learning locus of control and prior knowledge.

An Adaptive Web-based Course in Financial Engineering with Dynamic Assessment

Alberto Suárez, Universidad Autónoma de Madrid, Spain; Estrella Pulido, Universidad Autónoma de Madrid, Spain; Rosa Carro, Universidad Autónoma de Madrid, Spain

The increasing relevance of interdisciplinary skills calls for the design and implementation of novel strategies to address the problem of teaching a corpus of knowledge to a heterogeneous audience. We have chosen a problem in financial engineering, the valuation of European options, whose mastery requires the interplay of mathematical, computational and financial tools. The target audience in financial engineering courses is generally composed students of either financial background or from a scientific, non-financial area (mathematics, computer science, physics). The course is designed within the framework of the TANGOW system (http://www.ii.uam.es/esp/investigacion/tangow/present.html), which provides the necessary mechanisms to construct a web-based course whose contents are dynamically generated according to the student's profile and actions. The system includes the possibility of dynamic assessment, which involves testing not only the student's ability to understand static knowledge, but also his/her ability to actively design procedures (programming analytical formulas, realization of simulations) to achieve the prescribed goal.

Building Learner and Teacher Autonomy for New Learning Environments

Leena Subra, University of Jyvaskyla, Finland; Liisa Kallio, University of Jyvaskyla, Finland; Ulla Lautiainen, University of Jyvaskyla, Finland

The poster reports on the experiences of our departmental action research project aiming to explore the use of ICT-enhanced methods in promoting both learner and teacher autonomy/self-directedness in discipline-based language learning and instruction. The action research approach involves continuous staff development, needs identification and aims-setting, teacher and learner self-assessment, learner training, and development of a variety of learning tasks suitable for self-directed learning in both authentic and virtual learning environments. It also involves an attempt of creating a set of ICT-enhanced course formats which - without significant, time-consuming and technically demanding modifications - could be used in teaching and learning languages. The poster describes pilot courses which use different approaches, materials and programmes, and are aimed at different kinds of learners. They cover a variety of possibilities and combinations but remain within the same pedagogical framework, since learner and teacher autonomy are the basic guidelines in all the pilot courses.

Development of a Computer Aided Cooperative Classroom Environment

Akira Suganuma, Kyushu University, Japan; Ryunosuke Fujimoto, Kyushu University, Japan; Yutaka Tsutsumi, Kumamoto Gakuen University, Japan

In the educational domain, a popularization of computers and the Internet enable us to hold lectures using Web contents as a teaching material. We propose CACCE, Computer Aided Cooperative Classroom Environment, which is an WWW-based supporting system for a classroom teaching. CACCE consists of a server-software and a client-software, that is to say, a teacher's browser and a student's browser. These browsers are connected together by a socket connection, sends and receives some messages such as a URL and the CACCE's command. There are three main features of CACCE. First, CACCE automatically refreshes student's browsers. Secondly, CACCE displays a cooperated mark and text on these browsers. Finally, student's browsers automatically report an URL of page shown by them to teacher's browser. This information is used as one of the guidelines for teaching. It is concluded that CACCE is not only a tool that broadcasts the document on a teacher's browser to students, but also a cooperative environment.

Using Knowledge Models in Intelligent Tutoring Systems

Stephen G. Taylor, Champlain Regional College, Canada

The Virtual Tutee system will be introduced as a prototype of an intelligent tutoring system. The user of this system adopts the role of the tutor and studies photosynthesis by tutoring a virtual tutee residing within the software. The system was produced as a simulation based on a model of the tutoring learning situation called the Knowledge Modelling Approach, which will also be introduced. Fifty college students participated in a test of the system.

An Evaluation of Interactive Studio Physics I

Holly Traver, Rensselaer Polytechnic Institute, USA; Michael Kalsher, Rensselaer Polytechnic Institute, USA; Karen Cummings, Rensselaer Polytechnic Institute, USA; Keith Hmieleski, Rensselaer Polytechnic Institute, USA

Rensselaer Polytechnic Institute has implemented an innovative physics course ("Studio Physics") that promotes collaborative interaction. Students work in groups of 2-4 on computers connected to the local network and Internet. Class time is spent on short lecture and group exercises. This research study evaluated Studio Physics in terms of grades and alumni responses. An examination of course grades from students who took the first courses of Studio Physics yielded no significant difference between traditional lecture and studio courses. However, as the studio course has evolved, learning has improved. Alumni were contacted and asked for their opinions on all types of courses, including studio. Alumni indicated working collaboratively with others helped them to improve communication, interpersonal, and computer skills, as well as the abilities to work with others, learn new material, and perform at their current job. This finding is important for work organizations, since much of work today is group-based.

Grasp of Few body element's correlative operation using Multi points measure data-Compair with 2 kind selection-

Atsushi Tsubokura, Osaka Electro-Communiation Univ., Japan; Kiyoshi Masui, Osaka Electro-Communication Univ., Japan; Noboru Ashida, Osaka Electro-Communication Univ., Japan; Kagemasa Kozuki, Konami Co., Japan; Katsuhide Tsushima, Osaka Electro-Communication Univ., Japan

Expert Operator has any skill for machine operation.But novice has a little skill.The novice do and error operate when try need to new operation skill.Our target is to trace the Operator's skill learning process and the task identificate for the skill learned.The newer operation skill based another already learned operation skill.These Operator's skil was changing during Try Operating.The changed operation can show operation timming and used skill for operation. We used few body's measure data and identificate his operation using symbolic way.Measure device is Eye Mark Recorder,3D position or degress sencer(for Arm Motion),Data Grove.This paper propose the symbolic way for Multi Points Measure data's correlation and single measure data's characteristic, and evaluate the measure data using these way.This paper is introduction of these reserch.

Offline projects for cross-cultural competence improvement

Victoria Tuzlukova, Rostov State Pedagogical University, Russia; Irina Rozina, Rostov State Pedagogical University, Russia; Cyndy Woods, Arizona state University, USA

Russian and U.S faculty members from the Department of Foreign Languages, Rostov State Pedagogical University - RSPU, Russia and Arizona State University, Phoenix, USA, developed off-line writing projects designed to increase language proficiency, cross-cultural awareness, computer and networking skills. Targeting EFL students (English as a Foreign Language), the project has demonstrated that students not only increase English language proficiency, but students learn more about the way of life, basic values, and cultural background of the people, whose language they study.

Analyzing Artists' Interaction with an Artificial Reality

Elpida Tzafestas, National Technical University of Athens, Greece

Our long term goal is to understand how humans build models of biological phenomena. To this end, we are studying the relation between an artificial reality and the model of it that an observer deduces. The study is currently based on the observation of how Digital Art students interact with "PainterAnts", an educational simulation software that is used for laboratory work on intelligent and complex systems. The software is a special-purpose ant population demo that tries to convey and teach regulation principles using graphical means. Artists have shown a high motivation to experiment with the system, partly because they tend to regard it as a simple abstract art tool. They manage to create a functional model of complexity, without really understanding the underlying models. Few experiments with users of different background, have shown that humans, independently of background knowledge, tend to find complex top-down explanations to apparently complex phenomena.

Supporting Virtual Classrooms through Extranet technology: the Eurydices system

Kostas Bovilas, University of Patras, Greece; Aspasia Kanta,University of Patras, Greece; Nikos Piskopos, University of Patras, Greece; Bill Vassiliadis, University of Patras, Greece; Athanassios Tsakalidis, University of Patras, Greece; John Tsaknakis, University of Patras, Greece; Evangelos Sakkopoulos, University of Patras, Greece; Christos Makris, University of Patras, Greece

This work describes how collaborative, extranet-based services can be used to teach virtual classes to geographically-dispersed academic participants. Eurydices is an extranet-based training application, whose aim is the efficient management of the great variety of users and courses provided by the Greek Universities Network (GUNet).

A Web-based educational tool for solving equations

Maria Virvou, University of Piraeus, Greece; Maria Moundridou, University of Piraeus, Greece; Michael Loizos, University of Piraeus, Greece; Athanasios Papachristou, University of Piraeus, Greece; Nikolaos Polyzotis, University of Piraeus, Greece

This paper describes a web-based intelligent authoring tool for constructing problems in the area of equation solving. The main objective of this tool is to be useful to teachers and students of high school level in the area of algebraic equations. The teacher using this tool is able to provide the information needed to construct an exercise through a user-friendly interface on the web. Every exercise that has been constructed is immediately available to students. The tool also monitors students closely while they are solving the exercises through its student modelling component. The aspects we consider important in this tool are:

- The authoring capabilities it embodies. Teachers can continuously add new exercises and be assisted at their construction. Therefore the tool can be very useful for the construction of student assignments and/or exam tests.
- It is a Web-based tool. Therefore it can be used as a support tool for distance learning. It can also be used in classrooms and/or home as homework, exam tests, student practice or tutorial.
- The tool has ITS features such as the diagnostic capability. In this sense the tool can help the teacher to assess his/her students' progress and level of knowledge. It can also be very helpful at marking the assignments and/or exam tests. In addition it can be very useful to students in two ways. First for the self-assessment of their skills and second for the practice they can have with the provision of individualised feedback.

Constructing a Learning Environment for Knowledge Advancement

Feng-Kwei Wang, University of Missouri - Columbia, USA

The purpose of this research is to introduce the use of technology to construct a learning environment for knowledge advancement through three levels of knowledge -- know-what, know-how, and know-why. Know-what is concept-based domain content which is prepackaged and generalized. Know-how translates know-what into action-oriented skills. Know-why permits one to renew know-what and know-how and thus to solve larger and more complex problems. Different levels of knowledge require different learning methods and entail different learning activities. The most efficient approach to acquiring know-what is through comprehension and feedback. The process-based know-how can be best achieved through practices in simulation and case studies. Know-why can only be built over time through personal encounters with many different problems and solutions in real-world projects. This poster session will depict the theoretical grounds of this knowledge advancement framework and show how technology is employed to construct a learning environment based on this framework.

The Use of Cooperative and Collaborative learning in a Web-based Integrated Curriculum for the First Two Years of an Engineering Program of Study

John Watret, Embry-Riddle Aeronautical University, USA; Charles Martin, Embry-Riddle Aeronautical University, USA

The authors will describe and present the results of an innovative Integrated Curriculum in Engineering (ICE) designed for the first two years of an engineering program. Entering freshmen engineering student volunteers are placed into specifically designed sections of the foundation courses required of all engineering students: the calculus sequence, the physics sequence, the humanities sequence, social science, and introductory engineering courses. What differentiates the ICE program from traditional engineering curricula is that all courses incorporate cooperative and collaborative learning and a reliance in computer and web technology. In addition, the ICE program promotes team learning, team design projects, and a well-documented series of assessment practices. Although our program was written for an engineering curriculum, the underlying philosophy is applicable to a wide spectrum of programs of study as well as the general education component of many degrees.

Distance Learning For Government Agencies / Online Academies

Joseph Wilczak, American West Enterprise, USA

Government agencies are turning to online presentation formats for computer based instruction related to distance learning. CBT lends itself well to innovative visual curriculum and realtime information sharing. The educational / training implications that combine computer technology, the internet, email, and telecommunications are enormously untapped. CD Rom, online student / instructor interaction through chat rooms, or both are utilized. Material is presented in text supported with voice overs, and graphics. While writing screen text, voice over scripts should be written simultaneously, and graphics last. Lectures can be conducted online supported by video telecommunications. A final online exam is provided at the completion of each course with follow up sessions scheduled depending on course content. Presentations are suitable for newly enrolled student course material as well as recertification or ongoing certification requirements of the particular agency.

The Management of the Telecommunications Function: The Impact on Organizational Support, Planning and Training Quality

John Willems, Eastern Illinois University, USA; Karen Ketler, Eastern Illinois University, USA

This article reports the results of a survey of marketing managers in order to obtain information from the end user about the impact of the management structure of the telecommunications function on 1) the importance of the function within the organization, 2) the formalization of planning practices and 3) the quality of training on thirty issues. While the information systems manager was the most common form of management of the telecommunication function, the organizations with a distinct telecommunications manager reported greater satisfaction with top management support and a more formalized telecommunications planning and implementation process than the other organizations. The respondents from the organizations with a telecommunications manager also indicated better telecommunications training (although still somewhat unsatisfactory) than the other respondents. This was especially true in the managerial issues with a long term focus such as the use of telecommunications to gain a competitive advantage, and managing innovation and technology.

Online Learning Communities: Vehicles for Collaboration in

Stephanie Woolley, University of Colorado at Denver, United States; Stacey Ludwig-Hardman, University of Colorado at Denver, United States

Learning communities are environments that encourage mutual exchange between community members to support their individual and collective learning. Learning communities are founded on the social negotiation of meaning. Collaboration is the key tenet of constructivism and small-group theory (Springer Springer, Stanne, & Donovan, 1999; Grabinger, 1995; Duffy & Jonassen, 1992) that explains the social component of learning and demonstrates that "conceptual growth comes from sharing perspectives and modifying our internal representations in response to that sharing" (Grabinger, 1995, p. 669). Online learning communities provide the means for achieving "shared creation" and "shared understanding" (Shrage, 1991, p. 40). They are an excellent tool for integrating collaboration in online learning environments. The authors' poster demonstration defines collaboration and learning communities and addresses their theoretical foundations. The authors will discuss the benefits of collaboration and learning communities in online learning environments and provide a case study of a new online learning community at Western Governors University.

The Construction of World-Wide-Web Resource for Chinese Medicine and Acupuncture

Fan Wu, China Medical College, Taiwan; Shao-Fu Huang, China Medical College, Taiwan

As the information technology makes great strides in recent years, Internet has irresistibly reached into every aspect of our daily life. With its unique capability of well-integrating text, image and video, World-Wide-Web has been pervasive in the dissemination of medical discovery, the promotion of medical education and the application of clinical medicine. The issue of capitalizing on the state-of-the-art web technology to build Chinese medicine and acupuncture multi-media web resource is well addressed in this thesis. It is organized around:

1. The largest Chinese medicine news web site domestically.
2. The Chinese-medicine-centric high resolution multi-media Video on Demand in the field of Chinese medicine.
3. The electronic journal on Chinese medicine in the field of Chinese medicine.
4. The virtual classroom with complete features on Chinese Medicine and group-learning systems.

In addition, all the relevant web sites on Chinese medicine will be listed and linked for the benefit of the public. Integrated with Chinese medicine database, this set of medical resource helps to present teachers and researchers with an informative environment surrounded by Chinese medicine data. And it gives students the chance of individual learning and the space for the development for voluntary acquisitiveness for knowledge as well as paves the way for academic exchanges and pervasion of the information on Chinese medicine.

Automatic Generation of the Optimal Tutorial-Plan in Adaptive Educational Hypermedia System

Haiyan Xu, University of Science & Technology of China, P.R.China; XueHai Zhou, University of Science & Technology of China, P.R.China; Zhenxi Zhao, University of Science & Technology of China, P.R.China

Adaptive hypermedia system provides a good framework for web-based education. An ideal adaptive educational hypermedia system adapts to different learners during the whole period of the study. Aiming at the automatic generation of the adaptive tutorial-plan, we simply introduce the architecture of the KDAEHS: an adaptive educational hypermedia system based on structural computing, propose the concept of knowledge structure graph represented by AND/OR graph and then discusses the algorithms used to obtain optimal tutorial plan. Combined with the pedagogical strategies specified by the instructors, KDAEHS generates the optimal tutorial-plan which adapts to different learners based on the knowledge structure graph and the learners' knowledge level. Every tutorial-plan is well suit to the individual learner and can help the learner to fulfill the study goal efficiently.

Virtual Reality in astronomy teaching

Yoav Yair, CET / The Open University, Israel; Rachel Mintz, CET / Tel-Aviv University, Israel; Shai Litvak, CET / Tel-Aviv University, Israel

A new 3D model of the solar system with virtual reality (VR) features. It is based on powerful scientific visualization techniques and can be used as an effective aide in astronomy teaching is presented. The model allows for a powerful learning experience, and facilitates the mental construction of three-dimensional space, where objects are varied and different, but share common features and obey the same physical principles. The learner "enters" a virtual model of the physical world, journeys through it, zooms in or out as he wishes, changes his view point and perspective, as the virtual world continues to "behave" and operate in its usual manner. The new view helps to overcome the inherent geocentric view and ensures the transition to a scientific, heliocentric view of the solar system.

Uncovering cognitive processes in discourse synthesis using hypermedia

Shu Ching Yang, National Sun Yat-Sen University, Taiwan ROC

An exploratory study was undertaken to uncover the cognitive process of discourse synthesis within a hypermedia learning environment. The focus was on learners' discourse synthesis behavior and the problem solving strategies they employed using the Perseus database. The data for the study was transcribed from tape recordings of the 'thinking aloud' protocols as the learners attempted to work on their tasks. All protocols were transcribed verbatim and categorized according to each strategies content. A functional taxonomy were developed to characterize the cognitive operations and thinking processes of the learners' interactions with Perseus. The proposed taxonomy characterizes their cognitive engagement within hypermedia from a broader context. It is a multifaceted construct which entails thick cognition with many highly correlated factors. The study is concluded with practical and theoretical concerns emerging out of this focus on discourse synthesis within hypermedia.

Integrating Technology Into the Curriculum

Rosanne Yost, University of South Dakota, USA; Ray Thompson, University of South Dakota, USA

This session describes a teacher education course designed to help K-12 educators integrate technology into their curriculums. The Technology for Training and Development (TTD) Division at the University of South Dakota has developed the course by using the same curriculum planning process that the course is designed to teach. The overall goal of TTD 782: Technology Integration, is to help teachers develop an understanding of the potential for technology to transform school curriculum so that it is student centered and future orientated. As the professors have modeled the curriculum planning process they teach to their students they have themselves become better at using technology. The benefits to both teacher educators and classroom teachers have included classrooms where active learning occurs and where students gain some control over there own learning. A variety of learning styles and needs are now being met as teachers and students learn "how to learn" together.

Using Web Resources to Enhance the Interdisciplinary Nature of Freshman Preceptorial Course

Kesheng Yu, Union College, USA

The purpose of this poster is to demonstrate the design and development of the web-based set of materials designed to help instructors become familiar with topics or readings in which the preceptors' group has little expertise. The focus of Freshman Preceptorial is on cultural difference and on contemporary issues seen in historical or philosophical perspective. Three Freshman Preceptorial projects were funded in 1998 and 1999. While two of these projects are still in the progress, the Resources for Teaching the Bible are finished. This website is designed for faculty teaching and students taking Freshman Preceptorial, though others are certainly welcome to use it. While the demonstration of the design and development of the web resources, the effect of web resources on Freshman Preceptorial course and student attitude toward the use of the web resources would be discussed as well. The URL for the web site: http://www.union.edu/RESOURCES/curriculum/fpbible/

Development of an Virtual University Online Course Using an Interprofessional Approach to Teach Qualitative Research

Cheryl Zaccagnini, Shippensburg University, US; Denise Anderson, Shippensburg University, US; Kent Chrisman, Shippensburg University, US

Using an interprofessional approach, a qualitative research course was designed and taught as a virtual university course. Professors from the disciplines of early childhood, special education, and social work developed a qualitative research online course to utilize virtual university resources to reach graduate and undergraduate students at distant education sites. It was developed to implement the course as an interactive research course with web-based programming and video conferencing sites to enhance the quality of the course and to provide sufficient web-based content but most importantly to create an atmosphere of communication and connectedness with the professors and students at other sites. Syllabi was developed using a team teaching approach with access to the professors via video conferencing, e-mail, and web-based instruction. Formative and summative evaluation results indicate that teaching qualitative research through virtual university resources can be an effective alternative.

Going the Distance:Offering Design Curriculum in the University of Utah's Distance Learning MFA in Directing/Theatre Education

David Zemmels, University of Utah, USA

In the fall of 1999, the University of Utah's Department of Theatre, in collaboration with Sundance Institute/Sundance Theatre Lab admitted the first cohort to its pilot distance learning MFA in Directing/Theatre Education. The intent of this session is to provide an overview of the pilot program—its underpinnings, its infrastructure—and examine one solution to offering a theatrical design course within the parameters set by the program. Demonstration and examples of assignments and delivery methods will help conference participants envision ways to use distance learning technologies as part of program development at their home sites.

Merging Fine and Performing Art with Digital Technology:An Exploration of the University of Utah's Arts Technology Certificate Program

David Zemmels, University of Utah, USA

Successfully integrating traditional forms of artistic expression with digital technology is an ongoing challenge in the fine and performing arts. In the 21st Century, digital art forms will likely become even more important. Computer technology has become a pervasive and necessary aspect of the arts, whether you are a music therapist, art historian, actor, musician, designer, photographer, or painter. This past fall, the University of Utah's College of Fine Arts began the Arts Technology Certificate Program, an interdisciplinary pilot program offering classes in digital technology as a tool for artistic expression across all art forms. The intent of this session is to provide an overview of the pilot program and the methods and strategies used to implement it, and to showcase representative examples of student work. Demonstration participants will also explore ways to integrate digital technology curriculum as part of program development at their home sites.

Comprehensive Examinations via e-mail

David Zimmerman, James Madison University, USA

This paper will examine the electronic administration of the written comprehensive examination for the Masters Degree in School Library Media Services from James Madison University. Prior to the fall semester, 1998, all students traveled to the main campus in Harrisonburg, Virginia to take the three hour exam. Beginning in November, 1998, four students were sent the exam via e-mail and returned their responses via the same method. The following paper will include a comparison of the two methods of administration, the results of a seven-item questionnaire and a review of the James Madison University Honor System.

NOTICE

REPRODUCTION BASIS

- [x] This document is covered by a signed "Reproduction Release (Blanket) form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

- [ ] This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").